Epistolution: An Empirical Test for Holistic Causation in Biology

The current Neo-Darwinist paradigm in biology represents organisms as controllers driven by encoded information contained in the genome, but this paradigm poorly matches experimental results that show redundancy in the genome, indirect causal connections from genes to traits, and large amounts of non-coding genetic material. Knockout experiments suggest the majority of genetic coding regions may not affect phenotype under normal conditions. In addition, Neo-Darwinism would not predict that epigenetic changes could be heritable under many conditions, that some organisms can rearrange their genomes, or that mutations are non-random with respect to function. These and other results suggest that the current paradigm of the biological sciences may give an insufficient explanation for life.

One possible new interpretation of these results may be that the overall arrow of causation in biology is reversed. Naked DNA, without a cell, does not generate life, and no experiment has ever separated a living cell from the environment that supports it. We have not actually established whether life is causally organized by DNA or by the larger envelope of the environment. Instead of a controller driven by the system of its DNA code, perhaps a life form is a transducer of its environmental system. Ashby's law of requisite variety requires that the controlling unit of a system be greater in complexity than the controlled unit. Genes, then, would be like keys on a piano played, so to speak, by the environment. In this model, it would be the surroundings of the organism that give it its self-organizational logic, and the genes would be merely essential heritable templates for making proteins. This idea is supported by microbiome studies which show that many trillions of microbes with foreign genes form obligate components in human cognition, metabolism, and immunity. If this is so, perhaps a common property of all cells allows the formation of functional systems, given the correct environmental controls. The only formula general enough to describe the developmental changes in all the networks of multicellular animals and their microbiotic partners would be a simple Lamarckian one: "If used: reinforce; else mutate." This simple formula could govern the self-organization of living systems.

A living cell separated from its supportive environment dies immediately, while a cell without DNA survives, for a time. This is suggestive, but in order to fully test biological causation, we must test the Lamarckian formula itself in an artificial organism. If we consider all biological networks as rhythmic oscillators, coupled by positive and negative feedback between them, then we have a plausible model for a self-organizing system. Networks which are triggered by the environment in which they are placed are reinforced, and networks which are unused mutate stochastically. By applying this formula to a large software graph coupled to sensory input nodes and motor output nodes in an embodied machine, we could test for self-organization. If this resulted in self-organized behavior defined as rhythmic anticipation of the environment, we would have shown a plausible logic for the behavior of the nervous system. This result might also explain why complex multicellular animal life has convergently evolved REM sleep. As such a system runs quasi-independently of its environmental inputs during a REM cycle, the effects of new environmental rhythms may be consolidated into network memory. If this occurred, this result would provide an explanatory model for general intelligence. We describe the fruits of human general intelligence as "actions" as if they began in the brain, but the laws of physics describe a world in which nothing begins anywhere in particular, rather all actions are interactions with the larger universe. This experiment might resolve this obvious philosophical problem with the idea of intelligent decision-making agency. This would reframe not only protein lifespan research but all the biological, social, and environmental sciences, and solve the problem of artificial general intelligence.