Point-Based Physics Maths are Insufficient for Understanding Biology

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Email Excerpt

Roger, all,

Thank you for the link to the Aeon article by James Shapiro [1]. It is a long but fascinating article that makes a good point: Evolution in modern life is much more complicated than waiting for the next purely accidentally beneficial mutation.

For comparison, imagine this: What if Microsoft's only method for improving Word way was to make copies of the program on ratty, error-prone tapes and then run the mutated copies to see which one works better?

While long-term Word users like Roger and me might suspect this is *precisely* how Microsoft "improves" products, the point is this: The more complex the machine, the *less* likely a simple binary code mutation is to "improve" that machine.

But why? In a naïve model of how to code a complicated machine, the number of interdependencies with each bit increases with the complexity of the resulting machine. These interdependencies are like expectations — "I'm relying on you to stay *stable*, Bit 243553!" — which means the odds of a mutation damaging the machine versus improving the machine drop quickly as the complexity of the machine (e.g., Word) increases. That, in turn, means mutation-only evolution should grind to a halt as the odds for *any* mutation to produce damage rather than improvement approaches certainty.

But that's not what happens! If anything, complex life seems to adapt and improve *faster* per generation than simple life. What's up with *that*?

Somewhere in my decades of notes, I came up with a phrase: "evolving for evolvability," by which I mean there is an enormous survival pressure for life not just to make most mutations harmless (Gray coding [2]) but to begin leveraging them as a resource by developing a coding strategy that reduces deleterious entanglements [3] while enhancing the odds of changing the machine in a fashion that is "functionally interesting." [4]

I think evolving-for-evolvability was more-or-less what this author was getting at. He mentions John Mattick, whose work I like very much and with whom I've had a few pleasant email exchanges.

One quibble: I wish Shapiro had better summarized his alternative explanation at the article's start rather than just dismissing mutation. I'd say he should have been a lot less timid and started his article with its *last* sentence:

> *"Rapid genome reorganisation is not only a feature of all organisms but has proved essential for the survival of life."*

Of course, having worked at MITRE, I would have made that into an acronym: RGR, Rapid Genome Reorganization.

Inadequacy of Physics Maths for Living Systems

However, RGR is just one piece of the broader and still-cryptic puzzle of how evolution evolves evolvability (E3? :)

My best guess is that this must necessarily end with new maths since current models of information biology, including evolution, rely on the same points-are-fundamental math strategies of physics that, in the end, are incompatible even with special relativity, let alone with quantum physics. No version of mathematics that assumes points to be fundamental can ever fully capture the information processing complexities of either small, near-atomic systems or multi-scale, highly interconnected systems.

Speaking of the non-existence of points: My goal today was to finish an interesting (I think) Apabistia Notes paper on the experimental non-existence of point particles based on a lovely Feynman lecture adaptation by Dibyajyoti Das. Time to get back to work!

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[1] J. A. Shapiro, *Evolution without Accidents*, Aeon (2023-07-06). https://aeon.co/essays/why-did-darwins-20th-century-followers-get-evolution-so-wrong

[2] I should have published the Gray code idea when I first had it since it was years before anyone else proposed it. It's a well-accepted idea these days.

[3] In software, data abstraction is one such tactic. DNA, however, takes the idea to more robust and messier levels, e.g., introns and exons, than our rigid and somewhat naïve formality-is-always-first models permit. We need to get out of "control freak" mode.

[4] Unit replication at all levels — cells, body segments, duplication of the entire genome — seems to be a precious tool in making mutations more likely to be beneficial. Local accommodation — if your nose grows larger, your face adapts — is another huge helper.