

# Re: Cope's rule and bacterial evolution

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- *From:* [anon1@xxxxxxx](mailto:anon1@xxxxxxx)
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bacteria ... are optimizing by discarding rarely needed functionality and thereby gaining a competitive edge in a narrowly specialized niche. But, in doing so, they risk eventual extinction.

And of course, counter to this micro-evolutionary trend, there is the macro-trend. It is the generalist bacteria with the relatively large genomes which branch and produce new bacterial species.

Extrapolating backward we can imagine that the LUCA (Last Universal Common Ancestor) was the most versatile and generalist micro-organism of them all, and had the biggest genome.

Or maybe there was no single LUCA. Did you ever consider that possibility? You talk like it's been mathematically proven there must have been a single LUCA, and all we need to do is figure out how it was.

What if there were a whole bunch of separate common ancestors, each in a tiny eco-niche where it originated. It was totally sloppy in just about everything regarding security, because it didn't come into contact with the others elsewhere. For example, it'd leak out DNA and protein products indiscriminately and then take them back in later, from its neighbors rather than from itself most usually, but it didn't matter because neighbors were brothers. Cellular structure helped concentrate biochemical pathways to make them more efficient, but cellular structure weren't used to defend the genome against neighbors. (Earlier there might have been adhesion on particles of clay, or adhesion on metallic surfaces, instead of enclosure in a membrane, to hold enzymes close together to make pathways more efficient. But later enclosure in membranes gave good-enough close-holding combined with much better freedom of motion during reactions, so was an improved tradeoff, hence the takeover from adhesion to enclosing.)

These early forms of life were not very good at filling eco-niches worldwide. Most of the ocean was devoid of life. Only in those very few places \*most\* hospitable for life was there any yet. There were huge gaps between adjacent eco-niches that had life in them.

As the surface of the Earth cooled and tektonic plates moved around and fissures opened and closed and modulated intensity, ecological niches

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expanded and contracted and moved around. From time to time two eco-niches of \*different\* kinds of life would get close enough together that some DNA leaking from one would get into the other, the first instances of horizontal gene flow (HGF). Depending on the environment, selection pressure might merge genomes, or have one drive the other to extinction, or favor cells which happened to be able to defend against invasion of alien DNA. Most likely most parts of each genome would be kept while a few parts would be eliminated as redundant and not as good as their counterparts.

As eco-niches split apart, a single genome would remain in \*both\* parts, separate from each other, allowing divergence of genomes to occur. Meanwhile more meetings of formerly-separate genomes would happen. The combination of natural selection and merging of disparate genomes resulted in overall better fitness of the surviving genomes, so they now occupied a larger portion of the ocean, and encounters between adjacent genomes became more and more common, until eventually nearly all of the eco-niches had merged to form a single eco-niche that spanned the globe. So instead of separate genomes in separate eco-niches, there was a graduation of genome from one kind of environment to another kind of environment, with constant leakage of DNA in both directions. At this point there would be advantage to defending against invasion of alien DNA, to avoid this cross-environment pollution that kept diluting any local natural selection that had occurred. So there was now selection pressure to develop cell walls that blocked nearly all intake of alien DNA, and also to block nearly all leakage of DNA since once it leaks out it can no longer ever come back in. Those genomes which survived this time, i.e. those which indeed chanced into reasonably good (but not perfect, just good enough) protection against HGF, thereby became the very first true quasispecies/strains/clades of cellular life, the LUCAs of all present-day life. Prior to that "clade" was meaningless. Now (ignoring a low level of HGF which continued occurring) we had true clades at the cellular level.

Now tack on the scenerio I discussed a few weeks ago, where these first true clades (ignoring low-level HGF) were not prokaryotes, only pre-prokaryotes, (ur-karyotes as some call them) but eventually merged their genomes in various combinations to yield three true prokaryote clades, which were so immensely successful that they drove all remaining ur-karyotes to extinction, and how one of the three clades developed much more advanced cytostructure than the other two (not discussed specifically in my earlier posting), evolving to form the very first pre-eukaryotes, which later used their cytostructure to invent mitosis, whereupon we'd consider them true eukaryotes despite them not yet having mitochondria endosymbionts.

As to when the RNA-or-whatever to DNA takeover happened amidst that complicated sequence: My best guess is very shortly before the merging of the ur-karyotes to the three clades of prokaryotes. DNA replicase, and the genetic code, is what made those three clades so much more

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successful than the remaining ur-karyotes, driving ur-karyotes extinct. Transcription and reverse transcription already existed in the ur-karyotes, which is how DNA was created (as archival storage because RNA was too fragile), and how DNA was retrieved to restore RNA later from the backup (when regulatory machinery detected that RNA had gotten degraded, or constantly in parallel so no detection of RNA damage would be needed, but then the RNA genome would have a mix of restored ancestral sequences and the very latest evolved sequences which would slow the effective rate of evolution). After the DNA takeover, retro-transcription was no longer needed, so most genomes eventually lost that capability, but some viruses found it a wonderful tool so they kept it. Since the genetic code actually works on RNA not DNA, perhaps I should re-phrase the above. The genetic code and transcription both directions between RNA and DNA was already in place, and DNA replicase was invented as a way of making backups of backups, which immediately made RNA-to-DNA transcription almost unnecessary, but because cell fission was still synchronized with RNA replicase, RNA replicase was still necessary for cell fission. That moment when cell fission became synchronized with activity of DNA replicase (instead of with RNA replicase as before) is the defining moment of the DNA takeover, when both RNA replicase and RNA-to-DNA transcription became no longer useful.

I think I've just convinced myself that RNA-world was the immediate predecessor of our current DNA-world. So where I said whatever-or-RNA, you can now replace that with a firm \*RNA\*. (I hope you don't mind these train-of-thoughts articles I write, where you can observe my actual train of thoughts as I conceive new ideas. If I ever become famous for any of these hairbrained ideas of mine, and somebody wonders where I got the ideas from, just look here, if Google preserves their archive of newsgroups all that time, which is not guaranteed!)

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