Some thoughts about evolution and probabilities

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This paper is
http://www.cs.bham.ac.uk/research/projects/cogaff/misc/evo-prob.html
A PDF version may be added later.

A partial index of discussion notes is in http://www.cs.bham.ac.uk/research/projects/cogaff/misc/AREADME.html

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These comments are an extension to the discussion of teaching intelligent design alongside evolutionary theory, available at

http://www.cs.bham.ac.uk/research/projects/cogaff/misc/teaching-intelligent-design.html

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We should expose unsolved problems in current science and show how to think about them, instead of leaving it only to people who want to attack science either because they are ignorant about it or because their primary goal is religious, as in many of the arguments about intelligent design (ID).

Some of the arguments for ID are based on real gaps in current theories. We should present the gaps and show how to think about them, instead of leaving it to the theists and theologians to offer only one way to think about them, disguised as science.

By exposing the unsolved problems in the context of a scientific approach rather than leaving them to be exposed to some people only in the anti-scientific approach we help people to see why the fact that they are unsolved does not show that current theories are false -- though they could turn out to be, as happened to Newton. Even less does it show that ID is true, of course.

The improbability of evolution of humans

Here is a rough and ready calculation: suppose that producing a design for a human-like animal requires 30000 binary design decisions (probably a considerable underestimate), and that after each decision there are always at least two further branches. Then the search space of possible designs requiring that number of steps has 2 to the 30000 end nodes, which is a number with over 90,000 digits in it.

Now suppose that the earth is 4 billion years old and that at any time there are a million million million species, each switching to a new variant every second. The maximum total number of designs that could have been explored on that basis would be

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    1000000*1000000*1000000*60*60*24*365
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I.e.

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    31536000000000000000000000
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a decimal number with only 27 digits.

Suppose I've underestimated the number of species in existence at any time by a factor of a billion: that would bring the upper limit up to 36 digits. Compared with a number containing 90,000 digits that's infinitesimal. Now suppose that there are a billion billion possible ways of designing a human. It's still the case that the probability of random design switches leading to any of the human designs is minuscule, and likewise for most of the other animal or plant designs that exist on earth.

That might lead someone to think that intelligent design was needed to guide the processes.

I suppose the standard answer would be that nothing that is highly unlikely needs its existence to be explained just because it is unlikely. It might just be one of the many highly improbable things that happen in the universe (including events in gambling casinos), and it could for that reason be the case that no other place in the universe has anything remotely like humans in physical or information-processing capabilities, just as it is very unlikely that anyone else on earth looks and thinks exactly like me.

In that case the truth (its just one of those highly improbable, inexplicable things) would be rather boring, and scientists like Einstein would not like that.

So the search for a more aesthetically and scientifically satisfying explanation of how things are might lead some to try to bring in an intelligent designer. In principle that is no more unscientific than Democritus postulating an atomic theory of matter when he had no idea how to test his theory.

But there could be other explanations. For instance the calculations could be wrong because there is a deep mathematical reason why almost all the design choices would fail to produce viable organisms, so that the vast majority of 30000-step explorations would terminate very early leaving the remainder exploring only a small subset of the search space.

Moreover, there could be further mathematical arguments about the way in which the possibilities for further change (or non-change) of any species at any time would be heavily pruned by the existence of all the other coexisting species (designs) at any one time (including the location in a food pyramid i.e. the location in predator-prey league tables.

I.e. there may be what Brian Goodwin calls 'laws of form' (mathematical laws) that are not really part of Darwinian theory but may be needed to provide answers to the questions that the *honest* ID people are asking.

(I think this is also closely related to some of Stuart Kauffman's ideas and to the books by Ian Stewart and Jack Cohen).

As far as I know these questions and the possible answers are not generally taught to biology students. One of my ulterior motives is to provide an educational niche where they will have a chance of being taught, developed and tested because they are the scientific answers to some of the valid questions the ID people pose, but answer incorrectly, sometimes honestly sometimes dishonestly.

I suspect there is a mathematical theorem something like this waiting to be proved:

> In any environment that supports Darwinian processes it is an inevitable property of ecosystems with co-evolving species in a multitude of cooperative, competitive and parasitic relationships that if the combinatorics of the physical infrastructure makes it physically possible for species with cognitive capabilities to exist, then (a) the probability of some such species actually evolving is very high, and (b) once that has happened, the probability of a small subset of those species developing ever richer cognitive competences (up to some limit) is close to 1.

Actually I don't think I know yet how to formulate the theorem, let alone prove it. Maybe someone else has already done it.

Installed: (some time before Nov 2005?)
Last updated: 11 Nov 2005; 5 Feb 2012