Self-portrait in the Pharaoh's Mirror: a Reflection of Ancient Egyptian Knowledge in Teilhard de Chardin's Evolutionary Biophysics

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Using Peircean logic on ancient documents, this paper is part of a continuing inductive argument, testing predictions based on an hypothesis on Ancient Egyptian texts supporting that the semiotic phenomenology of the pharaonic priesthood harbors an eschatological survival message for humans, viz., horizontal gene transfer (HGT) mediated by a virus in the quantum ecological niche. Once considered an extraordinary event, experimental documentation of HGT in many studies supports significant gene shuffling in the domains of Bacteria, Archaea and Eukarya, including human cells. Against scientific critics who have argued that the Jesuit paleontologist Teilhard de Chardin's evolutionary system is anti-scientific, unintelligible, and a 'bag of tricks', this paper compares the Egyptian hypothesis on pharaonic biophysics with the Teilhardian system, showing that both mirror the same *semiotics of evolvability*. This transformative biology embedded in physics is connoted by a dialectics of conical forms (mountain, peak, pyramid, whirlwind, and so on) and bridging mechanisms (twin mountain peaks, ladder, tunnel, spindle, and so on), contextualized with related signs (light, fire, water and so on). In both first-person accounts, self-reflection expresses intentionality directed toward the experience of climbing to the mountaintop, the content or meaning of this act pointing to a change of state in the quantum-electromagnetic-gravitational domain. The comparative review supports C. S. Peirce's evolutionary cosmology comprised of three doctrines: tychism (spontaneity exists in the universe), agapism (love is a vital evolutionary force) and synechism (continuity is essential).

Evolutionary Biophysics
Horizontal Gene Transfer
Ancient Egyptian Afterlife
Teilhard de Chardin
Semiotic Phenomenology
Self Reflection
Semiotics of Evolvability

A guess at the mystery of the sphinx, the hybrid conveys the idea of horizontal gene transfer (HGT), the exchange of DNA between two different species. Once considered an extraordinary event, experimental documentation of HGT in many studies supports significant gene shuffling in the domains of Bacteria, Archaea and Eukarya, including plants, fungi and human cells (Sorensen et al. 2005: 700). Microbial gene-swappers are expanding our idea of living organisms, as well as revising concepts such as species barriers and evolution. Genetic engineering is generally defined as the activity of HGT and transformation, viz., cloning. Acting as a carrier molecule for DNA fragments, the versatile virus is used often in cloning experiments. Theories exist that the virus invented DNA (Whitfield 2006: 131) and that the eukaryotic nucleus evolved from a complex DNA virus (Bell 2001: 251). Nonetheless, the possibility exists that ancient cultures were also aware of HGT.

The *Isis Thesis* asserts that the Egyptian pharaonic priesthood preserved an eschatological survival message for humans, viz., HGT and transformation mediated by bacteriophage Lambda (a complex virus infecting bacteria). The extensive Egyptian sign-system explains the horizontal gene transfer and transformation of the dead pharaoh as a matter-to-energy conversion in a DNA magnetic field wormhole. In this gene regulatory network, Egyptian deities are signs for viral and bacterial genes and proteins. The texts describe the DNA wormhole network as having the thermodynamic properties and topology of a quantum mechanical Kerr black hole connected to a white hole, a microscopic Einstein-Rosen bridge. (King 2004; 2005; 2006) Microscopic wormholes are allowed by the mathematics of general relativity, and Visser et al. (2003) demonstrated the existence of spacetime geometries containing traversable wormholes that are supported by arbitrarily small quantities of exotic matter, so this possibility is not science fiction.

In Egyptian texts, the transformative biology embedded in quantum physics is connoted by a dialectics of conical forms and related topologies (mountains, peaks, pyramids, triangles; valleys, pits, caves, holes; mouths, jaws; cones, horns, funnels, whirlwinds; spheres, circles, spirals, coils), including bridging mechanisms (ladder, wormhole, double mountains, double-headed serpents, bull horns).

The *Isis Thesis* emerged from analyses of eminent English translations of inscribed hieroglyphs, as well as artwork from the least-corrupted *Pyramid Texts* and *Coffin Texts*, *Amduat*, *Book of Gates*, *Book of Two Ways*, *Book of the Dead*, and *Edifice of Taharqa.* In this consistent model, the value or meaning of each sign emerged, not by choice, but rather from an analysis of each sign's interaction within a matrix of 870 interlinked thematic signs related to literature, art and architecture, spanning 2,000 years of Egyptian history.

Peirce describes a logical theory for dealing with ancient testimonies, beginning with a hypothesis or abduction to be tested, followed by deduction and induction (EP 2.75-113). So one might infer that if Egyptian knowledge endorses HGT mediated by a virus, then humans may have a viral origin, as well as viral traits and behavior, supporting that HGT may be possible at death. A deductive study (King 2007)

addresses this problem by expanding biosemiotic theory to include the virus as a living system in the natural history of the human lineage. Supporting Jesper Hoffmeyer's "evolutionary intentionality" based on code-duality, the study shows that human behavior is a biological message flow related to microbial genetics, viz., HGT and transformation in a bacterial cell, an argument also supported by the microbial history of life's evolution, human genome research proving humans have viral and bacterial genes, and recent scientific studies on HGT.

Yet, this deductive argument for the Egyptian evolutionary option only shows the proposition is probable, based on humans exhibiting viral behavior and having a genetic heritage of viral and bacterial DNA due *probably* to HGT, so inductive evidence is necessary. If HGT is a true survival message for humans, it should be evident in more than one semiotic system of human thought. Accordingly, a preliminary study (2007a) exploring three random historical subjects, the Jesuit paleontologist Teilhard de Chardin (1881-1955), the Aztecs, and the Book of Revelation, found the mountain is a marginal sign of a biophysical idea-system defining an energy landscape related to the molecular dynamics of proteins folding in funneled energy landscapes that mirror micro Kerr black hole physics, the same semiotics of evolvability present in pharaonic texts. Teilhard's use of language defines the biology of HGT and transformation, while his sign-system (mountain, cyclone, whirlwind, tornado, hurricane, vortex, pyramid, spiral, cone, spindle) describes micro Kerr (spinning) black hole dynamics related to a cosmogenesis or psychogenesis for survival. For example, Teilhard describes his biophysics as an activation of energy and "glorious vision" still retained "when I come down from the mountain" (1976: 100).

The study also discusses Teilhard's comparison of the universe and his Omega point to a crystal, since viruses self-assemble like complex crystals (Dawkins 2004: 45), and proteins fold and crystallize to unique stable structures. In light of this preliminary study, the major problem for semioticians and this inquiry becomes Teilhard's scientific query: "Is there or is there not, in man, a continuation and transformation of the biological process of evolution?" (1963: 311) To address this question, a clear definition of the Teilhardian system must be compared to modern knowledge of protein folding biology

and micro Kerr black hole physics. Therefore, this paper presents a comparative taxonomy clearly defining Teilhard's biophysics.

1. A Taxonomy of Teilhard's Biophysics

In a 1961 review of Teilhard's *Phenomenon of Man*, Nobel Prize laureate Peter Medawar claims Teilhard's ideas are "anti-scientific", "unintelligible" and a "bag of tricks". Teilhard's writings have been widely criticized by scientists, the Catholic Church, and anthropologists because his transdisciplinary system encompasses religion, evolution, metaphysics, philosophy, biology, and physics. Teilhard describes the universe as "a sort of biological 'vortex'" and his system as "*omnipresence of transformation"* with a "temporo-spatial peak" (1976: 94). His converging universe is in the process of cosmogenesis or psychogenesis, and he compares the collective, quantum reality of the "Human-million" to a "giant molecule of protein" (1976: 31), always depicting the energy conversion process with drawings of an inner cone of evolving, rising mind versus an outer cone of decomposing matter. This topology is similar to a Kerr black hole and the protein folding landscape. Biologists generally agree that protein folding occurs along convergent pathways or folding funnels that guide folding to the protein's native state. Today physicists know that quantum mechanical equations resemble those of the kinetic theory of molecules (Musser 2004: 89). Yet, scientists may be unaware of the striking comparative behavior of micro Kerr black holes and protein folding dynamics as shown in this taxonomy, which presents Teilhard's concept first, then the biological and physical complements.

1. Teilhard's "self-arranging universe" collapses to the quantum due to gravity; it *"converges upon itself"* (1976: 86), and Man is swept along in the "universal Flux" (87). The gravitational world is transformed or converges under "the irresistible pressure of a planet that is contracting upon itself" (1955: 48), "under the heightened pressure of an infolding world" (267).

Biology. Hydrophobic collapse, accompanied by secondary structure formation, is an early step in the protein folding pathway. A protein native state forms by rearrangement of a compact collapsed structure (Dill et al. 1995; Ptitsyn 1996; Duan and Kollman 1998; Hagen and Eaton 2000).

Physics. Gravitational collapse forms a black hole, and a Kerr black hole drags spacetime flux into an accretion disk.

2. Teilhard explains his Omega point as "a focus of union" (1955: 263) that is alive with "isospheres of consciousness"; "the world is *convergent*", and the "isospheres are simply a system of waves which as time goes on (and it is they which measure time) close up around Omega point." (1963: 102)

Biology. A protein's native state guides folding dynamics in a convergent, rugged funnel-like landscape biased toward the native structure. (Onuchic et al. 1997: 545)

Physics. A stable sonic point is necessary for accretion onto a Kerr black hole. Also, the black hole final state hypothesis proposes matter converges to a unique state, translating incoming states to outgoing states (Horowitz and Maldacena 2004; Lloyd 2006)

3. "Groping is *directed chance"* (1965: 110) to Teilhard's Omega, and "universal groping has been since the beginning" (250). Our "world appears as an immense groping in the dark, an immense searching" (1965: 115). The human condition is one of "atoms patient of synthesis" (1963: 56-7).

Biology. Computer simulations show protein folding to the native state is a searching process (Duan and Kollman 1998) or directed self-assembly (Leopold et al. 1992).

Physics. A searching procedure for the "true sonic location" or critical point is evident in a Kerr black hole (Mukhopadhyay 2003). The warping of space produces the geometry of a hill. Matter that falls through the axial inner horizon of a micro Kerr black hole can bounce back or peak into an exploding white hole (Einstein-Rosen bridge).

4. Teilhard's universe converges to a peak or cone of two energies: "one axial, increasing, and irreversible, and the other peripheral or tangential, constant, and reversible: and these two energies are linked together in 'arrangement', but without nevertheless being able either to form a compound or

directly to be transformed into one another, because they operate at different levels." (1963: 393) One must escape "through the axis (by convergence, that is)" (1963: 69).

Biology. Wang et al. describe the free energy having a "double-well shape" around folding temperature, "with one well corresponding to the nonnative unfolded states and the other one corresponding to the native folded state." (2005: 1615) (respectively, Teilhard's tangential and radial)

Physics. Within a Kerr black hole, physicists refer to tangential and radial pressures.

5. Teilhard speaks of "an explosive climax: and this at the high temperatures of the Centre and on the scale of the whole" (1976: 83).

Biology. Protein folding is "temperature dependent", for "At high temperatures, folding is an uphill process thermodynamically" (Socci et al. 1996: 2).

Physics. With Hawking radiation, a micro black hole evaporates, decreasing its mass as its temperature becomes higher until it disappears in an explosion. (Wald 2001)

6. Teilhard's axial or radial energy reflects, and "reflection" can only occur on a "favoured axis of evolution". Humans have "reflection" or "the power acquired by a consciousness to turn in upon itself, to take possession of itself *as of an object*" (1955: 165). Therefore, humans can make the "hominization leap" (1963: 277) and move to a "Being of higher order." This "reflection" operates by the universal "*laws of union"*. Teilhard compares reflection to a change of state: "Or, taking a series of sections from the base towards the summit of a cone, their area decreases constantly; then suddenly, with another infinitesimal displacement, the surface vanishes leaving us with a *point.*" (168)

Biology. Quantifying kinetic paths in protein folding is a current challenge to biophysicists due to the multidimensional configurational space. However, Wang et al. (2005: 1616-1617) identified bounce-back points in the dominant flow of paths directed toward the native state.

Physics. The bounce-back of energy in a time-reverse evolution is the mirror effect of black hole reflection: "a particle can bounce back from the event horizon". "For low energy particles . . . the

reflection is strong, a black hole behaves as a mirror." (Kuchiev 2004; 2004a) Further, Juan Maldacena (2004) has shown black holes operate according to the holographic principle. In black hole reflection, the holographic horizon operates as a mirror and particles bounce back or rebound.

7. Teilhard describes decreasing entropy, as radial energy rises to Omega, which is "a *distinct Centre radiating at the core of a system of centres*" (1955: 262). The "reflection" to Omega is the "reversing current" or what Teilhard calls the "Noosphere", where the "reflected elements" or "Divine Milieu" are rising and escaping to a "new psychic dimension" "without duration or space." The elements are "animated by a sort of elevating force, it seeks to rise up radially, like a rocket, from the monocellular stage to polycellular stages, in the direction of Omega" (1963: 107). The "Noogenesis" is this "rising upstream against the flow of entropy" (1955: 290), for the inner cone is "a sort of anti-entropy" (1963: 315), whereas due to entropy, the outer energy cone is the "dissipation of energy and the disintegration of matter." Again, this "reflection" only occurs within the axial inner cone, not the disintegrating outer cone of peripheral or tangential energy.

Biology. Free energy in the protein folding funnel is determined by a competition between energy and entropy. As the protein chain moves to the native structure, the entropy reduces. (Socci et al. 1996) The native structure exhibits the lattice model of atoms.

Physics. Because black hole reflection results in a time-reverse white hole, entropy decreases. At the Planck scale, our world is not 3+1 dimensional, but is best described as degrees of freedom "defined on a two-dimensional lattice, evolving with time" ('t Hooft, 1993).

8. Teilhard's peripheral or tangential energy dissipates.

Biology. Nonnative interactions that assist folding to a protein's native structure do not fold to the native structure. (Clementi and Plotkin 2004).

Physics. Outer-horizon, ingoing states of energy rotate around the periphery to be crushed at the ring singularity.

Through the "play of chance" (1963: 105), Teilhard's evolutionary "*laws of union*" support that "everything in the universe moves in the direction of unification" (115). "*Thought* . . . concentrates in the pure state, in a cosmic peak: and this it does in its most stable form, which means in the form that has become the most completely irreversible." (1976: 35) Teilhard often defines "irreversibility" as "immortality" (149). He envisions "*something that is ultra-human* lying ahead of us", disclosing "not only the promise of some millions of years of existence but a permanent immortality" (1963: 399-400).

2. A Ceremony of Innocence

The Teilhardian system clearly describes protein folding dynamics that mirror micro Kerr black hole/white hole formation/evaporation processes relative to the growth or evolution of mind. Teilhard's prescient biophysical knowledge is impressive, for Roy Kerr did not discover his solution to Einstein's field equation for a spinning black hole until 1963 (Thorne 1994: 541), eight years after Teilhard died. In addition, Avery in 1944, and Lederberg and Tatum in 1946, are credited with discovering actual HGT and transformation, yet Teilhard described the process in 1920, as did the pharaonic priesthood 4,500 years earlier. Again, this inductive argument is not absolute verification of the *Isis Thesis*, but offers support for its truth.

After Teilhard's experience in World War I as a stretcher-bearer, he refined his biophysics in a series of essays, some of which were sent via a mutual friend, Father Auguste Valensin, to the philosopher Maurice Blondel for criticism. In their 1919 correspondence, both thinkers explore the process by which the creation transforms into the cosmic Christ, but they are unable to define the scientific process (Blondel 1967: 41-46), a problem never resolved during Teilhard's lifetime.

Valuing the "*within* as well as the *without* of things" (1955: 164), Teilhard supported orthogenesis, a discredited teleological theory. Today, research on HGT is convincing some biologists that these theories should be re-evaluated, a process paleontologists are already pursuing (Syvanen 1994: 256). In fact, Erwin and Valentine attribute the sudden appearance of novel morphologies in the fossil

record to HGT (1984: 5482). Similarly, Teilhard attributes the novel morphology of *Homo's* bigger brain that appeared at the end of the Tertiary to a rapid "mutation leap" (1956: 74), suggesting HGT. At the end of the Tertiary, the evolutionary transition from the chimpanzee-sized brains of *Autralopithecus* to the bigger brains of *Homo* "has always been murky" (Lieberman 2007: 291). Regarding this transition, Teilhard wrote that "a mutation *unique of its sort*," produced four novel properties in Man: the ability to expand, differentiate, germinate and interconnect (1956: 73). In his essay "Reflections on an Ultrahuman", Teilhard describes the "hominization leap", claiming Man "belongs to another level, another form, another species of life in the universe." (1963) In short, Teilhard's evolutionary "leap" and his discussion of Man's adaptive viral qualities suggest HGT mediated by a virus. Modern biologists also refer to HGT as a process of "evolutionary leaps" (Raymond and Blankenship 2003: 7419). According to Teilhard, Man "corresponds in reality to an original rebound of evolution on itself—one that by the crossing of a characteristic threshold, introduces a complete transformation." (1963: 276) Teilhard insists a second collective "reflection" is possible at human death, what may be the quantum propensity for HGT.

3. *Spiritus Mundi*

Without doubt, Teilhard's emphasis on reflecting, event-reversing, axial energy mirrors the Egyptian instructions to the dead pharaoh (King 2007a). From the axial inner horizon, a Kerr black hole is a gateway to an Einstein-Rosen bridge. To describe his physics, Teilhard uses the mountain sign-system, describing the "organic bridge from one species to another" and a "spindle-shaped universe, closed at each end (to the rear and in front) by two peaks of diametrically opposite character." Similarly, on the biological end of Lambda lytic transformation, research supports a mirror spindle model in the self-assembly viral protein process related to DNA bending functioning to produce outgoing clones (Tzlil 2003: 1616). Teilhard claims the "inevitable reaction" changes the "Corporeal into an incredible Energy of Radiation" (1976: 44). This represents his Divine Milieu, an escaping energy similar to outgoing Hawking radiation in a micro Kerr black hole. Physicists infer that "either information is lost or cloning of arbitrary quantum states . . . can occur" (Gottesman and Preskill 2004: 1).

The activity of axial "reflection", detailed by Teilhard to denote psychic evolutionary survival and describe a "rebound of evolution", mirrors the micro black hole process related to Hawking radiation called *reflection*. A ***finite probability*** exists for any particle that approaches the black hole event horizon to bounce back or reflect, and this probability depends on the energy of the incoming particle, its charge, and its projection of the orbital momentum on the black hole's axis of rotation (Kuchiev 2004: 1-2; 2004a). Egyptian texts define the same conditions for the dead pharaoh's HGT and transformation (King 2004), while Teilhard only targets the axis of rotation as the psychic survival factor. To speculate, HGT may be a possible selectable mechanism at human death for species survival because adaptive sequences may be encoded in the unconstrained, non-coding elements of the human genome due to our microbial inheritance, and at death, genetic barriers preventing HGT may be eliminated. According to the ENCODE Project Consortium, the human genome exhibits functional, unconstrained, non-coding DNA that can change randomly over time, while functioning potentially as a "warehouse" for "lineage-specific elements and functionally conserved but nonorthologous elements between species." (2007: 800)

Also interesting is that Teilhard's Christianity mirrors Egyptian religious themes. On a very detailed biological level, Egyptian texts and artwork define bacteriophage Lambda's asexual viral protein lifestyles that parallel the activities of their dying/rising god Osiris, the virgin goddess Isis, and other deities that mirror cross-cultural mythological and religious themes (King 2004). Perhaps these patterns provided a rationale for Teilhard's attempt to reconcile the Christological events with evolutionary law.

To Teilhard, a "new universal love" is possible, and love is the "agent of universal synthesis" (1963: 71) that "links and draws together the elements of the world, centre to centre", suggesting an intermolecular force such as hydrogen bonding. Associatively, his Omega operates as light (112), an attribute of quantum molecular energy states, for atoms emit and absorb light. Teilhard also identifies "the fire that unites in love" and "the fire that destroys in isolation" (1957: 110), two "contrary manifestations of the same energy" (112). His definition of fire suggests the average kinetic energy of atoms or temperature, as well as thermodynamic reactions in black holes. According to Teilhard, "death puts us into that state which is organically necessary" (1965: 130).

4. The Widening Gyre

The Teilhardian system is remarkably similar to Peirce's metaphysics. In his essay "A Guess at the Riddle", Peirce speaks of states chancing "to take habits of persistency" so as not to disappear, while other states "that fail to take such habits, will fall out of existence." His laws of nature consist in "the permanence of mass, momentum, and energy." Space dimensionality will become uniform and "multiple connections, except at infinity, where substances never go, will be obliterated." (EP 1.279) Peirce mentions "the bridge which unites the present and the absent, of a Process as such." (283) Also, related to Peirce's concept of Final Causation, Hulswit identifies two symptoms. First, "*the end state of a process can be reached in different ways*" and "*the process is irreversible.*" (2002: 95) Is Peirce describing a protein's multiple routes to the irreversible native state? Like Teilhard, molecular biology embedded in quantum physics is grounding semiosis.

Peirce understood the classical barriers of habit, biopower, fear, and intuitive assumptions of reality that maintain ignorance about "Man's Glassy Essence". He also conceives that the *modus operandi* of "Man's Glassy Essence" is the "flying asunder of molecules, and the reparation of the parts by new matter. It is, thus, a sort of reproduction." (EP 1: 361) Further, his ideas of "Evolutionary Love" and continuity mirror Teilhard's conception, as does his vision of the rationalized world as a system "in which mind is at last crystallized." (EP 1: 297) Peirce emphasizes that this occurs through chance.

> But although no force can counteract this tendency, chance may and will have the opposite influence. Force is in the long run dissipative; chance is in the long run concentrative. The dissipation of energy by the regular laws of nature is by those very laws accompanied by circumstances more and more favorable to its reconcentration by chance. There must therefore be a point at which the two tendencies are balanced and that is no doubt the actual condition of the whole universe at the present time. (EP 1: 221)

Similarly, the pharaonic priesthood's perceptual acuity in their religious dwarf world, as well as Teilhard's in his unifying vision, affirm the primacy and survival of higher-ordered mind after death via quantum laws. Evolution is linked to universal growth of mind through a self-assembled creative union, dependent on biophysical principles leading to a primal state of pure Firstness or potentiality. If matter is the epiphenomenon, as Teilhard, Peirce, and the pharaonic priesthood believed, then human consciousness may have a *finite probability* of transforming to mind or energy in the universe.

By walking the Planck, the pharaonic priesthood, Teilhard and Peirce may have discovered a lawful biophysical system for preservation of mind long before modern scientific aspirations. Our 21st century quantum technology and Time's arrow, signs of higher order and the progress of symmetrical mechanization of mind, may have tricked us into believing we are exploring new horizons related to HGT and cloning, when we are circling over the same repetitive terrain. As Yeats expressed it, "The falcon cannot hear the falconer".

And the sphinx? According to Kevelson, "Ancient peoples understood the significance of hybridizing in order to create new manifestations of the possible." (1999: 217) The sphinx, then, may be a sign of HGT, the exchange of DNA between a human and a bacteriophage, cohabitants of the same natural class.

REFERENCES

AVERY, Oswald.T., Colin M. MACLEOD, and Maclyn MCCARTY.

1944. Studies on the chemical nature of the substance inducing transformation of pneumococcal types. February 2. Reprint: The Oswald T. Avery Collection at National Library of Medicine.

BELL, Philip. J. L.

2001. Viral eukaryogenesis: was the ancestor of the nucleus a complex DNA virus? September, *J. Molecular Evolution*. 53(3): 251-256.

BLONDEL, Maurice.

1967. *Blondel et Teilhard de Chardin* (Letters addressed to Auguste Valensin with notes and

commentary by Henri de Lubac), English trans. by William Whitman published as *Pierre Teilhard de Chardin. Maurice Blondel, Correspondence* by Herder and Herder (New York).

CLEMENTI, Cecilia, and Steven S. PLOTKIN.

2004. The effects of nonnative interactions on protein folding rates: Theory and simulation. *Protein Science* 13(7): 1750-1766.

DAWKINS, Richard.

2004. *A Devil's Chaplain*. (Houghton Mifflin Co.)

DILL, Ken A., S. BROMBERG, K. Z. YUE, K. M. FIEBIG, D. P. YEE, P. D. THOMAS, and H. CHAN.

1995. Principles of protein folding - A perspective from simple exact models. *Protein Sci.*, 4 (4): 561-602.

DUAN, Yong, and Peter A. KOLLMAN.

1998. Pathways to a protein folding intermediate observed in a 1-microsecond simulation in aqueous solution. *Science.* October 23, 282(5389): 740-744.

ENCODE Project Consortium.

2007. Identification and analysis of functional elements in 1% of the human genome by the ENCODE pilot project. *Nature.* June 14, 447(14): 799-816.

ERWIN, Douglas. H. and James W. VALENTINE.

1984. "Hopeful Monsters," Transposons, and Metazoan Radiation. *PNAS*. September 1, 81(17): 5482-5483.

GOTTESMAN, Daniel and John Preskill.

2004. Comment on "The black hole final state". *J. of High Energy Phys.* 03 (2004) 026: 1-5.

HAGEN, Stephen J. and William A. EATON.

2000. Two-state expansion and collapse of a polypeptide. *J. Mol Biol*. Aug. 25, 301(4): 1019-27.

HOROWITZ, Gary T., and Juan MALDACENA.

2004. Black hole final state. *J. High Energy Phys*. Doi:10.1088/1126-6708/2004/02/008.

HULSWIT, Menno.

2002. *From Cause to Causation A Peircean Perspective* (Dordrecht/Boston/London: Kluwer Academic Publishers, Philosophical Series #90).

KEVELSON, Roberta.

1999. *Peirce and the Mark of the Gryphon.* (New York: St. Martin's Press).

KING, Judy K.

2004. *Isis Thesis* (Gaylord: Envision Editions, Ltd.)

2005. "Biosemiotics in Ancient Egyptian texts: the key to long-lost signs found in myth, religion, psychology, art and literature", *International Journal of the Humanities.* 3(7): 189-203.

2006. "Biosemiotics in Ancient Egyptian texts: the key unlocking the universal secret of sexuality and the birth of the limitless", paper presentation on October 25, 2006, to the Second International Congress for Young Egyptologists, Lisbon, Portugal; in press.

2007. "Man the MisInterpretant: will he discover the universal secret of sexuality encoded within him?", *International Journal of the Humanities,* 4(9): 1-16.

2007a "From History's Dustbin: a semiotics of evolvability discovered within Man and his mountain of transformation", *International Journal of the Humanities,* in press.

KUCHIEV, M. Yu.

2004. Reflection, radiation and interference for black holes. *Phys. Rev. D.* 69, 124031: 1-10.

2004a. Reflection from black holes and space-time topology. *Europhys. Lett.* 65: 445-451.

LEDERBERG, Joshua and E. L. TATUM.

1946. Novel genotypes in mixed cultures of biochemical mutants of bacteria. Cold Spring Harbor Symposia of Quantitative Biology.

LEOPOLD, Peter E., Mauricio MONTAL, and José N. ONUCHIC.

1992. Protein folding funnels: a kinetic approach to the sequence-structure relationship. *PNAS* 89(18): 8721-8725.

LIEBERMAN, Daniel E.

2007. Honing in on early *Homo*. *Nature,* September 20, 449 (7160): 291-2.

LLOYD, Seth.

2006. Almost certain escape from black holes in final state projection models. *Phys. Rev. Lett*. 96, 061302.

MALDACENA, Juan.

2004. Black holes and the structure of spacetime. Aired October 2, 2004: online lecture. Perimeter Institute for Theoretical Physics.

MEDAWAR, Peter.

1961. Review of Pierre Teilhard de Chardin's *The Phenomenon of Man. Mind* 70. <cscs.umich.edu/~crshalizi/Medawar> (accessed August 15, 2007).

MUKHOPADHYAY, Banibrata.

2003. Stability of accretion disks around rotating black holes: a pseudo-general-relativistic fluid dynamical study. *Astrophys. J.* April 1, 586: 1268-1279.

MUSSER, George.

2004. Was Einstein right? *Scientific American.* September, 291(3): 88-91.

ONUCHIC, José N., Zaida LUTHEY-SCHULTEN, and Peter G. WOLYNES.

1997. Theory of protein folding: The energy landscape perspective. *Annual Rev. of Phys. Chem.* 48: 545-600.

PEIRCE, Charles S. (10 September 1839 to 1914 April 19)

Note: The designation EP followed by volume and page numbers with a period in between abbreviates the 2-volume set of *The Essential Peirce*, a selection of essays by the Peirce Edition Project. EP 1 covers the years 1867 to 1893; EP 2 covers 1893 to 1913 (Bloomington: Indiana University Press, 1992, 1998, respectively).

PTITSYN, Oleg B.

1996. How molten is the molten globule? *Nat. Struct. Biol.* 3(6): 488-490.

RAYMOND, Jason and Robert E. BLANKENSHIP.

2003. Horizontal gene transfer in eukaryotic algal evolution. *PNAS* June 16, 100(13) 7419-7420.

SOCCI, N. D., José N. ONUCHIC, and Peter G. WOLYNES.

1996. Diffusive dynamics of the reaction coordinate for protein folding funnels. *J. Chem. Phys*. April 15, arXiv:condi-mat/9601091 v1. Jan 21.

SORENSEN,Soren J., Mark BAILEY, Lars H. HANSEN, Niels KROER, and Stefan WUERTZ.

2005. Studying plasmid horizontal gene transfer *in situ*: a critical review. *Nature Reviews Microbiology*. September, 3(9): 700-710.

SYVANEN, M.

1994. Horizontal gene transfer: evidence and possible consequences. *Annu. Rev. Genet.* 28: 237-61.

'T HOOFT, Gerard

1993. Dimensional reduction in quantum gravity. In *Salamfestschrift: a collection of talks*, World Scientific Series in 20th Cnetury Physcis, vol 4, ed. A. Ali, J. Ellis and S. Randjbar-Daemi (World Scientific).

TEILHARD DE CHARDIN, Pierre.

1955. *Le Phénomene Humain* (First published by *Editions du Seuil*, Paris), English trans. by Bernard Wall and Introduction by Julian Huxley in 1959 by William Collins Sons & Co. Ltd., London, and Harper & Row; reprinted in Perennial (New York, 2002).

1956. *Le groupe zoologique humain* (Originally published in Paris, Michel, 1956) trans. by René Hague as Man's Place in Nature: the human zoological group (London: Collins, 1977, c1966).

1957. *Le milieu divin* (First published by *Editions du Seuil*), trans. by Siôn Cowell as Divine Milieu (Brighton, 2004)

1963. *L'activation de l'énergie* (First printed by *Editions du Seuil*), English trans. by René Hague as *Activation of Energy* (New York, 1971).

1965. Hymne de l'univers (Writings selected by Fernande Tardivel), English trans. by Simon Bartholomew as Hymn of the Universe (London, Collins, 1965).

1976. *Le Coeur de la matiére* (The essays "*La Nostalgie du front*", "*La Grande Monade*", "*Mon Univers*", "*Note pour server á l'évangélisation des temps nouveaux*" and "*Les Noms de la Matiére*" first appeared in the French editions of *Ecrits due temps de la guerre* by Editions Bernard Grasset, 1965), English trans. by René Hague as Heart of Matter (London, Collins, 1978).

THORNE, Kip S.

1994. *Black holes and time warps: Einstein's outrageous legacy* (new York, London: W. W. Norton & Co.).

TZLIL, Shelly, KINDT, James T., GELBART, William M., and Avinoam BEN-SHAUL.

2003. Forces and Pressures in DNA Packaging and Release from Viral Capsids. *Biophys. J.* 84(3):1616-1627.

VISSER, Matt, Kar SAYAN, and Naresh DADHICH.

2003. Traversable wormholes with arbitrarily small energy conditions violations. *Phys. Rev. Lett.* 90, 201102.

WALD, Robert M.

2001. Thermodynamics of Black Holes. *Living Rev. Rel.* 4 (2001) 6.

WANG, Jin, Kun ZHANG, Hongyang LU, and Erkang WANG.

2005. Quantifying kinetic paths of protein folding. *Biophysics J*. September, 89(3): 1612-1620.

WHITFIELD, John.

2005. Base invaders. *Nature.* January 12, 439(7073): 130-131.

YEATS, William B.

1986. "The Second Coming" in *British & American Poets, Chaucer to the Present* (New York: Harcourt Brace Jovanovich, Publishers) 640-641. *Note:* This poem is the source of several section headings.