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The resolution of ambiguity as the basis for life: A cellular bridge between Western reductionism and Eastern holism

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ABSTRACT

Boundary conditions enable cellular life through negentropy, chemiosmosis, and homeostasis as identifiable First Principles of Physiology. Self-referential awareness of status arises from this organized state to sustain homeostatic imperatives. Preferred homeostatic status is dependent upon the appraisal of information and its communication. However, among living entities, sources of information and their dissemination are always imprecise. Consequently, living systems exist within an innate state of ambiguity. It is presented that cellular life and evolutionary development are a self-organizing cellular response to uncertainty in iterative conformity with its basal initiating parameters. Viewing the life circumstance in this manner permits a reasoned unification between Western rational reductionism and Eastern holism.

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Doubt is not a pleasant condition, but certainty is absurd.

Voltaire

1. Introduction: from the inanimate to the animate

A fully integrated approach to Biomathics that is sought in this Special Issue of Progress in Biophysics and Molecular Biology must account for both Eastern and Western approaches to the natural sciences. The following provides a path between Western reductionism and Eastern holism as they are applied to biology by recognizing a fundamental flaw in our way of thinking about the premise of our existence as self-referential organisms.

Life on Earth originated with the formation of protocells from

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asteroid-derived lipids floating in the primordial oceans (Deamer, 2017) [see Fig. 1]. The ability to produce bioenergy through chemiosmosis was facilitated by the formation of endomembranes that partitioned negatively and positively charged ions on either side of them (Mitchell, 1966), initiating the first protocell/micelle (Deamer, 2017). Such constrained boundaries enabled life as a negentropic state that exists far from thermodynamic equilibrium, as first defined by Schrodinger (1944). This pseudo-physical state is sustained within the interior milieu of this membrane-bound compartment through homeostatic regulation (Torday, 2015a) as the reciprocating hub between the negentropic moment of the cellular interior and an ever-changing external environment. Therefore, homeostasis is a dynamic process realized through chemiosmosis that serves to maintain a range of far from equilibrium states within the boundary limits of the cell.

When negentropy, chemiosmosis and homeostasis are achieved, the conditions are met under which self-referential awareness may arise (Torday and Rehan, 2012; Torday and Miller, 2016a). The origin of such self-awareness is unknown, although it has been considered a phase shift derivative of the thermodynamic scale expressed as a state function (a function that does not depend on the path taken to arrive at its present condition) (Miller, 2016). Though the actual dynamics are unknown, there is empiric evidence for physical self-organization based on observations of Ytterbium atoms that demonstrate coherent, spontaneous alignment. This phenomenon has been categorized as 'time crystals' (Vishwanath et al., 2017). It can be considered that is the physical template for biological phenomenon (Torday, 2013).

It has further been maintained that life and its evolution are dependent upon communication (De Loof, 2015; Witzany, 2015). Plainly, communication is the transfer of information between 'knowing' entities. Therefore, as communicating entities, living organisms are information-dependent (Miller, 2016).

However, this requirement for information with regard to life raises a distinct paradox. Despite its overt material biological form, life is thoroughly imbued with ambiguities. Within biological media, neither the sender nor the receiver of information are necessarily known to each other (Czárán and Hoekstra, 2009). The communication between living organisms, whether through physical processes such as electrical signals, or by bioactive molecules is more akin to a general broadcast than definitely targeted information, such that highly integrated and ordered hierarchical systems must interact (Guenther, 2012). Furthermore, all communicative signals are subject to a range of physical parameters that render information 'noisy' by a series of time- or distance-related degradations. Therefore, any difference between the physical order within the internal milieu and the external environment is always a source of uncertainty since this depends on multiple interdependent components (Torday, 2015b). In such circumstances, life is always conditional self-organization in which the available information is equivocal (Torday and Miller, 2017; Miller, 2016).

2. The First Principles of Physiology and cell-cell communication

From life's initial calcium burst at the time of conception (Antoine et al., 2001), to the synaptic neuronal activity of the brain, the cardinal properties of negentropy, chemiosmosis and homeostasis manifested by the first protocell can be advanced as continuously constituting the First Principles of Physiology (Torday and Rehan, 2012). Together, these processes mediate the communication mechanisms between the unicellular organisms that dominated Earth for its first four billion years (Cavalier-Smith, 2006). Cellular communication evolved into cell-cell interactions that accommodated multicellular metabolic drive as a means of coping with a continually shifting environment, most particularly, as a rise in environmental oxygen (Berner et al., 2007).

These communicative properties of cells form the key elements for any mechanistic understanding of the evolutionary process. Initially, primitive cells interacted with their environment in a limited manner in continuing compliance with the First Laws of Physiology (Torday and Rehan, 2012). Since evolution can be defined as the aggregate of its communications directed towards problem-solving (De Loof, 2015), it might be surmised that the reciprocating complexity of cellular networks may have arisen as a defensive mechanism against the organized pseudo-multicellular behaviors of bacteria, such as quorum sensing (Castillo-Juárez et al., 2015) and biofilm (Majumdar and Pal, 2017). This coordinate problem solving by the three cellular forms (Bacteria, Archeae,

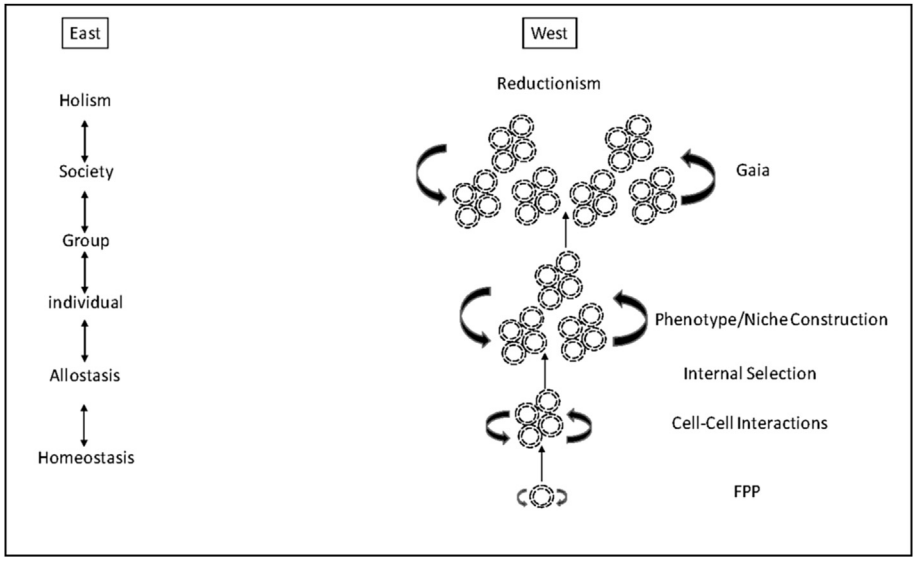

Fig. 1. Eastern versus Western Philosophy of Life. The Eastern perspective on the origins and evolution of life is depicted on the left. The Western perspective is depicted on the right. FPP= First Principles of Physiology (Torday and Rehan, 2012); Gaia refers to the theory that the Earth is an organic whole.

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