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Biologic relativity: Who is the observer and what is observed?

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When quantum physics and biological phenomena are analogously explored, it emerges that biologic causation must also be understood independently of its overt appearance. This is similar to the manner in which Bohm characterized the explicate versus the implicate order as overlapping frames of ambiguity. Placed in this context, the variables affecting epigenetic inheritance can be properly assessed as a key mechanistic principle of evolution that significantly alters our understanding of homeostasis, pleiotropy, and heterochrony, and the purposes of sexual reproduction. Each of these become differing manifestations of a new biological relativity in which biologic space-time becomes its own frame. In such relativistic cellular contexts, it is proper to question exactly who has observer status, and who and what are being observed. Consideration within this frame reduces biology to cellular information sharing through cell–cell communication to resolve ambiguities at every scope and scale. In consequence, it becomes implicit that eukaryotic evolution derives from the unicellular state, remaining consistently adherent to it in a continuous evolutionary arc based upon elemental, non-stochastic physiologic first principles. Furthermore, the entire cell including its cytoskeletal apparatus and membranes that participate in the resolution of biological uncertainties must be considered as having equivalent primacy with genomes in evolutionary terms.

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"The most curious part of the thing was, that the trees and the other things round them never changed their places at all: however fast they went, they never seemed to pass; anything. "I wonder if all the things move along with us?" thought poor puzzled Alice. And the Queen seemed to guess her thoughts, for she cried, "Faster! Don't try to talk!"

Lewis Carroll, Through the Looking Glass

1. Introduction

An instinctive human frame of reference governs our perception of the life cycle of macro organisms as an arc, initiated with birth, extending across development and maturity, ultimately leading to death. The result is a natural impression of a clock-like progression. This is consistent with the general terms of directionality that Newtonian mechanics imposed upon physics with respect to space and time. Darwinism is entirely rooted in a causal model that is in conformity with this conceptualization of biological space-time as absolute. Within those terms, evolutionary motion proceeds by

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natural selection based upon the accumulation of gradual internal genetic modifications that continue by direct vertical descent, yielding differential reproductive fitness. In such a macro-organic frame, it is not surprising that reproduction became the centerpiece for the standard narrative of Darwinian evolution (Koonin, 2009). However, contradictory evidence suggests that the cellular constituencies of macro-organisms rather than the whole are of greatest importance (Shapiro, 2011; Miller, 2013). In this biological frame, perceptions of space and time need not be co-aligned with macro-organic priorities. When re-appraised in this manner, eukaryotic evolution becomes a fractal reiteration of basic physiologic first principles established in the unicellular form to which it maintains perpetual fidelity (Torday, 2013). In consequence, evolutionary development can no longer be considered within any Newtonian conception of space-time as an absolute, and must be reconsidered instead in new terms of biological relativity.

2. A genome in motion

This differing perspective is driven by the intersection of several critical and well-substantiated factors. First principles of physiology have been identified that can be shown to extend forward from the unicellular form throughout eukaryotic macroevolution in unbroken linkages (Torday and Rehan, 2012). The critical role of epigenetics in evolution is now being acknowledged. Further, it is clear that all cells are cognitive entities and decision-making capacity is invested at every scope and scale in biological forms. Lastly, all macro-organic entities are holobionts [the inherent community of innate cells of any eukaryotic macro-organism and all of its symbiotic microbes], not biological singularities. The crux of that intersection is at the level of the eukaryotic, unicellular zygotic phase-all eukaryotic life undergoes an obligatory recapitulation through it. Moreover, it is now becoming clear that all eukaryotic life remains deeply anchored to it, and adherent to that phase throughout the ensuing life cycle despite outward appearances through biological first principles that resonate from it (Petrov et al., 2015). In consequence, biological and evolutionary development can be appropriately re-appraised as always remaining centered within cellular rather than macro-organic mechanisms that unfurl according to a consistent set of principles in fractal reiterations. It becomes evident then that any absolute terms for biologic space and time that have been traditionally imposed as implicit to the macro-organic form need not apply to the cellular constituencies that compose those organisms. This perspective shifts our perceptions of the means by which biologic organisms react to environmental stress and settle ambiguities in biological terms. Consequently, a re-ordered understanding of biological causation is impelled. A central question then emerges: in biological terms, who is doing the observing and exactly what is being observed?

Determining an answer is aided by abundant research that has identified an ever-greater role for epigenetic factors in biology (Rapp and Wendel, 2005; Jablonka and Raz, 2009; Bossdorf et al., 2008; Upham and Trosko, 2009). This Lamarckian form of inheritance of acquired characteristics is both horizontal and vertical (Brody, 1973; Potter, 1974). These environmental impacts are now understood to have significant evolutionary implications (Jablonka et al., 2014). Environmentally acquired epigenetic marks are heritable, transferring to the next generation through egg and sperm as germ line cells (Gapp et al., 2014). Yet, not all epigenetic impacts yield heritable changes. Some, such as terminal differentiation or apoptosis of stem cells are not inherited somatically, and others are only “transient” in progenitor and differentiated cells, such as those needed for cell division. The extent to which some are retained and others rejected during meiosis, at fertilization, or in the post-zygotic stage is only now being actively determined (Daxinger and Whitelaw, 2012; Grossniklaus et al., 2013). It is clear that epigenetic marks are processed at multiple stages during embryogenesis, centered upon homeostatic principles during morphogenesis (Feng et al., 2010; Morgan et al., 2005). The life cycle itself may play a role in this epigenetic selection process since the timing and duration of its stages from infancy to senescence are all determined by the endocrine system, which is under epigenetic control by the environment (Zhang and Ho, 2011). However, basic research is indicating that a dominant locus of that discriminatory process lies within the zygotic unicell, through which all eukaryotic organisms must recapitulate (Reik et al., 2003; Jahnke and Scholten, 2009; Wossidlo et al., 2011; Rousseaux et al., 2008). In this context, it is worthwhile citing a comment about cancer made by Potter (1973)- “The biochemistry of cancer is a problem that obligates the investigator to combine the reductionist approaches of the molecular biologist with the wholistic approaches of the holistic requirements of hierarchies within the organism. The cancer problem is not merely a cell problem, it is a problem of cell interaction, not within tissues, but with distal cells in other tissues. But in stressing the whole organism, we must also remember that the integration of normal cells with the welfare of the whole organism is brought about entirely by molecular messengers acting on molecular receptors.”

It is also now understood that the end products of all eukaryotic biological development are holobionic organisms. On a cellular basis, we and all other eukaryotic organisms are as much or more microbe than innate cellular material (Turnbaugh et al., 2007: Peterson et al., 2009; Hoffmann et al., 2015). Macro-organisms are now being understood as complex linked cellular ecologies (Miller, 2013). Imperatively though, the continued existence in any macro form remains an exclusive path through the unicellular zygote. There are no exceptions in eukaryotic biology. Therefore, any stage in which there is significant assortment of epiphenomena as they intersect with any innate genome must be assessed as having significant dominion. That express stage is the always-recapitulating unicellular phase.

When considered in this fashion, embryological development can be reduced to the fundamental ubiquity of cell–cell communications at every scope and scale, preceding and enabling the recapitulated unicellular form, and then continuing through it towards its macro-organic elaboration (Trosko, 2007, 2011a).

Several implications then follow. A straightforward dynamic underscores all eukaryotic development: cell–cell communication is a sender-receiver operation necessitating cellular cognition. When that faculty is honored as inherent to all the cellular constituents of holobionts, both those that are innate cellular constituents and our ubiquitous microbial partners, then the fundamental principles of development consequently shift into a focused concentration upon the cellular domain in all evolutionary development (Trosko et al., 1990; Trosko, 2011a, 2011b, 2014). When considered in this manner, first principles of physiology become evident (Torday and Rehan, 2012). For example, fundamental links between the evolution of the lung can be traced backwards in time through its development and phylogeny using the cellular interactions for the synthesis of lung surfactant phospholipid at a level of adaptation that is centered at the cellular level rather than a macro organic one (Torday and Rehan, 2004). The basic principles of vertebrate evolution can be understood as always leading back to the advent of cholesterol at its first insertion into the cell membrane of single celled eukaryotes, thereby facilitating oxygenation, metabolism and locomotion (Torday and Rehan, 2012). As the most primitive of surfactants, the role of cholesterol can be understood to form a crucial aspect of the continuous arc from the unicellular state and its cell membrane towards the emergence of the