From 'Egosystem' to 'Ecosystem'

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> *We all know that Art is not truth. Art is a lie that makes us realize truth, at least the truth that is given us to understand. The artist must know the manner whereby to convince others of the truthfulness of his lies.*
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> —Pablo Picasso

INTRODUCTION

Do you ever wonder why everything seems to be interconnected—humans, nature, planets, stars, the Cosmos? Life originated from unicellular organisms by circumventing the second law of thermodynamics using the first principles of physiology—namely, negentropy, chemiosmosis, and homeostatic regulation of calcium and lipids.[1] The discovery of the first principles of physiology offers the opportunity to understand how and why we have evolved from the environment.[2] By reducing developmental and phylogenetic processes to their cellular-molecular elements (which were ultimately driven by large-scale environmental changes), the causal relationships of "everything" can be more clearly envisioned, particularly when the mechanisms of homeostasis and dyshomeostasis (pathology) are superimposed. Viewing descriptive biology in the forward direction from unicellular to multicellular organisms, life's physical and chemical processes can be understood logically rather than dogmatically. By understanding what makes us "tick" at this fundamental level, we can better realize how we fit in to the great scheme of things personally, societally, and as one species among other species.

Having made these observations regarding the integration of the animate and inanimate, why is human life full of deceptions, obfuscations, dualities, dialectics, cheating? There is no question that this is the case, as chronicled by Robert Trivers in his landmark book, *The Folly of Fools*.[3] We would like to argue that deception is innate in the ultimate origins of humankind, so naturally it would pervade our existence.

IN THE BEGINNING

Life on Earth was spawned by the formation of the oceans and generated from frozen snowball-like asteroids striking the planet's surface. The process is complex but chemically can be well understood. Those asteroids contained polycyclic hydrocarbons, which became suspended in these bodies of water. As the Sun warmed the waters during the day, these lipids liquefied, expressing their hysteretic property, which is a physical form of "memory." The lipids deformed and reformed, ultimately generating protocells with semi-permeable membranes. Within these structures endomembranes partitioned positively and negatively charged ions, thereby creating bioenergetic flow. This electrical potential fostered negentropy, or the building of complexity, rather than the simplification of complexity within the cell in a process regulated by homeostasis. In the aggregate, this configuration of negentropy, chemiosmosis, and homeostasis constitutes the first principles of physiology, and the first niche construction.

EPIGENETICS AND NICHE CONSTRUCTION

As life thrived on Earth, it generated carbon dioxide, causing a greenhouse effect that warmed the atmosphere, causing waters to dry up, forcing some water-borne organisms to transition onto land, adapting to terrestrial life over eons. Two major characteristics that land life acquired—epigenetic inheritance and niche construction—were critically important for the successful adaptation to land. Epigenetic inheritance is the ability of the organism to acquire informational "marks" directly from the environment; niche construction is the organism's ability to modify its immediate surrounding environment.[4] When these two properties merge, this generates a dynamic capacity for the organism to interadapt to its environment, maximizing its likelihood of survival and ongoing evolution. And when niches impinge on one another and/or coalesce, they form networks for ever-expanding niches, ultimately covering the surface of the Earth. In the aggregate, this is the mechanism underlying the Gaia theory described by James Lovelock.

THE DECEPTION PROVES THE RULE

Robert Triver's book *The Folly of Fools* shows that cheating seems to be pervasive in nature. Yet biology is founded on principles of cooperativity. How can these contradictory characteristics constitute life? This seeming paradox is a testament to the great prank that life has foisted on its physical environs, which behooves us to acknowledge this inherent sleight of hand in order to be true to ourselves.

There is an inherent fallacy engendered in our understanding the transition from the physical to the biologic. So many dualities, dialectics, paradoxes, and counterintuitive aspects encountered in human experience could be resolved by acknowledging this fallacy. The quantum physicist David Bohm in his book, *Wholeness and the Explicate Order,* wrote that we misperceive our physical reality because we experience our physical surroundings through our subjectively evolved senses. This leads us to think that living and non-living matter are ontologically different; we embrace the pervasive notion, for example, that we are machines. In fact, we are merely a mechanism for converting the physical into the animate, monitoring our ever-changing environment in order to be able to survive, thrive, and communicate knowledge from one generation to the next effectively.

Armed with this more informed perspective, many otherwise threatening and dogmatically understood aspects of our being could be comprehended instead as a continuum from our origins forward. In our previous works, we have redefined many terms in biology as mechanisms in service to biology—for example, natural selection, the cell, homeostasis, pleiotropy, heterochrony, and the life cycle. These insights enable us to see how and why we have evolved as an integrated whole, as an agent for collecting information from the environment, rather than as the result of random mutations, seemingly without rhyme or reason—no wonder people default to belief rather than science. Importantly, this holistic vision offers the opportunity to fully appreciate our ecology, ourselves, and all organisms as one grand scheme, as referred to in the opening paragraph of this article.

We could even formulate a periodic table of biology, integrating all of the natural sciences into one functionally predictive database. A similar realization that the Sun is the center of the solar system once fundamentally changed human thought and action. Likewise, a firm understanding of where we came from (ontology), and how (epistemology), would have equal if not greater impact on human thought. Prior to the recalibration of the Earth as one of the planets circling the Sun, autocrats and soothsayers had exercised power by striking fear in peoples' hearts and minds through ignorance. But then came technological breakthroughs like the telescope and microscope, offering knowledge of our outsides and insides, respectively, that raised our sights and curiosity. And with the advent of the scientific method, we were enabled to "know what we do not know."

DECEPTION AND SOCIAL PATHOLOGY

But the stigma of deception remains as a barrier to our fullest knowledge of who and what we are as a species. Deception arose from the very origins of life itself, "cheating" Mother Nature by circumventing the second law of thermodynamics, which states that free energy must disperse over time. By utilizing the first principles of physiology as a means of instituting self-organization and self-reference, life has been able to generate a mechanism distinctly different from the physical laws governing non-living matter and energy in the universe. In *Wholeness and the Implicate Order*, Bohm has stated that the end result has been two different realms: the explicate and the implicate. The explicate realm is the one we think of as reality, when in fact it is one of our own making, distorted by our subjective, evolved senses. The true reality, which Bohm refers to as the implicate realm, exists on another perceptual plane. This duality is what has led to the deceptions we are familiar with in the explicate realm, offering the opportunity to cope with the inherent paradoxes we encounter daily.

Our own physiology has equipped us with the ability to endure such duplicity, but the consequence of that is stressful—it stimulates the hypothalamic-pituitary-adrenal axis. In its optimal state, the stress reaction facilitates learning, offering the opportunity to dominate the circumstances and evolve novel structures and functions that mitigate and can even eliminate the source of the stress by evolving means of internalizing otherwise-toxic substances in the environment, metabolic cooperativity/multicellularity, endothermy/homeothermy—or what we think of as physiologic evolution. Ultimately, such adaptive strategies, in combination with niche construction and epigenetic inheritance, can lead to homeostatic balance, both physically and physiologically, at least for the moment. However, there are conditions that are not conducive to such harmonious outcomes. In human evolution, there are social constructs that are not conducive to homeostatic balance because they are predicated on false principles and produce social systems that are unable to integrate with their environmental surroundings, as Jared Diamond discusses in his book *Collapse*. Such conditions perpetuate stress, resulting in elevated levels of adrenocorticotrophic hormone (ACTH) and cortisol, causing physiologic wasting in the host and transgenerational depression in the offspring.

Conversely, if we were to be able to recognize the systematic problem in perpetuating societal deception, perhaps we could live in a more harmonious environment. Peter Whybrow addresses this in his book *American Mania*, seeing the pathology from the point of view of a social scientist. And this problem is becoming endemic and pervasive with the advent of computer technology because it feeds into narcissistic behavior that resulted from the deceptions in the first place. Dacher Keltner has pointed out that we humans are naturally cooperative in his book *Born to be Good*, which is based on experimental evidence.

PHYSIOLOGIC STRESS

Before proceeding further, let us consider the evolutionary significance of stress in more detail. Hans Selye pioneered research on stress in his work on the physiology of the "fight or flight" mechanism.[5] Stimulation of the hypothalamic-pituitary-adrenal (HPA) axis under duress is critical for survival, fostering learning under optimal conditions, but when over-stimulated it can also cause disease.

The evolution of this integrated mechanism is most apparent during vertebrate adaptation to land, when the adrenal cortex and medulla evolved into one structural-functional unit. Prior to that, these two elements of the adrenal gland were physically separate structures. The merging of these two components of the adrenal gland constituted more than just a physical change; it had a profound effect on physiologic adaptation since the microvasculature of the corticoid-producing cortex was continuous with that of the catecholamine-producing medulla. Under stress conditions, increased production of ACTH by the anterior pituitary stimulates corticosteroid production by the adrenal cortex; the corticoids produced by the cortex pass through the adrenal medulla, stimulating the rate-limiting step in catecholamine production, phenylethanolamine N-methyltransferase. Consequently, catecholamine production is increased, augmenting many tissues and organs necessary for adaptation to physiologic stress-vasodilation, increased lung function, and glycogenolysis/gluconeogenesis.

In a recent article, Torday attributed the evolution of endothermy/homeothermy in mammals and birds to this mechanism.[6] Briefly, the lung evolved in a stepwise manner mediated by cell-cell interactions during the water-land transition in response to the increasing demand for metabolic drive. Periodically, the evolving lung would be inefficient for gas exchange, as evidenced by the fossil evidence for at least five independent attempts to breach land, suggesting a salutatory process of trial and error that would also have affected visceral organ development. That speculation is supported by research illustrating that when the parathyroid hormone-related protein (PTHrP) is deleted in the developing mouse embryo, it results in the failure to alveolarize the lung, calcify bone, and fully develop skin barrier function. The PTHrP-signaling mechanism was amplified during the water-land transition due to the duplication of the PTHrP type 1 receptor, likely due to the internal selection pressure for these specific tissues and organs generated by microvascular shear stress in adaptation to land.[7]

In parallel with their effect on the evolution of the lung, catecholamines would also have stimulated the secretion of fatty acids from fat cells in the periphery, increasing body temperature due to increased metabolism. This acute increase in body temperature would have been positively selected for since warm-blooded organisms require only one enzyme isomer per metabolic function, whereas cold-blooded organisms require several isozymes in order to accommodate their ambient environmental temperature efficiently. The former is much more energy efficient than the latter, favoring endothermy/homeothermy. This is consistent with the huge decrease in the genome of vertebrates in the post-Cambrian Burst era. We will return to endothermy again in another connection below.

Elsewhere, Torday has speculated that the evolution of endothermy in mammals and birds may have fostered bipedalism (both humans and birds are two-legged), since it takes more energy to walk on two legs than on four. The freeing of the forelimbs for specialized functions like flight and tool making would have offered positive selection for this cascade, putatively culminating in new and expanded behavioral and social possibilities for humans and birds.

Therefore, stress had a positive effect on vertebrate evolution. Yet too much of a good thing may lead to the law of unintended consequences. For example, we know that excessive myelination of neurons may lead to neurodegenerative diseases.[8] And there may be long-term consequences of physiologic stress, causing transgenerational depression.

AMBIGUITIES IN BIOLOGY

We use the term "ambiguities" to denote the problems generated when biological science does not take sufficient account of the fundamental negentropic achievement of evolved life on Earth. For example, confusion arises if the cell is thought of merely as the smallest functional unit of life. It must be viewed in addition from the perspective of evolution, during which the achievement of the cell in biological organization constitutes the first principles of physiology. Like all matter and energy, life should have been constrained by the second law of thermodynamics, but the cell solved that problem—or worked around that constraint—by generating negentropy through chemiosmosis, regulated by homeostasis. It is those foundational principles that allowed for both sustaining and changing the phenotype when necessary.

A number of other ambiguities arise in biological knowledge that can be resolved through an evolutionary and thermodynamic perspective. These involve the concepts of homeostasis, aging, pleiotropy, life cycle, phenotype, and economy. In concluding the first part of this article, we will briefly review these in turn.

Homeostasis. Homeostasis is conventionally thought of merely as a synchronic (same time) servo-mechanism that maintains the status quo for organismal physiology. However, when seen from the perspective of developmental physiology, homeostasis is a robust, dynamic, intergenerational, diachronic (across-time) mechanism for the maintenance, perpetuation, and modification of physiologic structure and function. The integral relationships generated by cell–cell signaling for the mechanisms of embryogenesis, physiology, and repair provide the needed insight to appreciate the scale-free universality of the homeostatic principle. This offers a novel opportunity for a systems approach to biology. Starting with the inception of life itself, with the advent of reproduction during meiosis and mitosis, moving forward both ontogenetically and phylogenetically through the evolutionary steps involved in adaptation to an ever-changing environment, biology, and evolutionary theory need no longer default to teleology.

Aging. Organisms have survived because they have devised adaptive genomes that allow them to change in response to the ever-changing nature of Earth's environments. This has come in the form of their reproductive strategy, which is optimized to generate the largest number of offspring suited for the environment into which they are born. This comes at a cost, however, because the energy of reproduction is selected to optimize the organism's internal physiologic milieu. But that energy debt must somehow be repaid because the second law of thermodynamics cannot be violated—the first and second laws of thermodynamics state that the total energy content of the universe is constant, and that total entropy is continually increasing.

This assumes that there is a finite amount of energy during the life cycle. Leonard Hayflick has unequivocally stated that longevity is genetically determined, whereas aging is epigenetic. Therefore, by definition, there must be a finite amount of energy generated during the life cycle of any organism that is then distributed throughout the period between birth and death in response to selection pressure for reproductive success. As a result, the bioenergetics are optimized during the reproductive phase, followed by a progressive loss of energy during the post-reproductive phase of life, leading to the breakdown in cell–cell communication, aging, and ultimately death, as a result of the progressive increase in entropy. This mechanistic explanation for the process of aging is consistent with descriptive theories of aging such as the mutation theory, antagonistic pleiotropy, and the disposable soma.

Pleiotropy. Pleiotropy is usually defined as the random expression of a single gene that generates two or more distinct phenotypic traits. However, in contrast to this probabilistic conception of pleiotropy, it actually should be understood as a deterministic consequence of the evolution of complex physiology from the unicellular state. Pleiotropic novelties emerge through re-combinations and permutations of cell–cell signaling exercised during reproduction, based on both past and present physical and physiologic conditions, in service to the future needs of the organism for its continued survival. Functional homologies ranging from the lung to the kidney, skin, brain, thyroid, and pituitary exemplify the evolutionary mechanistic strategy of pleiotropy. The power of this perspective is exemplified by the resolution of evolutionary gradualism and punctuated equilibrium in much the same way that Niels Bohr resolved the paradoxical duality of light as complementarity.

Life cycle. Based upon observation, the life cycle describes the milestones of an organism through birth, infancy, childhood, adolescence, teenage years, adulthood, senescence, and death. Yet we know that there is a great deal of variability in these stages of life, both within and between species. Hominids have a protracted infancy and childhood, which is usually attributed to the amount of time required to form our oversized brains; neoteny is the process by which an organism retains its juvenile phenotype; longevity is highly variable, as exemplified by the Mayfly, which only lives for a day, and the giant sequoia, which lives for thousands of years. What should we make of this variability? Elsewhere we have laid claim to the idea that since the epigenetic marks acquired during the life cycle are not expunged during meiosis, their incorporation into the developing conceptus during embryogenesis is similarly a means of determining the "fit" of those epigenetic marks based on homeostatic principles. Based on that idea, why should we assume that the influence of epigenetic inheritance stops at the time of birth? Perhaps the phases of the life cycle are also a way of utilizing epigenetic inheritance.

Since the stages of the life cycle are determined by the endocrine system, that would be a place to look for the influence of epigenetics. As it turns out, epigenetics does affect the endocrine system, substantiating the fact that epigenetics affects the organism at all stages of the life cycle.

Phenotype. The conventional understanding of phenotype is as a derivative of descent with modification through Darwinian random mutation and natural selection. Recent research has revealed Lamarckian inheritance as a major transgenerational mechanism for environmental action on genomes whose extent is determined, in significant part, by germ line cells during meiosis and subsequent stages of embryological development. In consequence, the role of phenotype can productively be reconsidered. The possibility that phenotype is directed toward the effective acquisition of epigenetic marks in consistent reciprocation with the environment during the life cycle of an organism can be explored. We would propose that phenotype is an active agent in niche construction for the active acquisition of epigenetic marks as a dominant evolutionary mechanism, rather than a consequence of Darwinian selection toward reproductive success. The reproductive phase of the life cycle can then be appraised as a robust framework in which epigenetic inheritance is entrained to affect growth and development in continued reciprocal responsiveness to environmental stresses. Furthermore, as the first principles of physiology determine the limits of epigenetic inheritance, a coherent justification can thereby be provided for the obligate return of all multicellular eukaryotes to the unicellular state.

RESOLUTION OF THE AMBIGUITIES BY ASSIMILATING THE THERMODYNAMIC DECEPTION

Thus far we have been examining the origin of the ambiguities in biology resulting from failing to acknowledge the deception of the second law of thermodynamics. Now we can move on to resolve many of the misunderstandings that have become dogma in biology.

The Cell as the First Niche Construction—Self-Organization Overcomes the Ambiguity

Niche construction nominally describes how organisms can form their own environments, increasing their capacity to adapt to their surroundings. It is hypothesized that the formation of the first cell as "internal" niche construction was the foundation for life, and that subsequent niche constructions were iterative exaptations of that event. (Exaptations are pre-existing characteristics that enhance the ability of a species to adapt to environmental change.) The first instantiation of niche construction has been faithfully adhered to by returning to the unicellular state, suggesting that the life cycle is zygote to zygote, not adult to adult as is commonly held. The consequent interactions between niche construction and epigenetic inheritance provide a highly robust, interactive, mechanistic way of thinking about evolution being determined by initial conditions rather than merely by chance mutation and selection. This novel perspective offers an opportunity to reappraise the processes involved in evolution mechanistically, allowing for scientifically testable hypotheses rather than relying on metaphors, dogmas, teleology, and tautology.

The Evolution of Endothermy; or, Self-Organization Overcomes Biologic Ambiguities

Only mammals and birds are warm blooded, or endothermic. How this trait evolved has never been explained based on an integrated physiologic mechanisms emanating from the ontogeny and phylogeny of visceral organs. A recent paper on the role of physiologic stress in the evolution of endothermy,[9] based on the appearance of specific physiologic traits in birds and mammals, has provided such an explanation for the first time, as follows:

Conditional endothermy. It has been hypothesized that endothermy evolved as a direct consequence of intermittent hypoxia during the water-to-land transition. Briefly, based on fossilized skeletal evidence, vertebrates breached land several times thereby avoiding extinction in drying up bodies of water. Since our overarching hypothesis is that visceral organs evolved through cell–cell interactions, as the lung evolved from the swim bladder of fish there would have been stages at which the lung was inefficient, resulting in hypoxia; hypoxia is the most potent of all physiologic agonists, causing stress, stimulating the HPA. The net result would have been increased catecholamine production, which would have alleviated the constraint of the inefficient lung by stimulating surfactant production, increasing the distensibility of the alveoli and thus their surface area, increasing oxygenation acutely. Over time, this ad hoc response to hypoxia evolved into increased numbers of alveoli because stretching of the lung stimulates PTHrP, which promotes alveolarization of the lung. As evidence for this mechanism, PTHrP appears in the pituitary of mammals and birds, where it augments ACTH production. PTHrP also appears in the adrenal cortex of mammals and birds, where it augments the effect of ACTH on corticosteroid production. Corticosteroids produced in the adrenal cortex of mammals and birds stimulate phenylethanolamine-O-methyltransferase activity in the adrenal medulla, amplifying epinephrine production. As a note added in proof of the evolutionary amplification of the HPA by PTHrP, Richard Wurtman has shown that the microvasculature of the adrenal medulla is augmented in rats, increasing the surface area of the capillaries for corticosteroid amplification of the epinephrine production.

In tandem with the facilitating effect on air breathing, catecholamines also stimulate free fatty acid secretion by fat cells in the periphery, providing substrate for enhanced metabolism and increasing body temperature. Ultimately, the increase in endotherm body temperature would have been selected for since warm-blooded metabolism is much more efficient than cold-blooded. In order to metabolize efficiently, a cold-blooded organism requires several forms of the same enzyme to accommodate metabolism at different environmental temperatures, whereas endotherms/homeotherms only require one. This increased metabolic efficiency is evolutionarily advantageous in being much more functionally efficient.

The causal nature of the interrelationship among physiologic stress, catecholamines, and endothermy/homeothermy is validated by the reverse effects of hibernation or torpor on lung surfactant lipid composition and cell membrane fatty acid composition. Under such conditionally low stress conditions, decreased catecholamine production results in both increased surfactant cholesterol, rendering lung surfactant less surface active, and decreased unsaturated fatty acid content of cell membranes, adaptively reducing oxygen uptake. And there are commonalities among stress, endothermy/homeothermy, and hibernation and meditation, leading to thoughts about the role of these mechanisms in fostering higher consciousness (see below).

Constitutive endothermy. Ultimately, the endothermic phenotype became functionally integral to the organism. Recently, it was discovered that deletion of the oxytocin gene in mice inhibited their ability to thermoregulate, indicating that this hormone evolved to centrally regulate endothermy.

Stress-Induced Evolution of Endothermy

Stress-induced evolution of endothermy by stepwise changes in physiology predicts bipedalism, evolution of the avian and hominid forelimbs, and higher consciousness. It is noteworthy in the context of metabolic evolution that both birds and humans are bipedal, which may have been a consequence of their both being endotherms. Being upright is metabolically costly, but by increasing their body temperatures in adaptation to land, both birds and humans have become much more metabolically efficient; cold-blooded organisms require multiple isoforms of the same metabolic enzyme to survive at ambient temperatures, whereas endotherms usually have only one isoform. Bipedalism may have resulted, freeing the forelegs to evolve into wings and hands—the latter with prehensile thumbs—through common genetic motifs.

Allan Hobson and Karl J. Friston have hypothesized that the brain must actively dissipate heat in order to process information. This physiologic trait is functionally homologous with the first instantiation of life formed by lipids suspended in water forming micelles, allowing the reduction in entropy (heat dissipation). This circumvents the second law of thermodynamics, permitting the transfer of information between living entities—which enables them to perpetually glean information from the environment—that is considered by many to correspond to evolution per se. The next evolutionary milestone was the advent of cholesterol, embedded in the cell membranes of primordial eukaryotes, facilitating metabolism, oxygenation, and locomotion, the triadic basis for vertebrate evolution. Lipids were key to homeostatic regulation of calcium, forming calcium channels. Cell membrane cholesterol also fostered metazoan evolution by forming lipid rafts for receptor-mediated cell–cell signaling, the origin of the endocrine system. The eukaryotic cell membrane exapted to all complex physiologic traits, including the lung and brain, which are molecularly homologous through the function of neuregulin, mediating both lung development and myelinization of neurons. That cooption later exapted as endothermy during the water–land transition, perhaps being the functional homolog for brain heat dissipation and conscious/mindful information processing. The skin and brain similarly share molecular homologies through the "skin-brain" hypothesis, giving insight to the cellular-molecular "arc" of consciousness from its unicellular origins to integrated physiology. This perspective on the evolution of the central nervous system clarifies self-organization, reconciling thermodynamic and informational definitions of the underlying biophysical mechanisms, thereby elucidating relations between the predictive capabilities of the brain and self-organizational processes.

Cold Stress and DRD4-7, Out of Africa?

Peter Whybrow makes the case for the Dopamine Receptor DRD4-7 being the cause for primates migrating out of Africa, since it is associated with risk taking.[10] At the time of the migration(s) out of Africa during the Pleistocene, the world was a lot colder than it is now and land masses were interconnected by ice bridges, facilitating human dispersal both north and east. Migratory behavior is of considerable biological importance because it leads to "gene dispersal" and reproductive advantage. "Out-migration," or dispersion as the primatologists call it, is dangerous, but it opens up new opportunities. In most primate species some animals will ultimately leave the group of their birth and seek another habitat. Commonly it is the males, but for some—chimpanzees, gorillas, and spider monkeys, for example—it is the females. Most out-migration occurs in adolescence, when risk taking increases. It is important to understand that in most monkey groups the adolescents leave because they want to, not because they are driven out. There is a second factor that interacts with risk-taking predisposition of those who migrate, the competition for scarce resources. This is where social rank becomes important in determining which animals leave the troop. In bad times, when there is not enough food to go around, the high-ranking animals usually stay in place and the aggressive, lower-ranking animals are most likely to leave. Such dispersion does not happen regularly or in every generation, but when it does occur it has a major impact on future generations by weeding out the parent troop and potentially seeding new ones.

Numerous studies of migrant populations all over the world support Lynn Fairbanks's conjectures that optimism, self-interest, curiosity (often described as restlessness or novelty seeking), and a vigorous ambition are the best predictors of emigres' adjustment to their new environment. Studies show that ambition and optimism are more commonly expressed in the men than in the women who migrate.

During the Miocene 20 million years ago, a global cooling began, and it was under these challenging circumstances, as the food supply dwindled and competition for survival increased, that our direct forebears emerged from the Rift Valley in Ethiopia. We know from the fossil record and genetic studies that humans, gorillas, and chimpanzees all descended from common ancestors—small ape-like creatures, called hominids, that were distinguished by walking upright—who lived late in the Miocene period, some 5 to 7 million years ago.

Novelty seeking, curiosity, and impulsive behavior are interrelated. Fairbanks has found that the most impulsive, risk-taking males in her colony are those who have the lowest levels of the serotonin breakdown product 5-hydroxyindolacetic acid (5-HIAA) in their cerebrospinal fluid. (Serotonin modulates behavior, opposing the curiosity-provoking dopamine superhighway and the alerting drive of norepinephrine). In some individuals or subspecies serotonin only weakly opposes the dopamine drive, so they may not be genetically "programmed" for migratory behavior

Jay Kaplan has found that those rhesus males who remain within a troop beyond puberty have higher levels of 5-HIAA in their CSF. In baboons in the Rift Valley, in whom dispersal occurs around puberty, there is an inverse relationship between serotonin levels and dispersal, again suggesting a strong role of dopamine drive in migratory behavior.

How Androgens Act to Reduce Ambiguities of Life

The sex ratio is defined as the number of males to females. At the time of conception the sex ratio is 4:1, whereas at birth it is 1:1—which raises the question why three out of four males die in utero. There are two peaks of fetal demise during pregnancy, the first occurring at sixteen to eighteen weeks gestation, and the second during the peripartum period. The cause of excess male deaths during the peripartum period is largely due to the relative immaturity of the male lung, caused by the production of androgens in the male conceptus, delaying lung development. The earlier demise at sixteen to eighteen weeks is the much larger population of spontaneous abortions, which is also due to the production of androgens by the fetus, as follows. At this stage of development the maternal ovary produces progesterone that maintains the pregnancy. The progesterone, in turn, stimulates human chorionic gonadotropin (HCG), which is produced by the placenta and stimulates development of the fetal gonads. The fetal testis and ovary synthesize androgens in response to HCG, which pass from the fetus to the mother via the placenta. Androgens can inhibit progesterone synthesis if they are produced in too large an amount, causing the abortion of the fetus. This mechanism prevents the development of a fetus that produces large amounts of androgen, causing fetal overgrowth, which endangers the life of both the conceptus and the mother at birth because the fetus cannot pass through the birth canal. So we see here an example of how the sex steroids are being used as a failsafe mechanism for reproductive health. Androgens inhibit serotonin, thus increasing dopaminergic activity in the brain.

How Art Resolves the Deception of Life

When we view works of art, we often find solace or escape from reality in the content because it is evidence that there is logic, or truth, in nature. This is because the artist is providing a way of seeing reality in ways that are self-organizing and self-referential, much like our biologic origins. The artist who painted the first cave paintings in Lascaux, France, was probably telling a story about the hunt, providing a rationale for life. The use of techniques in painting that encourage the viewer's eye to come full circle in appreciating the content of the work, for example, giving one the sense of an integral whole. So art encourages us to think that there is harmony in the universe, if only we could see it.

How Music Resolves the Deception of Life

Music similarly teaches us that there is harmony in the universe, like Gustav Holst's "music of the spheres." Again, we find refuge here but fail to find resolution outside of the musical construct. Instead, at least for us, it was encouraging to think that perhaps science could resolve this ambiguity. We realized biology is a deception, cheating nature by circumventing the second law of thermodynamics, which provided deep insight into the fundament of life as a pseudo-physical construct. Many physicists have tried to understand this interrelationship, but have failed. For instance, Ilya Prigogine's assessment of life's irreducible complexity concludes that biology is too complicated to define.[11] In contrast to such attempts to understand biology by analyzing it in its present synchronic form, we have approached the question of the mechanism underlying evolution by starting from its cellular origins, moving forward in biologic time diachronically, factoring out time and space to reveal the absolute nature of the process. This is analogous to the physicists viewing the universe as having originated from the Big Bang, and understanding such phenomena as the patterned distribution of the elements and the cosmic microwave background, with the formation of black holes and supernovas as a result.

CONCLUSION

Understanding life as cognitive dissonance vs scientific principles. Most of hominid history has been dominated by myth making. It is only in the last five hundred years that we have begun to emancipate ourselves intellectually using the scientific method as a way of "knowing what we don't know." The use of science to leverage truth is a powerful weapon against the deception built into our DNA. The mere fact that creationism has held sway over evolution theory speaks to the fact that there is currently no scientific evidence for the latter, so the debacle comes down to one belief system versus another.

We must be able to address evolution theory using scientifically testable and refutable methods. We have proposed a cellular-molecular approach for scientifically determining the evolution of vertebrate physiology based on cell–cell communication. Thus far, we have used this approach to redefine a series of otherwise dogmatic concepts in biology—the cell, homeostasis, heterochrony (a change in the timing of development), pleiotropy, phenotype, and life cycle—successfully to show the value added in understanding these processes mechanistically rather than descriptively. Moreover, we have experimentally demonstrated the developmental and phylogenetic properties common to amphibian and mammalian lung, hypothesizing that leptin evolved as a cytoprotective mechanism against oxidant injury. Since evolution is a structurally and functionally linked series of exaptations, it was predicted that leptin would have the same effect on the amphibian lung as it does on the mammalian lung. Cell–cell communication will reveal the same evolutionary mechanisms for all of physiology, given that it can be traced back to the unicellular eukaryotic state using cholesterol-related traits as the common denominator to vertically integrate physiology.

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NOTES

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7 In tandem with the above-mentioned stresses, the stimulation of the HPA axis would have increased the production of catecholamines, alleviating the stress on the lung by stimulating lung surfactant production by the alveoli, acutely increasing the alveolar surface area for gas-exchange. Ultimately, this way of alleviating the constraint on lung gas exchange would have increased the gas-exchange surface area constitutively since the increased distension of the lung alveoli would have stimulated PTHrP production by the alveolar type II cells, fostering more the formation of additional alveoli.
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