Review of: "Evolution, Through the Lens of a Physicist"

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The author opens the commentary putting forward their view of biology and biological processes. The reductionist approach of physicists is sorely missed by biologists, who often converge towards overcomplicated systems because of limitations in the experimental (e.g., “take one away” or “add one” approach that is often used for gene function determination) and analytical (e.g., very few tools to map and interrogate noisy hybrid networks) approaches. The caveat here, however, is what drives what in biology. The author uses the example of reproduction to explain that biology goes beyond chemistry and that function is important. I'd argue that the emergence of function is random but that improvements (defined here from an evolutionary perspective) get fixed in the population. So, biology is still chemistry-driven, but the random walk along the accidents sometimes gives out something worth adopting and optimizing - examples are often referred to as ‘frozen accidents.’

Looking at how biology works (at all levels), chance alone can explain all that is observed - if enough time is given and if biology is considered a non-linear system. Therefore, inclusion of purpose/design seems to address a human need/wish and goes against Occam's razor. We have tools to identify systems that deviate from chance alone, but they are rarely applied correctly (e.g., https://royalsocietypublishing.org/doi/10.1098/rsos.140216). In addition, it is not always possible to apply those to non-linear systems that also evolved redundancy in their networks.

The EPR example is problematic because the stochastic behaviour of individual “experiments” is being emphasised while the between the two experiments is being ignored. The clustering seen to form the EPR pattern is likely to be statistically different from a random process; therefore, the thought experiment (to me) does not show that a non-random structure can emerge from random processes. On the other extreme, what must also be taken into account is that our brains are primed to picking up patterns even when they do not exist and that could impose a limitation on how we interpret randomness. This comes up again in the discussion when proposing that biologists cannot distinguish between chance and intent. It is unclear to me why intent is required for an explanation when chance alone is sufficient.

It is not clear to me why we should conclude that quantum statistics play a dominant role in mutations. That may, however, be my own limitation in not seeing a significant difference between statistical noise and the statistical laws of QM.

I find the argument of what engineers cannot achieve more of a criticism of our current biological engineering tools than an example of biology being different from chemistry and physics. That remains irrespective of belief in whether a living organism can or cannot be synthesised from individual molecules. This is repeated when quoting Anderson, where the

separation between reductionism and constructionism is more a remark on the limits of our tools than on the difference of philosophies.

I have great respect for classic philosophers, but I feel we must also consider their limitations (or those of their time/society/background). Our understanding of biology is relatively new (molecular biology is little older than 50 years), and I feel no single modern philosopher has emerged with in-depth biological knowledge to explore metaphysical questions, if indeed those questions would be relevant to such a philosopher.

Overall, the article is a personal opinion and could be further developed. In particular, I would suggest increasing the depth of the article so that it becomes accessible to both physicists and biologists (while knowing that both monikers are used to group very diverse communities with overlapping but distinct training backgrounds in each). That should also provide a more stepwise thought process to address the metaphysical arguments.