The Continuum from Ontology to Epistemology as the Logic of 'Holism'

John S. Torday
Professor of Pediatrics University of California- Los Angeles

1 Introduction

There is an implicit 'holism' in everything we experience [41], such as 'being', the environment, stars, weather, physiology, mathematics, physics, chemistry, and so on, and so forth. But when we attempt to systematically determine 'the forest for the trees', things begin to deteriorate into subjective ways of knowing. There is an inherent error in devising different ways of understanding our beginnings (ontology) and how and why they have affected our way of knowing (epistemology) that will ultimately fail [4]. So how can we formulate an ontology and epistemology that are inherently consistent with one another?

This question has arisen because experimentally, if you deprive differentiated cells of the force of gravity, they lose their phenotypic identities [44]; [32]; [6], providing a testable/refutable 'synthesis' of the inert and the living for the first time. That observation has offered the opportunity to understand and exploit the origin and trajectory of a holism as a foil to the implementation of Artificial Intelligence (AI), which threatens to deprive us of our birthright as sentient beings since it cannot account for non-local consciousness [55]. The following is a deconvolution

John S. Torday has been the recipient of NIH Grant HL055268

of native intelligence for the sake of knowing what the latter actually is, allowing us to make informed decisions about AI.

2 The Homology Between Evolution and The Periodic Table of Elements

There is a homology between the process of evolution and The Periodic Table of Elements (PTE) based on their homologous (of the same origin) structural-functional infrastructures [51], as follows. Evolution is characterized by ontogeny and phylogeny as its respective synchronic, or 'real time', and diachronic or across space-time components when both are seen as cell-cell interactions as their 'common denominator' [52]. The synchronic component is represented by ontogeny, or development, which occurs horizontally, or synchronically in space-time, whereas phylogeny, or speciation, occurs vertically, or diachronically across space-time. Now, turning to the PTE, it too has both synchronic and diachronic features, the synchronic being represented by the horizontal rows of Elements describing their physical characteristics alchemically, whereas the vertical columns are the diachronic, across space-time number of protons in the nuclei, defining their elemental identities, ultimately originating from the Big Bang. Therefore, both the way in which life has evolved and the elemental composition of the Cosmos share a common algorithmic structure and function [51].

Furthermore, underpinning both is a shared empiricism. In the case of evolution, it is the ways in which the organism interacts with its environment ([19]; [58]) to maintain homeostatic energetic balance [46], or how Jacob described evolution as 'tinkering' [19]. Likewise, in the case of the elements, Mendeleev used empiricism to intercalate the positions of the elements in the PTE [36].

3 What is the Underlying Principle/ Mechanism That Explains this Homology?

In order to reify the convergence of the inert and living conditions, one has to sound the depths of the formation of the elements, which constitute the 'logic' underlying both the Cosmos and life itself. The elements formed through the process of Stellar Nucleosynthesis - the two lightest elements, hydrogen and helium combining iteratively to form the next heaviest element, etc., etc. [17] from 1 to 94. In actuality, this is a Fibonacci sequence, the next in the sequence being the sum of the two previous, simpler values. Ultimately, that sequence gives rise to all 94 of the natural elements in the exact order of their atomic masses from hydrogen to plutonium, effectively providing a 'logic' for the Cosmos.

It is that same source of logic that biology assimilated through Symbiogenesis [35], the mechanism by which organisms maintain homeostatic control of their energy energy in an ever-changing environment due to an ever-expanding Cosmos. In so doing, biology acquires the Cosmic logic inherent to the elements, forming a common denominator for the inorganic and the organic, non-life and life. It is that commonality that mechanistically explains the homology between evolution and the PTE.

4 The First Cell

We do not know how or why the first cell formed some 3.8 billion years ago, but a 'paradigm-shifting' experiment has demonstrated that the force of gravity is necessary for evolution to occur [44], providing empiric evidence for the relevant interaction between physics and biology to form a cell for the first time. An earlier study [9] had shown that gravity was necessary for lipid micelles to provide the basis for the protocell. Based on these observations, combined with the process of Symbiogenesis [35], a hypothesis was formulated for cellular evolution from its origin [58], cells coping with existential threats by assimilating them to form their physiology based on "The First Principles of Physiology" [49].

5 Self-referential Self-Organization Redux

In their landmark book, entitled "Autopoiesis and Cognition", Maturana and Varela [27] described autopoiesis as 'self-referential self-organization', but they did not provide a mechanistic explanation for said process. Without such a mechanism, there is no way to test their hypothesis.

Conversely, the present work provides such a mechanistic explanation. Briefly, when cells encounter an existential threat, homeostasis provides the 'recoil' for maintaining their energetic equipoise. However, if the threat is overwhelming, the cells will lose their homeostatic balance, causing them to produce Oxygen Free Radicals, known to cause genetic mutations and duplications ([42]). That process of recovering homeostasis through cell-cell interactions that rectify structure and function [48] is described as the process of cellular evolution.

6 On the Origin of Symbiogenesis

The above mechanism for the formation of the cell raises the question as to the origin of Symbiogenesis, given that all of evolution is characterized by serial pre-adaptations, or exaptations [14]. In a recent article [56], that practice was traced to the non-dual monism, or holism from which the Cosmos has arisen, all of its inorganic contents being generated by the Big Bang some 14 billion years ago. As Jude Currivan informs us in "The Story of Gaia" [10] everything in the Cosmos exists at its lowest energy state, including living organisms, but how does life do so? It has been hypothesized that mathematics is the language used in common by both the animate and inanimate [57]. Therefore, the organism seeks that lowest energy state in synch with its environment, which Darwin described as 'survival of the fittest', and now we can understand Natural Selection as the mechanism of homeostatic fitness.

7 Pre-adaptations

But all of that leaves open the question as to what the pre-adaptations [14] for such properties as Symbiogenesis and homeostasis were. To answer that question we turn to Stellar Nucleosynthesis, the mechanism for the formation of stars from the serial reactions between hydrogen and helium [5], the Elements of the Cosmos being the by-products of said reactions. Hydrogen, the first Element in the Periodic Table, formed within the first second after the Big Bang, and is the most plentiful Element in the Cosmos [10]. Helium, the second Element in the Periodic Table, was produced by the the fusion reaction by hydrogen. In essence, hydrogen as the first element represents 'self', morphing into helium as 'non-self'. That is said in all candor, for if the concept of holism is to be fully embraced, it must be seen as a continuum from the Big Bang to hydrogen, helium, Stellar Nucleosynthesis, the stars, the elements, the cell, Symbiogenesis, physiologic homeostasis and ultimately consciousness. Seen through that lens, hydrogen is can be understood as 'self' as the first element, helium being the product of hydrogen from nuclear fusion as 'non-self'. This is not an anthropomorphism, but a true embracing of the concept of holism.

The Elements in the PTE formed as byproducts of Stellar Nucleosynthesis. They do so in the exact same order of their atomic masses, hydrogen, Element number 1, reacting with helium, Element number 2, this duo forming the template for the subsequent Elements. That precise ordering of elements forms the 'logic' of the Cosmos. Symbiogenesis, or the assimilation of Elements to form physiologic structures like the heme protein in red blood cells for oxygen carrying capacity, or iodine being used as the chemical foundation for the thyroid gland naturally forming the logic for physiology. It is this set of principles that underpin Weibel's Symmorphosis hypothesis [61], or why physiologic traits display the 'Goldilocks Effect', being 'just right' for their physiologic roles. The exception was the lung, which Weibel et al. concluded was 'over-engineered'. That may be because when the lung is inflated it produces a variety of physiologically-integrating agents such as prostanoids and bradykinin.

8 Finding the Lowest Energy State

As for how and why the organism determines what its lowest energy state is, it does so within the context of the energy within its immediate environment. Mathematics originated in the Cosmos [43]; [15]; [20]; [25], and yet again the process of Symbiogenesis not only assimilated material factors in the environment, but the mathematics associated with them as well. Over the course of utilizing those factors as organismal physiology, their associated mathematics and their logic were incorporated along with them. Thus, the commonly held mathematics of organisms and that of the Cosmos were used to synch their energies in ascertaining the lowest possible energy state for the organism, or what Darwin referred to as 'fitness'.

9 The Holism of the Cosmos and Mathematics

This scenario for Stellar Nucleosynthesis as the template for the stars, the elements, and life provides a way to understand the holism of the Cosmos for both the inanimate and the animate alike, founded on experimental evidence as a testable and refutable hypothesis. It is consistent with certain mathematical algorithms that have not been integrated epistemologically. For example, Cantor's use of diagonalization of Real Number sets to reveal the entirety of the Real Number sets ([7]) can be seen to be in common with Evolution and the PTE, the latter two being constituted by the diagonals formed from their mutually held synchronic and diachronic constituents [54]. And, for example, Gödel's Incompleteness Theorems [13] are incomplete because the author neglected to account for his own non-local consciousness, which was used to compose the formal mathematics in the first place. Roger Penrose refers to this as a "lack of understanding" [30].

More recently, several new mathematical algorithms have been formulated, such as Peter Rowlands' "Rewrite Mathematics" [33], Louis Kauffman's "Knot Mathematics" [21] , and Klein and Maimon's "Soft Logic Mathematics" [22]. All three of these formulations constitute 'holisms'. In the case of the Rewrite Mathematics, the 'attractor', zero, is the reference point for the dataset, and each time a new value is considered for entry

into that dataset, it must be evaluated with reference to all of the other existing values. That is comparable to the mechanism of epigenetic inheritance, by which factors in the environment are considered for assimilation in the organism's genome. That determination occurs in the sperm or egg using an as yet to be determined mechanism [1], but suffice to say that that calculation would be like the Rewrite Mathematics in determining the 'fit' with the other data in the set. Or Louis Kauffman's Knot Mathematics, the proof of a true mathematical knot being the ability to reduce it to a circle. A cell is a circle in two dimensions, and when the organism prepares to reproduce a diploid cell is reduced to a haploid cell during meiosis, figuratively 'unknotting' it. And Klein and Maimon's Soft Logic Mathematics includes both the set of Real Numbers and the set of zeroes, encompassing those values accumulated by symbiogenesis, the zeroes representing those data acquired by epigenetic inheritance. In this context, there are many biologic traits that ascribe to the Fibonacci sequence. Those traits reference Stellar Nucleosynthesis, helium + hydrogen equaling the next value in the series, or the Fibonacci sequence.

10 Fibonacci Sequence 'All the Way Down'

In closing, this article has mapped out a way of understanding how and why life evolved from non-life some 3.8 billion years ago as one continuous series of causal mechanisms set in motion by the force of gravity. Given the hypothesized role of the Fibonacci sequence at the ultimate origin of life, it should not come as a surprise that so many aspects of our physiology ascribe to it. For example, the process of aging has been shown to be a Fibonaccci sequence [46].

11 The Homology Between the Atom and the Cell

In retrospect, it is not surprising that there is a homology between the process of evolution and the PTE, given the underlying homology between the atom and the cell [50]. Both entities are topologies, exhibiting 'insides' and 'outsides'. The atom has both determined and probabilistic traits, the

former characterized by the number of protons in the nucleus, the latter by the electrons ascribing to the Pauli Exclusion Principle, the first three quantum numbers being determined, the fourth being time-based, and therefore probabilistic [28]. Turning to the cell, it too exhibits both deterministic and probabilistic traits as The First Principles of Physiology, namely negative entropy, chemiosmosis and homeostasis [50]. The negative entropy within the cell and the chemiosmotic process are determined principles, whereas the homeostatic control of energy is probabilistic, the cell varying about its set-point as if it were 'riding' a Schrodinger 'sine' wave [37]. Significantly, the identities of both the atomic and cellular holisms appear on their surfaces, the valence of the atom being presented as the electrons in the outer-most orbital. And in the case of the cell, the cell-surface receptors representing the cell's phenotypic identity. So the roles of these holisms in physics and evolution, respectively, are represented on their surfaces, as are their consequential roles in both evolution and the PTE. That is exemplified by the fact that in both cases the sequence of events is formulated by reactions- in the case of evolution, through the effects of Radical Oxygen Species causing gene mutations and duplications within the context of cell homeostasis [56], as a consequence of chemical reactions [42]; in the case of the PTE, Scerri informs us that the position of the elements in the PTE are partially empirically calibrated based on their chemical interactions [36].

12 Gravity as the Common Denominator for Both the Earth and Its Environs, or Gaia

There is a school of thought that gravity was necessary for the formation of the earth [62], which is of interest in the context of gravity also being necessary for evolution [46] because that would dictate that both the planet and its inhabitants are universally under the control of gravity as an integrating mechanism for Margulis and Lovelock's 'Gaia' [26].

13 On the Nature of Stellar Nucleosynthesis: from Stellar-Elemental Field to ECM

But even more fundamental than the role of gravity in integrating the earth and its organisms is the interrelationship between the Stellar-Elemental field (SEF) and the extracellular matrix (ECM) between the cells that stabilizes the latter. Once cells have established their structure and function through cell-cell interactions, they form the ECM in order to economize on the amount of energy they must expend, having reached equipoise vis a vis each other and their environment. However, if that equipoise is destabilized, the cells involved digest their ECM in order to recapitulate the cell-cell interactions that formed their homeostatic state in the first place. The dyshomeostatic cells produce Radical Oxygen Species [42] that can cause gene mutations and duplications necessary for the remodeling of the cells in order to establish a new homeostatic set-point compatible with the prevailing conditions, re-establishing the ECM to 'solidify' their new metabolic status. The nature of the ECM is hypothesized to be homologous with the SEF residue from Stellar Nucleosynthesis and the formation of the elements, acting as a reference for the formation and reformation of the ECM.

14 The Ontology and Epistemology of Stellar-Elemental Fields Determine the Physiology of the Extracellular Matrix

If we start from Stellar Nucleosynthesis forming the stars, the by-products of which are all of the 94 natural elements aligned exactly according to their atomic masses [17], it enables us to recognize the hierarchical interrelationships between cells and their ECMs, on the one hand, and SEFs and cells on the other. That is to say that cells assimilate lighter elements such as potassium, sodium, oxygen, hydrogen intercellularly via Symbiogenesis [35] to facilitate their homeostatic control of energy. In contrast to that, the heavier elements than iron are relegated to the ECM, where they act to stabilize the matrix, acting as catalysts for metalloproteinases to efficiently and rapidly breakdown the ECM under injury-repair conditions [22]. The partitioning of the lighter and heavier

elements by the cell membrane ensures the optimal use of said elements, and at the same time synergizes the latter's properties both physiologically and Cosmically. Absent the gravitational force that maintains the SEFs, the ECM does not form physiologically [11], providing empiric evidence for the role of the SEF in sustaining and perpetuating life.

Exceptions to the rules of lighter elements within the cell, heavier elements outside the cell in the matrix are such elements as calcium [atomic mass 40], and iodine [atomic mass 53], which have been exploited intracellularly to form calcium fluxes, Red Blood Cells and the thyroid, respectively. These exceptions to the rule exemplify the interactive relationship of the cell with Stellar Nucleosynthesis, and may hypothetically be exaptations of the Quantum Mechanical realm, given the homology between Symbiogenesis and Quantum Entanglement [54].

15 The Physiology and Pathophysiology of the ECM

Under normal conditions, the ECM forms between cells in order to stabilize them structurally and functionally. However, under pathologic or otherwise abnormal environmental conditions the ECM will commensurately develop abnormally accordingly, causing the overlying cells to experience dyshomeostasis [18]. The laying down of the ECM structural proteins collagen, elastin and proteoglycans is determined by the force of gravity, providing the infrastructure for the ECM [24].

16 Diagonalization Reveals the Holism of the Implicate Order

The classic example of the diagonal revealing the underlying nature of things is a prism revealing that a beam of white light can be dispersed into its component color wavelengths [29]. In mathematics, Georg Cantor was the first to 'diagonalize' the set of Real Numbers to reveal an infinite number of such underlying sets [7]. In this vein, the diameter of a circle is its maximum 'diagonal', the universal constant pi, or 3.1417 being

calculated as the ratio of the circumference to the diameter of the circle. Similarly, Rowlands' "Rewrite Mathematics" [33] juxtaposes the so-called 'attractor', or zero with the data set as a diagonally skewed way of interrelating the math with the biology of epigenetic inheritance [1]; similarly, Lou Kauffman's 'Knot Mathematics' [21] is homologous with the cell because the 'proof' of a true mathematical knot is the ability to unfold it to form a true circle. That is like an embryo twisting and turning to form the offspring; conversely, when the organism reproduces, it 'unfolds' the diploid cell to form the egg or sperm, which are haploid. And then there's Klein and Maimon's "Soft Logic Mathematics", composed of the family of Real Numbers and the family of 'zeros', holistically describing the process of epigenetic inheritance, the factor in question localizing in the egg or sperm, where it is interrogated to determine if it's a fit with the pre-existing genome.

One way to characterize all of the above constructs is as 'holisms', from Cantor's diagonalization of the family of Real Numbers, to Rowlands' "Rewrite Mathematics", to Kauffman's "Knot Mathematics', to Klein and Maimon's "Soft Logic Mathematics", to the Fibonacci sequence, to pi since they are all mathematical representations of wholes. But what is the origin of such interrelationships? It has been proposed that if Stellar Nucleosynthesis, or the production of stars through the reaction of hydrogen and helium [17] generates all of the natural elements of the Cosmos in the exact order of their atomic mass, from atomic number 1, hydrogen, to plutonium, atomic number 94, that that process provides a logic for the Cosmos. If you then superimpose Symbiogenesis on Stellar Nucleosynthesis, living organisms assimilating factors in their environment [35], the logic of the Cosmos is conveyed to the former, particularly physiology being the way the elements are implemented. Cells sense as a function of calcium fluxes regulated by calcium channels, which evolved due to the accumulation of calcium, the recursive deformation and reformation of the cell membrane by the Sun warming them by day, contracting at night in the absence of the Sun. That expansion and contraction caused the accumulation of calcium, forcing the evolution of calcium channels to regulate calcium or perish due to the toxic effect of calcium on lipids The Emergence of Everything: How the World Became Complex. A number of physiologic traits show bilateral 'asymmetry', such as the eyes, ears, nose and tongue.

In all of the above cases there is a differential input, which can be thought

of as being diagonal from one source to the other. It has been hypothesized that there is a homology between Symbiogenesis and Quantum Entanglement [54], both of which are in service to serial homeostasis [57]. The differential may refer to the Quantum realm that underpins the Newtonian [54]. And that property may extend to proprioception by the body, the ability to maintain balance with the environment.

But why the homology between the atom, the cell and the Black Hole, all three having topologies characterized by their 'energy' being expressed on their surfaces, facing outward? The body being bilaterally symmetric for that very reason [2]. So where do these properties arise from? In general, organisms re-use evolved properties, which then become genetically determined, referred to as the Baldwin Effect (Simpson, 1953). In that vein, it makes sense that homeostasis 'seeks' the lowest possible energy state that synchs the inherent mathematics of the environment with the organism. For example, in her book "The Story of Gaia", Jude Currivan [10] states that all of the Cosmos tends to seek the lowest energy state. It behooves us to consider the role of gravity in this property, particularly since Einstein's gravity is produced by tearing the fabric of space-time on a diagonal, releasing that force, and when gravity is applied to a curved surface, like a cell, it produces the energy needed to maintain negative entropy [38].

17 On the Origin of Consciousness

Delving more deeply into the above interrelationships, hydrogen was produced by the Big Bang, whereas helium formed from hydrogen through the force of nuclear fusion. The subsequent iterative reactions of hydrogen and helium formed the stars [17], the byproducts of which were the natural elements, from 1 to 94 in their exact order of their atomic masses, rendering the 'logic' of the Cosmos. Some ten billion years later, life evolved through the formation of micelles, or semi-permeable protocells, generated by lipid molecules suspended at the air-water interface – lipid molecules are 'zwitterions', having both a negatively and positively-charged pole. The negative pole points downward into the water because it is hydrophilic, whereas the positively-charged pole points upward because it is hydrophobic. Consequently, the lipid molecules align at the air-water interface and pack together until their aggregate negative charge is strong

enough to neutralize the Van Der Waals force for the surface tension of water, resulting in a quantum leap from individual lipid molecules to the semi-permeable membrane of the first cell [58]). Parenthetically, because the micelle accounts for both classical Newtonian and Quantum Mechanics, it accounts for the cell being able to accommodate both states of 'being' ([56]).

Such micelles were the prototype for the cell as a topology, floating on the primordial ocean surface. They were able to cope with the ever-changing environment caused by an ever-expanding Cosmos due to Symbiogenesis, Lynn Sagan's hypothetical mechanism for assimilating factors in the environment that threatened the homeostatic control of energy within the cell. Such factors were made useful as physiology, along with their associated mathematics, generating local consciousness. The organism's capacity to find a location within its environment where it could expend the least amount of energy was due to the mathematics of our physiology aligning with that of the Cosmos. This is a mechanistic explanation for what Darwin described as 'Survival of the Fittest' (1859), fitness being constituted by that mathematical matching of physiology and environment.

The aggregate of physiology as adaptation to the environment constitutes consciousness as awareness of said environment. It is composed of the totality of homeostatic interrelationships embedded within the organism ([56]).

18 On the Nature of Consciousness

The nature and origin of consciousness remain controversial. Yet what consciousness actually constitutes is perhaps the most important unanswered question for Mankind, particularly as Artificial Intelligence begins permeating our lives, and distorts natural and man-made intelligence. Most of the research in this field focuses on the brain, but there is no evidence for the brain being the seat of consciousness. Herein, it is shown that consciousness can be seamlessly traced all the way back to the unicell, and beyond to Stellar Nucleosynthesis, the process by which starlight is generated based on the serial chemical interactions between hydrogen and helium, the rest of the elements being the by-products of stellar evolution [5]. By integrating the physical with the biological we are

able to begin understanding consciousness as the aggregate of our physiology in connection with the Laws of Nature [53], gaining fundamental insight into our physical and mental health ab origine.

In brief, Organisms have assimilated factors in their environment using Symbiogenesis [35], thus hypothetically acquiring the 'logic' of the Cosmos formed by the ordering of the elements through Stellar Nucleosynthesis [5]. That logic forms the basis for consciousness. In the absence of gravity differentiated cells lose their phenotypic identity [44]; [39]; [6]), and their ability to conduct a calcium flux ([39], rendering them effectively unconscious as evidence for this hypothesis.

19 Folding Paper Circles as Consciousness vs non-Local Consciousness

One way to think about the above is in the context of local and non-local consciousness. Local consciousness is accounted for synchronically, in 'real time', whereas non-local consciousness redicts our physiology back to the Cosmos [56]. It is that transcendent property that is reflected in the Hansen-Smith paper circle folding exercise, the 'local circle', when folded, revealing the deeper fractal properties hidden within itself [16], like the components of our physiology that allow us to connect in a 'retrograde' manner all the way back to the Cosmos, Stellar Nucleosynthesis forming the stars, their byproducts being the elements in their exact order of their atomic masses as the logic of the Cosmos.

Stellar Nucleosynthesis is due to the serial reaction between hydrogen and helium, the latter having formed from the former through nuclear fusion, generating enormous amounts of energy for further reactions. This generative relationship between hydrogen and helium constitutes 'self and non-self' as a holism, like that of the paper circle. Folding it reveals the underlying nature of its existence from phi, the Fibonacci sequence, reflected by 'hydrogen + helium', and the diameter of the circle as the longest diagonal leads mathematically to pi. Thus, the circle and the cell both exist between phi and pi.

This hypothesis could be tested using agents like alcohol or drugs that affect our physiology, interfering with local and non-local consciousness?

Or the obverse, like the biblical burning bush that appears to Moses on Mount Horeb in the book of Exodus, not consumed by the flames, like a catalyst mediating a chemical reaction. This is likened to the bush metaphorically representing the ordinary being used by the divine, the people of Israel enduring suffering without being destroyed.

20 Discussion

We are at an inflection point in human history with the introduction of AI before we even understand what 'native intelligence' or consciousness constitutes. If we are not prudent in the implementation of AI, it will steal our birthright for being able to problem solve beyond the day-to-day 'easy' problems that Chalmers spoke of, in contrast to the 'hard' problems of 'qualia' [8]. The present article provides a novel perspective on the evolution of life from non-life based on Stellar Nucleosynthesis [17], or the formation of stars, beginning with the reaction between hydrogen, atomic number 1 with helium, atomic number 2 to sequentially produce lithium, atomic number 3. Mathematically, that is a Fibonacci sequence, the next value in a series being the sum of the previous two values. That pattern continues for the entire series of natural elements from hydrogen to uranium, providing a 'logic' for the Cosmos that life has assimilated via Symbiogenesis [35]. The causal nature of this mechanism is revealed by the homology between the process of evolution and the PTE, both of which are characterized by synchronic and diachronic features. By analogy, in an article by Frescura and Hiley [12] the authors posit that by regressing two harmonic processes at right angles to one another, they generate cycles. Such cycles are generated when organisms assimilate factors in the environment that pose existential threats, referred to by Lynn Margulis Sagan as Symbiogenesis [35]. Similarly, the elements have been assimilated symbiogenically over the course of evolution, being made useful as physiologic traits like Red Blood Cells utilizing iron as the core of the heme protein for oxygen transport, and iodine as the foundation for the thyroid [58]. As a result, they naturally reference the elements in the Cosmos, and our physiology ascribes to the same logic as the Cosmos [59], underscoring the mechanistic continuum from Stellar Nucleosynthesis and the formation of the elements, to Symbiogenesis and serial homeostasis [57] as the foundation for evolution. This consilience could and should be exploited to formulate a universal algorithm for all of the natural sciences.

References

[1] Ben Maamar, M., Nilsson, E.E., Skinner, M.K., 2021. Epigenetic transgenerational inheritance, gametogenesis and germline development. Biol. Reprod. 105, 570-592.

[2] Boeyens, J., Glatthard, J., Gandar, E., Nimmrichter, S., Correa, L.A., Rubio, J., 2025. On the role of symmetry and geometry in global quantum sensing. arXiv preprint arXiv:2502.14817.

[3] Bohm, D., 1980. Wholeness and the Implicate Order. Routledge, London.

[4] Bunge, M., 1983. Exploring the World. Reidel, Dordrecht.

[5] Burbidge, E.M., Burbidge, G.R., Fowler, W.A., Hoyle, F., 1957. Synthesis of the Elements in Stars. 29, 547.

[6] Camirand, A., Goltzman, D., Gupta, A., Kaouass, M., Panda, D., Karaplis, A., 2016. The Role of Parathyroid Hormone-Related Protein (PTHrP) in Osteoblast Response to Microgravity: Mechanistic Implications for Osteoporosis Development. PLoS One 11, e0160034.

[7] Cantor, G., 1891. Ueber eine elementare frage mannigfaltigkeitslehre, Jahresbericht der Deutschen Mathematiker- Vereinigung. 1, 75–78.

[8] Chalmers, D.J. 1995. Facing up to the problem of consciousness. J. Consciousness Studies 2, 200-219.

[9] Claassen, D.E., Spooner, B.S., 1996. Liposome formation in microgravity. Adv. Space Res. 17, 151-160.

[10] Currivan, J., 2022. The Story of Gaia. Inner Traditions, Rochester.

[11] Davis T, Tabury K, Zhu, S., Angeloni, D., Baatout, S., Benchoua, A., Bereiter-Hahn, J., Bottai, D., Buchheim, J.I., Calvaruso, M., Carnero-Diaz, E., Castiglioni, S., Cavalieri, D., Ceccarelli, G., Choukér, A., Cialdai, F., Ciofani, G., Coppola, G., Cusella, G., Degl'Innocenti, A., Desaphy, J.F., Frippiat, J.P., Gelinsky, M., Genchi, G., Grano, M., Grimm, D., Guignandon, A., Hahn, C., Hatton, J., Herranz, R., Hellweg, C.E., Iorio, C.S., Karapantsios, T., van Loon, J.J.W.A., Lulli, M., Maier, J., Malda, J., Mamaca, E., Morbidelli, L., van Ombergen, A., Osterman, A., Ovsianikov, A., Pampaloni, F., Pavezlorie, E., Pereda-Campos, V., Przybyla, C., Puhl, C., Rettberg, P., Rizzo, A.M., Robson-Brown, K., Rossi, L., Russo, G., Salvetti, A., Santucci, D., Sperl, M., Tavella, S., Thielemann, C., Willaert, R., Szewczyk, N., Monici, M., 2024. How are cell and tissue structure and function influenced by gravity and what are the gravity perception

mechanisms? N.P.J. Microgravity 10, 16.

[12] Frescura, F.A.M., Hiley, B.J., 1984. Algebras, quantum theory and pre-space. Rev. Bras. Fis. especial, 49–86.

[13] Gödel, K., 1931, Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme I. Monatshefte für Mathematik Physik 38, 173–198.

[14] Gould, S.J., Vrba, E.S., 1982. Exaptation-A Missing Term in the Science of Form. Paleobiology 8, 4-15.

[15] Grice, M., Kemp, S., Morton, N.J., Grace, R.C., 2024. The psychological scaffolding of arithmetic. Psychol Rev. 131, 494-522.

[16] Hansen-Smith, B., 2023. the Circle: a wholemovement perspective. Wholemovement Publications, Takoma Park.

[17] Hoyle, F., 1946. The Synthesis of the Elements from Hydrogen. Monthly Notices Royal Astronomical Soc. 106, 343–383.

[18] Huang, Y., Kyriakides, T.R., 2020. The role of extracellular matrix in the pathophysiology of diabetic wounds. Matrix Biol. Plus 6-7,100037.

[19] Jacob, F., 1977. Evolution and tinkering. Science 196,1161-1166.

[20] Jaeger, G., 2013. The Quantum-like Revolution. Springer, New York.

[21] Kauffman, L., 2006. Formal Knot Theory. Dover Publications, Garden City.

[22] Klein, M., Maimon, O., 2021. Fundamentals of soft logic. New Math. Nat. Comput. 17, 703–737.

[23] Klein, T., Bischoff, R., 2011. Physiology and pathophysiology of matrix metalloproteases. Amino Acids 41, 271-290.

[24] Lambert, ChA., Nusgens, B.V., Lapiere, ChM. 1998. Mechano-sensing and mechano-reaction of soft connective tissue cells. Adv. Space Res. 21, 1081-1091.

[25] Livio, M., 2002. The Golden Ratio. Broadway Books, New York.

[26] Lovelock, J. E., Margulis, L., 1974. Atmospheric homeostasis by and for the biosphere: the gaia hypothesis. Tellus 26, 2–10.

[27] Maturana, H.R., Varela, F.J., 1980. Autopoiesis and Cognition. Reidel, Dordrecht.

[28] Morowitz, H.J., 2004. The Emergence of Everything: How the World Became Complex. Oxford University Press, Oxford.

[29] Newton, I., 2012. Optiks. Dover, Garden City.

[30] Penrose, R., 1996. Shadows of the Mind. Oxford University Press, Oxford.

[31] Plato, 2007. The Republic. Penguin, New York.

[32] Purevdorj-Gage, B., Sheehan, K.B., Hyman, L.E., 2006. Effects of low-shear modeled microgravity on cell function, gene expression, and phenotype in Saccharomyces cerevisiae. Appl. Environ. Microbiol. 72, 4569-4575.

[33] Rowlands, P., 2015. The Foundations of Physical Law. World Scientific, Singapore.

[34] Sacco, R.G., Torday, J.S., 2023. Systems biology of human aging: A Fibonacci time series model. Prog. Biophys. Mol. Biol. 177, 24-33.

[35] Sagan, L., 1967. On the origin of mitosing cells. J. Theor. Biol. 14, 255-274.

[36] Scerri, E., 2019. The Periodic Table: Its Story and Its Significance. Oxford University Press, Oxford.

[37] Schrödinger, E., 1926. An Undulatory Theory of the Mechanics of Atoms and Molecules. Physical Review 28, 1049–1070.

[38] Schrodinger, E., 1944. What is Life? Cambridge University Press, Cambridge.

[39] Sheehan, K.B., McInnerney, K., Purevdorj-Gage, B., Altenburg, S.D., Hyman, L.E., 2007. Yeast genomic expression patterns in response to low-shear modeled microgravity. BMC Genomics 8, 3.

[40] Simpson, G.G., 1953. The Baldwin Effect. Evolution 7, 110-117.

[41] Smuts, J.C., 1926. Holism and Evolution. Macmillan, New York.

[42] Storr, S.J., Woolston, C.M., Zhang, Y., Martin, S.G., 2013. Redox environment, free radical, and oxidative DNA damage. Antioxid. Redox Signal. 18, 2399-2408.

[43] Tegmark, M., 2014. Our Mathematical Universe: My Quest for the Ultimate Nature of Reality. Vintage Books, New York.

[44] Torday JS. Parathyroid hormone-related protein is a gravisensor in lung and bone cell biology. Adv Space Res. 2003;32(8):1569-76.

[45] Torday JS. Symbiogenesis redicts the monism of the cosmos. Prog Biophys Mol Biol. 2024 Sep;191:58-62.

[46] Torday, J., 2023. Quantum Mechanics, Cell-Cell Signaling, and Evolution. CRC Press, Boca Raton.

[47] Torday, J.S., 2003. Parathyroid hormone-related protein is a gravisensor in lung and bone cell biology. Adv. Space Res. 32, 1569-1576.

[48] Torday, J.S., 2013, Evolution and Cell Physiology. 1. Cell signaling is

all of biology. Am. J. Physiol. Cell Physiol. 305, C682-C689.

[49] Torday, J.S., 2015. The cell as the mechanistic basis for evolution. Wiley Interdiscip. Rev. Syst. Biol. Med. 7, 275-284.

[50] Torday, J.S., 2018. Quantum Mechanics predicts evolutionary biology. Prog. Biophys. Mol. Biol. 135, 11-15.

[51] Torday, J.S., 2022. Hormones and Reality. Springer, Chalm.

[52] Torday, J.S., 2022b. Evolution, gravity, and the topology of consciousness. Prog. Biophys. Mol. Biol. 174, 50-54.

[53] Torday, J.S., 2023a. The holism of cosmology and consciousness. Prog. Biophys. Mol. Biol. 177, 181-184.

[54] Torday, J.S., 2023b. Consciousness, embodied Quantum Entanglement. Prog Biophys. Mol. Biol. 177, 125-128.

[55] Torday, J.S., 2024a. Symbiogenesis redicts the monism of the cosmos. Prog. Biophys. Mol. Biol. 191, 58-62.

[56] Torday, J.S., 2024a. The quantum cell. Prog. Biophys. Mol. Biol. 188, 24-30.

[57] Torday, J.S., Klein, M., Maimon, O., 2024b. The mobius strip, the cell, and soft logic mathematics. Prog. Biophys. Mol. Biol. 186, 65-70.

[58] Torday, J.S., Rehan, V.K., 2012. Evolutionary Biology, Cell-Cell Communication and Complex Disease. Wiley, Hoboken.

[59] Torday, J.S., Rehan, V.K., 2017. Evolution, the Logic of Biology. Wiley, Hoboken.

[60] Torday, JS., 2023. The holism of cosmology and consciousness. Prog. Biophys. Mol. Biol. 177, 181-184.

[61] Wiebel, E., Taylor C., Hoppeler H. The concept of symmorphosis: a testable hypothesis of structure-function relationship. PNAS November 15, 1991 88 (22) 10357-10361

[62] Wurm, J., Teiser, G., 2021. Understanding planet formation using microgravity experiments. Nat. Rev. Phys. 3, 405-421.

John Torday

John S. Torday received a Masters and Doctor of Philosophy from McGill University. He has been on the Medical School Faculties of Harvard, University of Maryland and the University of California- Los Angeles. He has authored numerous peer-reviewed articles and fifteen monographs on the evolution of consciousness.