Rotational Frequency Matching of the Energy of the Changing Angular Velocity Magnetic Field Intensity and the Proton Magnetic Moment Produces a Ten Fold Increased Excess Correlation in pH Shifts in Spring Water

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ABSTRACT

Changes in pH in spring water placed in the center of specific temporal parameters of rotating magnetic fields with changing angular velocities separated by 10 meters displayed conspicuous evidence of excess correlation. Serial microinjections of a proton donor into one (increased acidity) of the two volumes were associated with small increased shifts in alkalinity in the other volume that received no treatment. The powerful effect occurred when the specific magnetic field intensity multiplied by the proton magnetic moment produced a quantum energy that matched the rotational frequency of the fields. Higher or lower intensities did not produce this effect. The "entanglement" was observed only for 25 cc but not 50 cc paired volumes. The quantity was consistent with the cumulative magnetic energy from the rotating magnetic fields available to the protons of the hydronium ions and was equivalent to the energy from the neutral hydrogen line per molecule. These experiments may be the first to demonstrate the physical bases and a potential method by which to produce excess correlation in simple "acid-base" reactions at the macroscopic level. The 10-fold increase of the excess correlation at the specific intensity when interacting with the proton magnetic moment occurred when the frequency from that quantum energy matched the rotational frequency of the magnetic field. One interpretation is that when the cumulative energy per H\(^+\) during the experiment reaches that of the hydrogen line entanglement occurs. However, when the cumulative energy approaches the equivalent of ~2.72°K (~10\(^{23}\) J per molecule), dissipation into the black body medium that defines the Cosmic Microwave Background prevents the excess correlations from increasing or continuing.

Key Words: excess correlation, entanglement, neuroquantum effects, pH, rotating magnetic fields, proton magnetic moment, quantum tuning


Introduction

The measurement of excess correlation between the dynamics of two chemical systems separated by non-traditional distances could suggest that "entanglement" may be demonstrable within macrosystems (Julsgaard et al., 2011). "Excess correlations" between processes separated by non-traditional distances have also been described as entanglement and has been considered one of the most important phenomena of the twenty-first century. Until recently such manifestations of "excess correlation" (Aczel,
2002; Vaziri et al., 2002) were assumed to occur only at quantum levels and to involve pairs of photons.

The general presumption is that if two photons are "entangled" a shift in the polarity of one of the pair results instantaneously in the shift in polarity of the other member of the pair regardless of the distance between them and without attenuation as a function of the inverse square law (Hotta et al., 2014; Megidish et al., 2013). Although the occurrence may be instantaneous (Hu and Wu, 2006a, b; 2013), its manifestation within matter may require a critical time coupled to emerging from the origin of the entanglement velocity and the actual time involved with the occurrence of the properties of matter (Persinger and Koren, 2013). This is at least one orbital time for an electron from which quantum numbers, Planck's constant and the most elementary expression of magnetism arise.

There is now empirical evidence that excess correlation after experimental induction of "entanglement" occurs in complex systems separated by non-traditional spaces if they simultaneously share the same rotating magnetic fields with changing angular velocities in a specific order of presentation. Burke et al (2013) was the first to demonstrate coherent changes within the brains of two human subjects who shared these fields but who were separated by 50 km when one of the two was exposed to a specific tone without the other person's awareness. Recently Scott et al (2015) showed specific phase-correlations of discrete power densities within the right temporal and parahippocamapal regions of five pairs of participants with each member of the pair separated by the Atlantic Ocean (~6000 km). The evidence of the excess correlation occurred only during the portion of the magnetic field stimulations that had been shown to produce: 1) doubling of photon emissions for photon reactions (Dotta and Persinger, 2012) between two loci and 2) parity in experimentally induced shifts in pH in spring water (Dotta et al., 2013).

We have been pursuing the assumption that protons within water may be centrally involved with experimentally-induced excess correlation in complex systems such as the current patterns of deep structure brain activity or alterations in pH within physiological-like spring water. Koren and Persinger had developed a system about 25 years ago (Ruttan et al., 1990) that allows programmable discrete durations of phase-modulated magnetic fields to be generated around a circular array of eight solenoids at specific rates of changing angular velocity. This novel circuit involved opto-couplers and Triac devices (Koren et al., 2015) so that photons would be a component of the current propagation to the solenoids. For example, if the field creation is for 20 ms at the first solenoid in the circular array and then decreases by 2 ms in each of the other adjacent solenoids as the pulsing field "rotates" around the circle. The angular velocity mediating a pattern within this specific type of geometry can be considered as "accelerating". We have termed the bulk movement of the field around the array as the "group velocity" and the temporal configuration of the irregular, frequency-shifting pattern that is being generated within this bulk movement as the "phase velocity".

We borrowed these terms of group and phase velocity as metaphors from Tu et al (2005) who reviewed the technical literature and concluded that for photons to exhibit non-zero upper limits for rest mass the group and phase velocities must be uncoupled or at least differ. As a result, different phenomena would emerge, such as the longitudinal photon, the non-local effects for nongauge fields for the Aharonov and Bohm phenomena and altered access to Casimir sources. One of the features of the Aharonov-Bohm effect is the flux, although endless, can be curved into a finite toroid. We considered these emergent properties as potential conditions whereby non-locality as reflected by excess correlations of physical reactions could occur.

For our original experiments with photon flux densities from chemiluminescent reactions we found that conspicuous excess correlation between two loci occurred only when both reactions shared the same field but only if the they were first exposed to an accelerating group velocity containing a decreasing phase modulated, structured field followed by a second field that exhibited a decreasing group velocity but an increasing phase-modulated structured field. All other combinations were not effective. The effective combination if the angular velocity was fixed, that is neither accelerating nor decelerating, was also not effective.

There are experimental results that strongly support the occurrence of "excess correlation" at the macrochemical level. For example, Dotta and Persinger (2012) placed chemical reactions in two separate rotating
magnetic fields programmed to produce the same changing angular velocities. Simultaneous injection of small aliquots of H$_2$O$_2$ into NaClO within the two volumes housed separately at distances of up to 3 km elicited photon flux densities that were double the expected values. In other words, the quantity of energy behaved as if the two sites had been transiently superimposed into the same space and hence had been injected with twice the volume. This could be considered an example of superposition and superimposition.

Later Dotta et al. (2013) employed the same experimental procedure involving two loci containing spring water. When they implemented the same protocol that produced the “excess correlation” of photon emissions they found that the serial injection of small aliquots of proton donors into the water within one focus was associated with a much smaller incremental increase in alkalinity in the spring water in the other locus. The shifts in pH were consistent with the proportion of hydronium ions present within the volume of water and the magnetic energy available from the applied fields.

In the pursuit of mechanism by which this “macro” excess correlation might be explained and utilized for practical application, we have selected the magnetic moment of the proton to be the focus at which the phenomena occur for several reasons. First, the universal ratio for the magnetic moment of a proton (1.4·10⁻²⁶ A·m²) divided by the unit charge (1.6·10⁻¹⁹ A·s) results in a diffusion term which is 0.88·10⁻⁷ m²·s⁻¹. When applied to the average viscosity of water around 25°C (8.94·10⁻⁴ kg·m⁻¹·s⁻¹) the force is 7.87·10⁻¹¹ kg·m·s⁻². If this force is applied across the distance of two O-H bonds (1.92·10⁻¹⁰ m) the resulting energy would be 1.5·10⁻²⁰ J (Karbowska and Persinger, 2015). This order of magnitude is a universal value (Persinger, 2015) that emerges from a variety of cosmological calculations and reflects the energy when the total universal force per Planck’s voxel (the cubic Planck’s Length) is spread across the distance of the neutral hydrogen line (21 cm).

The importance of the hydronium ion in this relationship becomes apparent when its lifetime (DeCoursey, 2003; Thamer et al., 2015) which has an empirical range of 0.24 to 3 ps (median 1 ps), is multiplied by the magnetic moment/unit charge ratio. The resulting area is 8.8·10⁻²⁰ m² or 2.97·10⁻¹⁰ m (0.297 nm). The actual distance between water molecules is considered to be 2.9 Å or 0.29 nm. In other words, the duration of the hydronium ion is coupled to the diffusivity of the dynamics of the H$_3$O$^+$ ion and this property. Diffusivity implies an intrinsic velocity by which the expansion occurs. The relevance of proton properties to weak, patterned magnetic field effects was shown quantitatively by Persinger and Koren (2007) and verified experimentally (Koren et al., 2014).

Simple quantum models depend on Planck’s constant to discern optimal frequency. In our experimental protocol that produces the excess correlation between photon emissions from peroxide-hypochlorite reactions the critical parameters for the continual, serial creation of the magnetic fields around a perimeter was a 20 ms base duration followed by a deceleration of 2 ms at each of the subsequent 7 solenoids in the ring of 8 solenoids that created the fields. The total time for a completion of one circular sequence was 216 ms. Hence the rotation of that field around a 60 cm perimeter would be 4.6 Hz. This was the frequency of rotation within the circular array of solenoids within the second (effector) phase in the Dotta and Persinger (2012) experiments that produced the robust excess correlation.

To obtain the later from Planck’s constant (6.626·10⁻³⁴ J) the energy must be 3.4·10⁻³³ J. The division of this value by the proton magnetic moment (1.4·10⁻²⁶ J·T⁻¹) is 2.18·10⁻⁷ T. This magnitude is easily generated within the laboratory. To test the validity of the prediction we designed a series of experiments where shifts in pH in two separate volumes of spring water that shared the same rotating magnetic field configurations were measured as a function of different intensities of the computer generated fields in discrete steps between 0.16 μT and 2.7 μT (the upper and lower boundaries of the field strength generated by the software and hardware). Here we present evidence that excess correlation in experimentally-induced acidity in one volume of spring water was associated with an increased alkalinity in the second (not injected) volume of water but only if the magnetic flux density was coupled with the predicted "quantum frequency" applied to a macростate.

**Method and Materials**

The essential paradigm is shown in Figure 1. Two arrays of 8 paired solenoids equally spaced around perimeters of 60 cm served as the source of the rotating magnetic fields. Each canister
containing the two reed switches was separated by 45 deg. The software (and hardware, US Patent 6,312,376 B1, Nov. 6, 2001; Canadian Patent No: 2214296) that created and operated the temporal patterns of the field was programmable at three levels: 1) the point durations for the patterns, 2) the time between the patterns, and 3) the parameters for accelerating or decelerating the activation of the serial pairs of solenoids that produced the magnetic fields around array in a counterclockwise (from the top) direction.

Figure 1. Schematic of the positions of the beakers containing the two volumes of spring water (small open circles), the circular array of 8 solenoids and distance between local (where the aliquots of protons were injected) and the non-local spaces. pH shifts were measured in both localities.

The patterns were generated from rows of numbers from 1 through 256 that were transformed to between -5 and +5 V with 127 = 0 V through a custom-constructed digital to analogue converter (DAC). The two patterns were asymmetric temporal configurations that have been shown to elicit powerful physiological and cellular effects. They are shown in Figure 2. They were composed of 859 and 230 points or integers, each between 0 and 257. In previous experiments the optimal point duration has been 1 ms. This is the duration each of the numbers that compose the configuration is activated by the software. Because the software is generated by 286 IBM computers (because of their reliable DOS timing) there is a slight expansion because of the port time. The time between the configurations was also 1 ms.

The second derivative component (assuming the circular rotation is always accelerating and is a “first derive”) was programmed by adding +2 ms or -2 ms to the base duration of 20 ms. For the accelerating angular velocity (20+2 ms) this meant that the duration the field was generated changed through 20, 18, 16, 14, 12, 10, 8, and 6 ms before it began again at 20 ms. The total circuit time was 104 ms. For the decelerating angular velocity (20-2 ms) the duration at each pair of solenoids was 20, 22, 24, 26, 28, 30, 32, and 34 ms before starting again at 20 ms. This duration was 216 ms and was the phase in which “entanglement” effects were conspicuous. Because the circumference of the array of solenoids was 60 cm and the total time before the cycle began again was the sum of the 8 durations (216 ms) the averaged rotational frequency was between 4.6 Hz.

The basic procedure was identical to that reported by Dotta et al (2013). After 4 min had elapsed after activation of the first (phase 1, primer) field, 50 μL of 0.83 M acetic acid (the proton source) was injected into the local beaker that was situated in the middle of one coil in one room (a Faraday cage within an acoustic chamber). Immediately after the onset of the second field (phase 2, effector) which was 8 min after the beginning of the experiment 50 μL was injected into the active beaker once every min until the 16th min (9 injections). Each volume of water in each room contained the sensor for pH detection (Dr. DAQ System) that was sensitive to the nearest 0.01 unit. The serial changes in pH were recorded in real time by computer software on laptop computers.

The injection of protons into the active volume produced the obvious decrease (increased acidity) of pH. The presumed demonstration of “excess correlation” was the shift over time of the pH towards alkalinity in the second (non-local) matched volume of water that was situated in the center of the second array of solenoids. These latter volumes of water were never touched. The difference in pH shift between the end (18 min) and beginning of the experiment for each of the 60 experiments (10 intensities, 2 volumes, 3 replicates) within the water contained within the beakers in the non-local space were obtained as the value for the treatment. To ensure there was no drift in the pH sensor additional sham operations were completed whereby only 18 min of pH measurements were completed. The shift over time was less than 0.02 pH units.
The intensity of the magnetic field was controlled from the computer software. This contained a programmable attenuator that ranged in this study from 1, 0.9, 0.8 until 0.1 and then 0.01 as well as 0 where the software was operating but no current was being generated from the DAC systems. Intensity of the magnetic field at the center of the circular array of solenoids, associated with each value of attenuation, was measured by a power meter and verified by a MEDA magnetometer. In decreasing order for these values were 2.73 μT, 2.44 μT, 2.29 μT, 1.95 μT, 1.73 μT, 1.39 μT, 0.94 μT, 0.54 μT, 0.22 μT, 0.14 μT, 0.16 μT, and (sham) 0.16 μT. In other words, the intensity of the field was titrated until the setting was below the background currents being direct through the circuit to the solenoids. Each experiment involved only one of these intensities.

Results

The results are shown in Figure 3. The major intensity-dependent effect for the amount of shift in pH within the non-local water located within the second circular array of solenoids in which no proton donor was injected was greatest for the 25 cc solutions exposed to the 0.22 μT intensities. This increase in pH within the volume of spring water that received no treatment when the pH decreased in the other volumes of water sitting within the second coil due to the direct injection of proton donors (the weak acid) defines the excess correlation (20120. This parity (opposite change in property, in this case pH) is characteristic of one form of entanglement and has been shown within this system for both pairs of random number generators (Juden-Kelly et al., 2015) and spectral power densities in coupled human brain function (Scott et al., 2015).

The energy associated with a proton each with a magnetic moment of 1.40-10^{-26} J·T^{-1} (A·m^2) within an intensity of 0.22 μT would be 3.08-10^{-33} J. When divided by Planck’s Constant (6.626-10^{-34} J·s) the equivalent frequency is 4.7 Hz. This is within the range of measurement error for the rotational frequency of the decreasing angular group velocity field around the circular array during the effector or “entanglement” phase of the exposure to the magnetic fields. The energy available within the volume of space occupied by the 25 cc of spring water based upon the relationship:

\[ E = [B^2(2\mu)^{-1}] \cdot m^3 \]  \(1\),

where B is the strength of the field (2.2-10^{-7} T), μ is magnetic permeability of free space (4π-10^{-7} N·A^{-2}) and m^3 is volume (25 cc=2.5·10^{-5} m^3) would be 4.82·10^{-13} J. Over the approximately 900 s before the effect approached an asymptote the cumulative energy would be 4.34·10^{-10} J. For comparison the energy associated with mass equivalence of a proton is 1.5·10^{-10} J. A maximum shift of 0.2 pH units towards basic from a reference point of pH=7.4 would be equivalent to 2·10^{-9} M.

Hence the numbers of molecules (accounting for 18 cc per M of water) would be ~1.66·10^{13} H^+. Within the first second after the initiation of the primer field the energy per proton would have been 2.91·10^{-26} J. However, at the point where the effector field was activated at 4 min (240 s) the cumulative energy would have

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**Figure 2.** The shape of the two wave patterns that were required to be presented in a specific temporal sequence to elicit the excess correlation. On the left is the decelerating phase modulation (Thomas pattern), on the right is the accelerating phase modulation (Burst-x). Vertical bars refer to the numbers that were transformed to -5 to +5 V. The horizontal axis refers to the numbers of points in the pattern.
been about $7 \times 10^{-24}$ J per molecule. The value would have been about $2.62 \times 10^{-23}$ J per molecule range when the effect achieved asymptote at about 900 s after the initiation of the fields. The temperature equivalence, obtained by dividing this value by the Boltzmann constant $(1.38 \times 10^{-23}$ J·T$^{-1}$) would be $\sim 1.9$ °K. The most proximal universal value associated with this temperature is the 2.72°K associated with the cosmic microwave background.

**Figure 3.** The absolute shift in pH towards basic within the “non-local” volumes of water (50 mL, open squares; 25 mL, closed squares) that were coupled by the same rotating shifting angular velocities as the volumes 10 m in distance and that received the proton injections during the entanglement phase. Vertical bars indicate standard errors of the mean.

**Discussion**

To our knowledge this is the first experimental production of a powerful demonstration of excess correlation at the macroscopic level of matter. Similar evident for excess correlation in distal pH reactions have been found for a different technology involving changing angular velocity pulsed fields within toroids that diminished the E-W values of the geomagnetic field by about 5 nT (Rouleau et al., 2014; Rouleau and Persinger, 2015). In our present experiments when the rotational frequency of the circular magnetic fields within which two volumes of spring water had been placed matched the frequency of the product of the magnetic field intensity and the proton’s magnetic moment, the excess correlation of a shift towards alkalinity increased by almost tenfold within the non-local condition. Even though there were no injections into these non-local volumes of water while small aliquots of a proton donor were injected into the other (“local”) volume 10 m in distance, the shift in pH was conspicuous. This remarkable enhancement was not evident when the strength of the field was either slightly less or greater. The narrow band of the effect is consistent with a type of “tuning” that is frequently seen at quantum and atomic levels.

That this specific intensity and rotational frequency is relevant to the non-local effects of entanglement is further supported by the temporal positioning of the effective frequency or rotation. The value of 4.6 Hz characterized the parameter of the second phase of the “entanglement” procedure within which the demonstrations of excess correlation between photon emissions during chemical reactions and parity responses between two random number generators have been measured. In recent studies in order to provide consistency with other technologies that also produce excess correlations between human cerebral EEG activities when two subjects were separated by thousands of kilometers this portion of the field (about 6 minutes after the onset of the fields) has been called the effector field. On the other hand, during the first six minutes of exposure (the phase 1 or primer field) when the rotational frequency was 9.6 Hz (the intensity remained the same), the demonstration of excess correlation was not apparent.

The quantitative values associated with the pH of the spring water and the time involved with the demonstration of excess correlation to approach asymptote during the effector phase may explain the limited nature of the effect. We have found, based upon about 100 trials (experiments) that the excess correlation effect is most optimal when the initial pH of the spring water is between 7.2 and 7.4. When the values were outside of this range the experimental elicitation of the effect was attenuated or did not occur. This specific band of pH within 25 cc of spring water could contain the optimal number of protons for which the quantity of magnetic energy could be effective.

The asymptote of the excess correlation effect after about 900 s following the initiation of the field would be congruent with the amount of energy per molecule, that is, $\sim 2.6 \times 10^{-23}$ J per molecule. The temperature equivalence of this quantum of energy per molecule is about 2°K. This is very similar to the Cosmic Microwave Background temperature. It presumes the properties of a black body spectrum. By definition this means that it absorbs all incidental radiation regardless of frequency or angle of incidence. If
our experimental conditions created the excess correlations with the universal space that has been assumed to be their substrate, then this convergence could explain the limiting manifestation of the shift towards alkaline pH.

Although there are several potential mechanisms, some less exotic than others, the shift towards greater pH in the water volume entangled with the one in which small aliquots of proton donors were being injected suggests that OH⁻ molecules were relatively increasing in the non-local volume. If this latter effect is significant then the ammonation (NH₃) of CO(OH)₂ to produce CONH₂OH + H₂O, which contains the essence of the amine (NH₂) and carboxyl groups (COOH) that define amino acids (the components of proteins) may require more thoughtful consideration. If even a component of the source of OH⁻ is aqueous systems is non-local, then abiogenesis and asymmetric chirality may have alternative explanations.

Previously Dotta and Persinger (2012) who first described the excess correlation between photon emissions between two chemiluminescent reactions separated by 10 m queried the source of the transience of the duration of this “entanglement effect”. The results of our present experiment with proton energy ratios might offer an explanation. Once the cumulative energy from exposure to the primer field reaches the energy associated with the neutral hydrogen line per H⁺ molecule would converge upon the frequency of the energy associated with the hydrogen line. In Dotta and Persinger’s original work they found that “primer durations” of only about 1 min was required to produce the doubling photon effect.

When these lower and upper boundaries are integrated, a potential explanation for the importance of the primer and effector emerges. First the protons within the hydronium ion that mediate pH are the central unit to the excess correlation phenomena we have measured. When the cumulative energy from exposure to the primer field reaches the energy associated with the neutral hydrogen line per H⁺ the conditions are set to display the excess correlation. The subsequent presentation of the effector field precipitates this excess correlation until the cumulative energy per H⁺ approaches the equivalent of the Cosmic Microwave Background level at which point it dissipates into pervasive black body absorption. For the double photon experiments the capacity to produce the transient bursts of summed emissions stops. For subtle pH shifts within water, in the present study, the values remained static after they approached an asymptote.
References


Burke RC, Gauthier MY, Rouleau N & Persinger MA. Experimental demonstration of potential entanglement of brain activity over 300 km for pairs of subjects sharing the same circular rotating, angular accelerating magnetic fields: verification by s_LORETA, QEEG measurements. Journal of Consciousness Exploration & Research, 2013: 4(1).

Decoursey TE. Voltage-gated proton channels and other proton transfer pathways. Physiology Reviews 2003; 83: 475-579.


Persinger MA and Koren SA. Dimensional analyses of geometric products and the boundary conditions of the universe: implications for a quantitative value for the latency to display entanglement. The Open Astronomy Journal 2013; 6: 10-13.


Cumulative Residual Photon Power Density of $\sim 10^{-12}$ W·m$^{-2}$ During Mild “Distress” in the Same Space: Implications for Temporal Entanglement

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ABSTRACT

The potential for entanglement of photons generated within the space-time continuum to remain as residuals of photon flux density within the same space requires excess correlations between successive temporal increments. Our model predicted that the quantitative relationship with the fundamental quantity of $10^{-20}$ J multiplied by the inverse diffusivity from the wave impedance and magnetic susceptibility of space and the electron orbital frequency would reflect excess correlation. The value would be $\sim 10^{-12}$ W·m$^{-2}$. To test this prediction experimentally, different mice were serially exposed within the same container box or each mouse was placed in different container boxes placed in the same space for 3 min per mouse while photons were measured from the dorsal surfaces in hyper-dark settings. Before asymptote was evident around 30 to 35 min of serial exposures the net increase in photon flux densities within that same space was $10^{-12}$ W·m$^{-2}$. These results suggest that the same “space” may “store” photon-related information as indicated by previous experiments involving chemiluminescent reactions. We postulate that entanglement between photons emitted from biological systems during distress within the same space and specific concurrent magnetic field patterns may create the conditions for the “retrieval” of these photon patterns at some later date when these fields recur.

Key Words: photon emissions, entanglement, excess correlations, mice, biophotons


Introduction

The assumption of a space-time manifold or a four dimensional fabric composed of the three traditional spatial planes and time predicts that there should be a residual of a representation of the spatial structure within that fourth dimension. To pursue the quantitative properties of this residual we considered that serial increments of three dimensional spaces (Δs) that define its successive maintenance of that space, that is the increments of time (Δts), must display excess correlations between them. From our perspective this suggests the successive Δts must be entangled and hence display excess correlations between and across successive organizations of space. As suggested by multiple experiments at the quantum level the most likely mediator of such excess correlation is the photon. Here we present evidence that irradiant flux densities from photon emissions from mice serially housed within the same space cumulate over time and that the
If increments of space are integrated over increments of time because the $\Delta t$s are entangled, then there should be evidence of persistence of temporal patterns of photon emissions or the residual of their radiant flux densities within the same space. Dotta and Persinger (2012) found that the photon emissions from two chemiluminescent reactions separated by 10 m and induced experimentally by injections of small aliquots of reactant displayed a doubling of photon emissions when the two loci shared specific types of circular magnetic fields with specific angular velocities. They suggested this doubling of photon emissions (as if twice the amount was injected into one space) was an example of entanglement-related superposition. It appeared as a superimposition of the two loci such that they became the same space. However, this effect was transient and dissipated after about 8 min and involved a procedure whose duration was about 20 min. A similar example of “excess correlation” between spaces that shared the appropriate rotating magnetic fields was noted for subtle shifts of pH in spring water whereby the injection of small amounts of protons (increased acidity) in one volume was associated with a small but energy-proportional increase in alkalinity in the untouched volume during the same phase of the experiment that showed the excess correlation for the photons.

When Dotta and Persinger (2011) inadvertently measured the photon emissions within the same space when the original magnetic fields were activated but no reactant was injected there was a conspicuous “spontaneous” increase in photon emissions. The burst frequency of these photon bursts were similar to the injection frequency (once per minute) for the experiments of the previous days when 1 cc of reactant was injected simultaneously into each volume of hypochlorite once every minute. During subsequent experiments the inter-injection times were reduced to either 30 s or 15 s. After a few days of these injections, only the activation of the associated magnetic fields (without injection of reactant) produced spontaneous photon emissions on average every 30 or 15 s, respectively. This “retrieval” could be obtained for about 3 to 4 days after the previous pairings. However, these spontaneous manifestations with only the magnetic field activation occurred only once. The experimenters suggested they had demonstrated a potential example of “space memory” that was coupled to photon emissions elicited within specific conditions that are associated with entanglement between the magnetic field configuration and the photon emissions.

There have been persistent cross-cultural and historical references to events that occur within the “present” displaying residual manifestations minutes to years after their occurrence. Usually the initial events were associated with might be considered enhanced physiological arousal such as terminal conditions of an organism or the sudden release of energy from a physical process. The form of the post-event manifestation when perceived and reported by human observers often involves varying degrees of apparent visual density that range from a nearly-transparent photonic field to an opaque or solid state that appears “real”. In most cases these manifestations are reiterations of the original event as if the sequences of the event were, to employ a modern metaphor, “replayed”. These events often occur in temporal clusters and in our unpublished studies are moderately correlated with the occurrence of global geomagnetic activity whose intensities are similar to the conditions at the time during which the initial event occurred. However, if these phenomena involve a space memory because of entanglement between successive increments of space-time, concurrent photon emissions, and an electromagnetic factor, then there should be evidence of “photon” accumulation that exhibit predictable temporal and flux densities. These increases of photon flux density within the same space would be a pre-requisite for entanglement by the appropriately-patterned magnetic fields.

The Model

There is compelling evidence that two values that exhibit universal presence is the quantity of energy of $\sim10^{-20}$ J and the flux power density of $\sim10^{-12}$ W/m$^2$ (Persinger, 2015a; Persinger et al., 2015; Vares and Persinger, 2013). The former is associated with the energy associated with forces between the distances of the potassium ions applied across that distance that contribute to the resting membrane potential as well as to the action potential of neurons (Persinger, 2010). At a more fundamental level, this quantity of energy is resident within water (Karbowski and Persinger, 2015). If the ratio of the proton’s
magnetic moment \((1.41\times10^{-26} \text{ A-m}^2)\) is divided by its unit charge \((1.6\times10^{-19} \text{ C})\) the resulting diffusivity term is \(0.88\times10^{-7} \text{ m-s}^2\). When multiplied by the average viscosity of water around life temperatures \((6.3\times10^{-3} \text{ Pa-s})\), the resulting force is \(7.87\times10^{-11} \text{ kg-m-s}^{-2}\). When this force is applied across the distance of two O-H bonds \((1.92\times10^{-10} \text{ m})\) the energy is \(1.5\times10^{-20} \text{ J}\).

This is not only within the energy range associated with the movement of a proton from the hydronium ion through water. It has been shown to be the solution for the energy when the proportional force within the entire universe per Planck’s voxel is multiplied by the distance of the neutral hydrogen line \((\text{Persinger, 2015b})\). From the perspective of the operation of the photon within this convergent value, it may be relevant that the product of the upper limits of the rest mass \((\text{Tu et al., 2015})\) of a photon \((2\times10^{22} \text{ kg})\), the velocity of light in a vacuum \((3\times10^8 \text{ m-s}^{-1})\) and the entanglement velocity calculated by three different methods \((2.8\times10^{23} \text{ m-s}^{-1})\) is about \(1.71\times10^{20} \text{ J}\). If the photon is involved with the integrative process that produces the continuity within the space-time manifold (the entanglement between successive \(\Delta t\)s for configurations of space), then this type of hybrid sharing of the velocities of light and entanglement would be expected.

The second universal increment \((10^{12}\text{ W-m}^2)\) has been measured from aggregates of cells within cultures. More specifically for neuroquantology, it is a connecting quantity between the average energy within the universe and the photon emissions from the human cerebral cortices. The average density of the total energy within the universe is about \(0.3\times10^{-9} \text{ J-m}^{-3}\) \((\text{Adler, 1995; Persinger and Saroka, 2014})\). Within the human cerebrum which is about \(1.3\times10^{-3} \text{ m}^{-3}\), this "potential" energy would be \(3.9\times10^{-13} \text{ J}\) per implicit second (Watts). When divided by the average surface area of the cerebral cortices \((1.8\times10^{-1} \text{ m}^2)\), the resulting flux density is \(\sim2.1\times10^{-12} \text{ W-m}^{-2}\). This is within the range of experimental values measured at 15 cm from the right side of the heads of volunteers sitting within hyper-dark conditions when they are instructed to imagining white light compared to more mundane images. Several experiments involving human brains, cell culture, and free space have shown that for every 1 nT decrease in the adjacent magnetic field strength of the earth as measured by a magnetometer the photon flux densities from this space increased by \(10^{-12} \text{ W-m}^{-2}\).

The relationship between \(\text{W-m}^{-2}\) and \(\text{J-s}^{-1}\) can be equated by:

\[
W\cdot\text{m}^{-2}=\left(s\cdot\text{m}^{-2}\right)\cdot\left(J\cdot\text{s}^{-1}\right)\cdot\text{s}^{-1} \tag{1}
\]

or as stated semantically the flux power density is equal to the product of joules per second, the inverse of diffusivity and frequency. We would expect the values for these quantities to be universal. We assumed \(\text{s}^{-1}\) is the rotational Bohr frequency for an electron \((6.59\times10^{15} \text{ s}^{-1})\). For inverse diffusivity we assumed that the wave impedance of 376.73 \(\Omega\) applied across the hydrogen wavelength \((2.12\times10^{-1} \text{ m})\), or \(7.79\times10^{1} \text{ }\Omega\cdot\text{m}\). When divided by magnetic permeability in a vacuum, which is \(1.26\times10^{-6} \text{ N-A}^{-2}\), the diffusivity would be \(6.33\times10^{7} \text{ m}^2\text{s}^{-1}\). The inverse value is \(6.16\times10^{7} \text{ s-m}^{-1}\). The product of \(1.5\times10^{-20}\text{ J}\) (the basic quantity that emerges as a property of water and the energy per Planck’s voxel), the inverse diffusivity term and the Bohr frequency is \(1.6\times10^{-12} \text{ W-m}^2\).

These relationships indicate that the proton may be central to this process. However, if entanglement were involved, there must be a quantified duration whereby this process occurs. The contraction of space-time according to Lorentz, which has served as a fundamental basis for various forms of relatively theory, indicates that shifts in a parameter such as time is:

\[
\sqrt{((1-v^2)\left(c^2\right)\left(1-v^2\right))^{-1}} \tag{2}
\]

If entanglement is intercalated with this process, then the quantitative values associated with this condition should solve for basic properties of the limit to the excess correlations between successive times of a spatial configuration and involve energies that correspond to the activity of fundamental particles. The connection should reflect an essential geometry of space-time that reflects the universe as a unit.

\(\text{Persinger and Koren (2013)}\) calculated the product of the closed symmetrical boundaries, a circle, or \(2\pi r\), \(4\pi r^2\), \(4/3\pi r^3\), \(2\pi r^2\) to be \(21.3\times10^{23} \text{ m}^2\text{s}^{-1}\). When set equal to the optimal combinations of four universal values, the gravitational constant \(G\), and the mass, length and duration of the universe to produce the same dimensional units, they found a velocity term of \(2.84\times10^{23} \text{ m-s}^{-1}\). A similar value was found for the ratio of the \(V\cdot\text{m}^{-2}\) divided by \(B\), the magnetic field strength when all of the energy within the current universe was transformed to those two qualities and quantities. When the circular dimension for the hydrogen line \((2\pi\lambda)\)
was divided by a “jiffy” (the time required for the velocity of light to traverse the radius of an electron) a similar velocity term emerges.

Several theoretical quantifications (Hoffman et al., 2007; Persinger, 2012; 2014) have shown the relevance of $21.3m^4$ as an energetic reservoir for the entire universe including that which is yet to be displayed. For equation (2) to produce the inverse $(4.82 \times 10^{-4})$ of this value $2.08 \times 10^{-3}$, the $v$ must be $0.9999998839 \ c$. When applied to temporal dilation, for every 1 s the expansion would involve 34.5 min. We assumed this value would reflect a window of representation. In several unpublished analyses we have shown that the spectral power densities of background photons measured as both numbers of photons per s by digital photomultiplier units and flux power density per min by analogue units indicate a subtle but reliable inflection of spectral power densities at frequencies which are equivalent to about 30 to 35 min.

When applied to the energy equivalence of the mass of an electron assuming complete transformation at $c^2$, the difference in energy between $c^2$ and the $v^2$ associated with the contraction 0.9999998839 is 1.9 $10^{-20} \ J$. There are two potentially relevant relations. First, the energy associated with the mass of an electron moving at the velocity of the solar system around the galactic center $(2.42 \times 10^5 \ m \cdot s^{-1})$ is about 2.2 $10^{-20} \ J$. Consequently, the energy associated with the Lorentz contraction for the geometric difference associated with the potential structure of space is similar to that amount at more galactic levels or the space occupied by galaxies. Second, the difference of $21.3m^4$ is remarkably similar to difference between the energy of the proton and electron when expressed as Compton wavelengths. That the electron and proton may be related to a singular source from the universal set (the universe) has been calculated previously (Persinger and St-Pierre, 2015). Finally, the local rest mass of an electron $(9.10939 \times 10^{-31} \ kg)$ multiplied by the geometric value is 1.89 $10^{-27} \ kg$. This is within ~12% of the mass of proton and ~6% of that of a Higgs’ boson.

Integrating the above information, we expected that there would be an accumulation of photon flux density within the same space occupied by successive different mice who were mildly distressed from removal from the home cage and placement within a closed area. The asymptote of this accumulation should be around the equivalent of the net increase of ~10^{-12} W-m^{-2}. The time required to achieve this “saturation”, which would reflect the Lorentz contraction value and the inflection for the background spectral power densities of “random” photon emissions, should be in the order of 30 to 35 min.

**Methods and Materials**

In three separate experiments adult male C57 mice that had been maintained 4 per cage within standard colony room conditions were selected as subjects. A total of 42 mice were involved. Each mouse was placed within a “container” box that was housed within a larger box. The larger box was 0.3 m x 0.3 m by 0.3 m and composed of 1 cm thick pine wood that had been painted black. The container boxes for the mice were composed also composed of light-colored wood. Each box was 9 cm x 5 cm x 5 cm; the walls were 05 cm thick. They had been purchased (as “craft boxes”) from local novelty store. All metal, including screws and the tops had been removed. A diagram of the arrangement is shown in Figure 1. Each mouse remained in the container box within the larger box for 4 min. To ensure the mouse’s position within the box, a medium transparent plastic cell culture plate was placed on top of the container box. For 2, 100 s measurements the numbers of photons per s were collected at 50 Hz (20 ms increments, the limit of the software) by a SDNS tech PMT DM090C digital photomultiplier. The aperture was placed faced down on the plastic cell culture plate in order to access the photon emissions from all angles. The output was sent to a Lenovo laptop computer which contained the software for analyses. The means of the numbers of photons for each of the 100 s samples for each mouse were averaged.

![Figure 1. Diagram of the experimental arrangement where the photon flux densities within the same space (the small dark rectangle containing the mouse silhouette) was measured. The grey rectangle refers to the PMT and the small thin white rectangle indicates its aperture above the mouse. All of the equipment was placed in a larger box. The computer system recording the data was external.](image-url)
The experimental room in which the measurements were completed was dark except for dim lights (< 1 lux) from the computer screen in order to minimize the effect on the PMT sensor that remained within the large dark box at all times. After each mouse was placed in the container box the PMT with the aperture facing towards the mouse was inserted over the plastic cell culture plate that covered the top of the container box. The top of the large box was then covered with several layers of thick black terry cloth towels. When the measurement for a mouse was completed it was removed and another mouse was placed within the same container box and the procedure was repeated. In part 1 of the experiment (composed of two parts) 6 and 12 mice were serially placed within the same container box while their photon emissions were measured. In part 2 of the experiment, to verify that the space and not the box were responsible for the photon flux density residue effect, each of the 12 mice that were sequentially placed in the same space were housed in its own container box (i.e, 12 different boxes). This experiment was repeated twice.

**Results**

The numbers of photon emissions per second within the same box as a function of the successively different mice (M1 to M12) placed in the space for the second part of that experiment are shown in Figure 2. As the numbers of mice (M) that occupied the same box and the same space increased, the differences from the original photon flux densities as inferred by the increase in photon counts per s increased. The mean numbers of photon count per s ranged from about 1700 photons per s for the first mouse to about 2200 to 2300 from the 12th sequential mouse. However, the cumulative increase in photon counts displayed an inflection point at mouse 5 (20 to 24 min) and achieved asymptote by about mouse 7 or 8. (28 to 32 min).

Assuming ~5·10^-19 J per photon at the optimal peak of the PMT the energy associated with 1700 photons for the first mouse would have been 8.7·10^-16 W and for the final mouse would have been 11.7·10^-16 W. The net difference between the two boundaries would be about 2 to 3·10^-16 W. Because the area of the aperture was about 3·10^-4 m², the net increase in flux power density before the inflection point occurred and the asymptote began around 30 to 35 min would be ~ 1·10^-12 W·m⁻². Both the duration to achieve the asymptote and the shift in total flux power density before this asymptote occurred are consistent with our model and hypothesis regarding "space memory" and its potential reflection of the entanglement between successive temporal intervals of spatial structure.
The mean numbers of photons per 20 ms (the upper limit of our software for data collection) from the condition in which all mice shared the same box within the same space or shared the same space but had been placed in their own individual boxes are shown in Figure 3. The vertical bars indicated Standard Errors of the Mean (SEMs). The difference between the photon emissions from mice placed in the shared box and the mice each placed in separate boxes was 18 and 12 units per 20 ms or 900 to 600 photons per s. The total (cumulative) flux density, assuming the quantum of energy per photon was within the range of $10^{-12} \text{W} \cdot \text{m}^{-2}$ for both. We considered this evidence that the individual box, per se, was not the source of the effect. Instead it was the cumulative effect of different mice displaying photons within the same space that elicited the effect. When the data for the single container box and multiple container box were combined, as indicated in Figure 4, the shift of about 400 counts per s before the asymptote was approached is evident. The vertical bars are standard deviations and not SEMs.

**Discussion**

There are many historical and cross-cultural references to the possibility that space-memory exists for events that involved distress or significant alterations in physiology that we now realize would be associated with increased photon emissions. Our approach to the four-dimensional space-time manifold is that spatial arrangements of matter and processes display excess correlations or entanglement with successive increments of time. However, there should be a limit to the displacement of the manifestations of these increments with which the excess correlations are evident. This limit would reflect the duration required for the "consolidation" of the information within a broader space-time context which might be accessed under specific conditions. In our experiments involving patterned elicitations of photon emissions within entanglement paradigms, the access required the production of the same field conditions under which the entanglement occurred (Dotta and Persinger, 2011). A similar phenomenon was measured for the occurrence of pH shifts within spring water within the same area when the paired magnetic field was activated (Dotta et al., 2014).

In the present experiment serial placement of different mice in the same box or the serial placement of different mice each in their own box within the same space produced a comparable increase in photon flux density. The asymptote for the net increase in this flux density compared to baseline occurred around $10^{-12} \text{W} \cdot \text{m}^{-2}$. According to the model the mediation required to produce the $10^{-20} \text{J}$ that would allow access to sub-matter regions of space within which entanglement might occur ($10^{-12} \text{W} \cdot \text{m}^{-2}$) must be multiplied by the inverse of the diffusivity term based upon universal wave impedance and magnetic susceptibility and the frequency of the Bohr magneton. The latter reflects the time required for one orbit of an electron. We assumed diffusivity that included the appropriate combination of the impedance of free space and the magnetic permeability of free space (within which matter is contained) would be essential.

The discrete amount of increase in energy that increased during the successive placement of different mice in the same space ranged from about 3.5 to $4.5 \times 10^{-16} \text{J}$ per second. When divided by the frequency of the hydrogen wavelength, 1.42 GHz, the value slightly exceeds the energy associated with the neutral hydrogen wavelength. If entanglement were to be involved with this process one would expect quantities of energy that would access or at least be potentially resonant with one of the most fundamental oscillations within space throughout the universe. This is the hydrogen wavelength. The test of the validity and "generalizability" of the effect measured in the present study will require its application to larger space-time phenomena.
References


Dotta BT and Persinger MA. Temporal patterns of photon emissions can be stored and retrieved several days later from the “same space”: experimental and quantitative evidence. NeuroQuantology 2011; 9: 605-613.


Dotta BT, Karbowski LM, Murugan NJ and Persinger MA. Incremental shifts in pH spring water can be stored as “space memory”: encoding and retrieval through application of the same rotating magnetic field. NeuroQuantology 2014; 11: 511-518.


Persinger MA. Discrepancies between predicted and observed intergalactic magnetic field strengths from the universe’s total energy: is it contained within submatter spatial geometry? International Letters of Chemistry, Physics and Astronomy 2014; 12: 1-11.

Persinger MA. The prevalence and significance of 10^{-20} J and 10^{-18} W·m^{-2} as convergent/divergent nodal units in the universe. In submission, 2015a.

Persinger MA. Thixrotropic phenomena in water: quantitative indicators of Casimir-magnetic field transformations from vacuum oscillations (virtual particles). Entropy 2015b; 17: 6200-6212.


Persinger MA and Koren SA. Dimensional analyses of geometric products and the boundary conditions of the universe: implications for a quantitative value for the latency to display entanglement. The Open Astronomy Journal 2013; 6: 10-13.

Persinger MA and St-Pierre LS. Compton wavelengths for the proton and electron may differ by hyperspace geometry: are they the same particle bifurcated? In submission, 2015.


Is it Quantum Sentience or Quantum Consciousness?
A Review of Social Behaviours Observed in Primitive and Present-Day Microorganisms

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ABSTRACT
Social and intelligent behavioural designs have been observed in primitive and present day microorganisms in all three kingdoms of life. These behavioural patterns help microorganisms to understand, evaluate and judge their constantly varying environment. Behaviour is represented as conscious moment, which occurs due to an event, which may be intentional or unintentional. Microorganisms have the capability of displaying behaviours, which can be compared to cognitive actions of the neural system in higher organisms. This review is a collection of social behaviours observed in present-day microorganisms as well as predicted behaviours in microfossils that have been studied so far. The intent of this review is to prove the origin and existence of consciousness or sentient awareness in microorganisms based on which these social behaviours originated and its comparison to multifaceted conscious behaviours observed in higher beings; its correlation to quantum generated consciousness which enables organisms to understand and judge perceptions, which gives the organism a prospect to behave as per will.

Key Words: consciousness, sentience, quantum, behaviour, archaea, bacteria, eukarya, microorganisms


1. Introduction
Human based consciousness comprises of, what we see, hear, touch, taste, smell, feel, etc, which is termed as ‘phenomenal consciousness’ and this has led to a one-way thinking in determining the existence of true consciousness (Clark, 2001). Humans evolved at a much later stage in evolution, before which the earth was dominated by organisms which survived and are still surviving based on their manipulative intelligence, to perceive and understand the environment. Conscious behaviours observed in microorganisms may not be similar to human consciousness but are unique in their own space. Superiority does not exist and cannot be falsely determined by the brain size or its capacity, as organisms much smaller have demonstrated capabilities which cannot be matched to human intelligence, especially when the human genome has almost 150 genes that have originated from microorganisms and viruses (Crisp et al., 2015).

Several forms of conscious behaviours are known to exist in organisms ranging from viruses to humans and there is no reason why arguments

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for possession of consciousness must be backed by the existence of the nervous system, which is a wonderful system, but in its own place and organism. In a recent study, the social IQ score for a bacterium Paenibacillus vortex was found to be the highest among the 500 bacteria, whose genomes were sequenced. This score was determined based on the number of genes that are needed by the bacteria to communicate and process information about the environment, to make decisions for synthesizing offensive and defensive agents as a mode of protection. The IQ score of these bacteria was found to be three standard deviations higher than the average brilliant social skills demonstrated by some of the renowned scientists of the world (Sirota-Madi et al., 2010).

According to Chris King, the computational power of the bacterial and archaean genome gives a presentation rate of new combinations of up to 1030 bits per second, in comparison to complex life forms, which show a much lower rate of 1017 bits per second, the reason being; few in number, lower reproduction rates and longer generations (King, 2011). According to Lynn Margulis “Not just animals are conscious but every organized being is conscious that is, consciousness is an awareness of the outside world” (Margulis and Sagan, 1995). A similar thought has also been put forward by Humberto Maturana, where he states that “Living systems are cognitive systems and living as a process is a process of cognition. This statement is valid for all organisms with or without a nervous system” (Maturana, 1980; 1970).

Failure to behave like humans does not mean the absence of capability. Simple biological systems such as viruses are capable of making complex joint decisions together with their host e.g. the genetically regulated lambda switch system in a bacteriophage which infects Escherichia coli, is a mutual decision taken by both organisms based on the condition of the host cells and number of phages present (Arkin et al., 1998). Many years ago, humans realized that in order to survive they needed to form communities with people of different talents which could be achieved through proper communication and cooperation. Microorganisms are known to display such social behaviours, and through communication and cooperation perform activities such as foraging, biofilm construction, reproduction, signalling, chemical warfare, quorum sensing, etc. They are also known to engage in Hamiltonian descriptions of cooperative interactions such as altruism, where interactions are beneficial to the recipient but costly to the actor e.g. programmed cell death (PCD) and mutualism, that provides a direct fitness benefit to the organism that performs the behaviour, which outweighs the cost of performing the behaviour e.g. Siderophores (Neilands, 1995).

Many researchers are in the process of understanding the evolution of cooperative behaviours in microorganisms (Crespi, 2001; Velicer, 2003; Travisano and Velicer, 2004; Griffin et al., 2004) and have evidences of conscious social behaviours observed in all their domains of life including bacteria, archaea, viruses, and many unicellular eukaryotes (e.g., some fungi and protists). The microorganisms can therefore, no longer be regarded as simple organisms as they can anticipate, modify and predict changes in the environment with a sense of space and time. At the first annual Francis Crick memorial conference on consciousness held on 7th July, 2012, a group of scientists formally declared a document entitled “Cambridge Declaration on Consciousness in Non-Human Animals” which stated that the capacity of consciousness emerged very early in evolution and those processes that support consciousness in humans are likely characteristics of many living organisms (Low, 2012). Evolution is therefore a communication between microorganisms and their environment, a communication that helped trigger multicellularity and the transfer of genetic material from one generation to another by means of reproduction.

Quantum consciousness is computed with of the help of proteins within the cytoskeleton of the cells basic units of life which comprise of unicellular and multicellular animal life (Pereira, 2015b). Evolutionary comparison of the cytoskeleton and its structures suggests that consciousness existed from the very beginning and has been propagating by means of the cytoskeletal network of the cell (Pereira, 2015a) and therefore forms the basis of consciousness for every living being. This review is a collection of some of the interesting social behaviours that have been observed and studied in all three domains of life – Archaea, Bacteria and Eukarya, with the intent to demonstrate the origin and existence of conscious type of behaviours in microorganisms even though it may not be equivalent or comparable to neural based consciousness. The signal that a microorganism gets from the environment is limited to random noise of the environment which is different as
compared to a neuron in the brain, which gets this signal from a highly coordinated input from other neurons; but generates awareness. In this sense bacteria can be compared to a neuron which through bacterial signalling creates a coordinated input as complex as the brain.

2. Predicted social behaviours in primitive microorganisms

Life in the universe only established when a semblance of stability prevailed. In nature, new species have arisen through heredity variation and selection according to laws of nature with those varying in conformity with the environment. Fossil studies have been of substantial evidence in depicting past life events, which can be acknowledged only with strong correlations with various geological endpoints. Microfossils, stromatolites and sedimentary carbon isotope ratios have indicated that microorganisms inhabited the oceans in primitive times and have been recorded in fossils found all over the world (Corsetti et al., 2003). Fossilized stromatolites reefs found in Shark Bay, Western Australia have provided great insights into primitive microbial life, which can be comparable to some of living stromatolites that have been found in recent times e.g. hot springs of Yellowstone National Park (Jahnert and Collins, 2012; Berelson et al., 2011). Fossilized stromatolites are petrological structures that represent lithified forms of microbial life observed in rocks aged 3.6 billion years old. Based on fossil analysis, it has been confirmed that stromatolites were very common in shallow marine environments in the Precambrian age but became rarer in the metazoan or multicellular age (Lepot et al., 2008).

The first signs of cooperative behaviour in microorganisms are based on evidences and studies conducted in the stromatolites that demonstrate the capability of forming loose cooperative communities as a mode of protection, by formation of biofilms, which are now proposed to be the propagators for multicellular life (Lyon, 2007). Mats and biofilms of chemotrophs dated as early as 4000 million years ago depended on hydrothermal vents for their energy source and with the gradual built-up of dead chemotrophs, there would have been an increased possibility of diverse methane-emitting and sulphate-reducing heterotrophic microorganisms (Nisbet and Sleep, 2001). Biofilm and mat formations are need based-architectural designs that have proven to be a great advantage to microorganisms and were definitely one of the key factors for survival in diverse environments and the initiators for communication and social behaviour (Nadell et al., 2009)

A community with diverse populations of microorganisms gave rise to strong interactions between primordial unicellular organisms, wherein it has been suggested that this primitive form of communication was purely chemical (Bertelson et al., 2012). Perception through cooperation developed the sensing capabilities of these microorganisms and enabled them to gather data from the surroundings giving rise to complex microbial communities, a beginning of primitive social evolution. Fossilized microbial mats dated back to early Archean have shown a pattern of coexistence of bacteria and archaea, consisting of cooperative chemolithotrips in a thermophilic environment. As these interactions in the microbial mats evolved, a diverse population began to exist in these mats with bacteria and archaea fermenters, respirers and methanogens taking up the basal layer of the mats and the cyanobacteria the aerobic layer (Forterre, 2013). This was clearly evident in a stratified stromatolite of the mid-Proterozoic Gaoyuzhuang formation (approximately 1400–1500 million years ago) where a tubular oscillatoriacean cyanophyte Siphonophycus inornatum, showed diurnal growth patterns based on the orientation of the algae in the silica filled layers (Zhang 1986).

Microbial mats studied in hypersaline ponds near Guerrero Negro (Mexico) have shown variation in bacterial populations that live mutually on the same mat and follow behavioural patterns to adjust to their requirements. These microbial mats consist of a layer of photosynthesizing purple bacteria which live along with chemotrophic sulphide-oxidizing and green-sulphur bacteria and have demonstrated migratory behaviour along the mat according to day-night cycles (Harris et al., 2013). Social behaviour evolved with conscious decisions within the microorganism community under the pressure of coordination and cooperation, as a mode to adapt to the ever changing environment. With diversity, different species cooperated and contributed to gain more or less equally or got involved in division of labour, where they would engage in tasks from which they received rewards directly or by benefits to the community. By comparing the characteristics of present day microorganisms with fossils, it may be possible to
predict conscious behavioural patterns which helped propagate evolution of multicellular organisms. Predicted behaviours studied in fossilized microbial mats and stromatolites, suggests that even in a reducing environment, microorganisms were consciously interacting, coordinating and cooperating to adjust and evolve.

3. Social behaviours in Archae

Archaea is one of the sub divisions of the phylogenetic classification system that was previously considered as a part of the bacterial group due to its prokaryotic morphology (Smeti et al., 2013). Archaea are a highly conserved primitive group of bacteria which were earlier found only in extremophilic environments (DeLong, 2003) but now have also been found in the human colon and navel (Eckburg et al., 2003). They are therefore considered to be a large diverse group of organisms that are widely distributed in nature. Archaea have shown high levels of lateral gene transfer between lineages and are confirmed to be a separate group of organisms, which evolved in a thermophilic environment with its ancestor being a thermophile (Ochman et al., 2000). The archaean lineage is one of the known primitive lineages that exists on Earth and is therefore an important link which would help understand Earth’s primitive atmosphere and life (Brown and Doolittle, 1997).

Archae are known to survive in extreme environments with high temperatures and are abundant in black smokers, oil wells, geysers, hot springs, etc. They are divided into groups such as halophiles, thermophiles, alkaliphiles and acidophiles based on their presence (Pikuta et al., 2007). Archaea are known to mutually exist with other microorganisms which have been observed in several fossilized as well as living microbial mats (Forterre, 2013). Early microbial mats may have been limited to the zones of hydrothermal vents with a colony of single species which diversified to include other species e.g. *Aquifex pyrophilus* is a strict chemolithoautotroph which may have lived alongside hyperthermophilic archaea bacteria like the modern thermoproteus (Strauss et al., 1992). A sense of awareness prevailed within this group of organisms which learned to socially adjust within their microbial mats to accommodate other evolving species. Photosynthesis is also known to have originated as an adaptation of thermotaxis in deep hydrothermal vents which allowed colonies of mesothermophilic bacteria to adapt to photic zones (Nisbet et al., 1995). In present times, mesophilic archaea and several bacteria share the same niche in the oceans and neither of them has shown any signs of extinction (Prosser and Nicol 2008) which demonstrates the capability of microorganisms to be conscious in order to cooperate and survive.

Archaeal halophiles show various adaptive features by which they demonstrate social and cooperative behaviours to survive in extreme conditions. The cell structures of many halophiles show thin, flat pseudo-geometric shapes, which is known to help in nutrient access, cell division and segregation, attachment, motility and survival (Young, 2006). *Haloquadratum walsbyi* or 'salt square' belongs to the genus of the family Halobacteriaceae which show box shaped structures, that give them a higher advantage with survival due to increased surface area (Dyall-Smith et al., 2011). Three similar strains have also been isolated from the brine cultures collected in Sinai, Baja California (Mexico) and southern California (United States) showing similar unique adaptive features (javor et al., 1982). An additional adaptive feature in these cells, are polyhydroxyalkanoate (PHA) granules and large refractile gas-filled vacuoles which provide buoyancy to the cells to support light harvesting by means of sheet or biofilm formation (Han et al., 2010). Several species of halobacteriales are also known to produce an exopolysaccharide that forms an ion absorbing mucous biofilm, which is another kind of adaptive form, used to regulate transport of ions to survive in hypersaline environments (Christensen 1989; Nicolaus et al., 2003). Thermophilic and mesothermophilic bacteria survive in extreme high temperatures due to the presence of thermophilic enzymes. An increase in extremozyme stability at high temperatures in these organisms which is associated with increased guanine-cytosine base pairs (Kaine, 1990; Saunders et al., 2003).

Adaptive behaviour is a form of social behaviour that is used to adjust to a situation or another form of behaviour (Staddon, 1983). In such high thermophilic and mesophilic environment, archaea have adjusted and adapted to the surroundings in order to survive, as well as mutually adapted to newer species that were in the process of evolving with the rise in oxygen levels in the atmosphere in primitive times. Adaptive form of behaviour is clearly evident in
the primitive microbial mats which portray a combination of survival instinct and social behaviour that existed in the anaerobic environment (Fenchel and Finlay, 2008). Archaea have developed unique adaptive features which help these organisms survive and demonstrate social behaviours in extreme conditions. Bacteriorhodopsin is a retinal-protein complex found in *Halobacterium salinarum*, which is used as a transmembrane light-driven proton pump used for energy production (Bhattacharya et al., 2002; Wang et al., 2006a). This form of adaptation is specifically found in halophilic archaea which comprises of an opsin protein and purple retinal that creates a proton gradient which is used by an F-class ATPase to synthesize ATP in anaerobic environments by absorbing photons (Oren, 1999). Methanogens also show such forms of energy-based adaptations. These organisms grow by the conversion of small compounds to methane by generation of ion gradients across the membrane that is used to drive the synthesis of ATP (Godin et al., 2010). Methanogens are also known to share an endosymbiotic relationship with protozoans and by means of their specialized organelles called hydrogenosomes, they generate hydrogen which is taken up by the protozoan (Fenchel and Finlay, 2010). Archaeobacterial evolution is highly based on adaptive social behaviour and can be simply understood as anaerobic thermophilic sulphur-metabolizing form which gave rise to methanogenic and halophilic methanogens and ultimately to aerobic extreme halophiles.

Archaeal microorganisms are flagellated organisms, unlike the cyanobacteria and these structures are a well-built feature used by these organisms to adapt and survive. The motility of archaeal organisms is managed by the rotation of the flagellar bundles which is driven by a biochemical motor and is a feature used during a behavioural response (Bardy et al., 2003). In behavioural studies halobacteria are known to react to light and chemical response and have also shown a learning ability by escaping unfavourable conditions with repetitive insults (Sundberg et al., 1985). Two archaeal organisms, *Methanocaldococcus jannaschii* and *Methanocaldococcus villosum*, were tested to be the fastest archaeal organisms measured as speed as bodies per second (bps) based on their swimming potentials. These flagellated archaeal organism's demonstrated speeds at close to 400 and 500 bps which are high speeds when compared to a bacteria like *Escherichia Coli* or a fast animal such as a cheetah which move at speeds of 20 bps (Herzog and Wirth, 2012). Finding of new archaean species and their unique adaptations continues to excite the scientific community and behavioural adaptations of archaean in hypersaline, hyperthermic and hypothermic environments have opened up many areas of research pertaining to the origination of life and the survival instinct of these unique organisms.

Awareness or being conscious holds the key to survival and is displayed by social behaviours in organisms. Adaptive cooperative behaviours observed in archaea, has helped these organisms survive extreme conditions in the past as well as present, which also justifies the fact, that these organisms have the ability of being aware of their surroundings. These were the first organisms to demonstrate cooperative behaviours in microbial mats which originated during the environmental transition period from anaerobic to aerobic form; a beginning of species diversity. Based on behaviours such as mutualism and unique foraging techniques shown by present archaea, we can predict that such behaviours may have been used to survive the ever changing primitive environment.

4. Social behaviours in Bacteria

Chemotaxis, signal transduction and quorum sensing are some of the social and cooperative behaviours observed and studied in bacteria which also resemble some of the most basic functions of the brain, such as sensory integration, memory and decision making (Trewavas and Baluska, 2011). Social and cooperative are a result of cooperative perception that gives bacterial colonies, the ability to sense and gathering data from its surroundings. It also gives them the ability to sense cell densities in order to control factors such as swarming motility, biofilm maturation and antibiotic resistance (Ng and Bassler, 2009). Biofilm formation and quorum sensing have been justified as sensing capabilities and social recognition in bacteria which are also observed in social insects e.g. ants, honey bees, etc (Gibbs et al., 2008). A bacterial biofilm is so well structured that its can sense and communicate messages by means of various techniques of information processing and collective gene regulation which can be suggestive of a lower form of cognitive function and social intelligence (Lyon, 2015). In a recent study, the genus *Burkholderia* has
was shown to use quorum sensing for the activation of cellular enzymes for the production of oxalic acid, which neutralized the ammonia related alkaline toxicity during the solitary phase of the bacteria preventing harsh environmental conditions (Goo et al., 2012). This bacterium therefore demonstrated the capability of anticipating a stressful situation and generating a preventive strategy for survival through a conscious decision which may have been voluntary or involuntary.

*Pseudomonas aeruginosa* uses quorum sensing to infect its host system by formation of a biofilm within the host’s immune system. During its latency period it can grow within the host without harming it and manipulates its behaviour by sensing its surrounding and coordinating the formation of biofilms, motility and cell aggregation to proceed with the infection (Smith and Iglewski, 2003). Human pathogenic bacteria such as *Salmonella* and *Staphylococcus*, quorum sensing is demonstrated by the release of virulence factors, which helps them cope with the immune system (Deep et al., 2011). Chemotactic behaviour plays a key role in quorum sensing, wherein the bacteria senses and responds to the environment and in pathogenic bacteria is demonstrated by the perception of the stimulus in order to resist the innate and adaptive immune response of their host and survive the antibiotic exposure (Wadhams and Armitage, 2004). Complex gut bacteria in mammals show benefit from social behaviours by means of symbiotic relationship in order to deal with environmental stressors (Dinan et al., 2015). The gut bacteria benefit wholly due to constant source of nutrition to microorganisms which perform functions such as food processing, synthesis of vitamins and inhibition of pathogens (Cecchini et al., 2013; Ramakrishna, 2013).

Bacterial biofilms are structures created due to colonization, wherein the bacterium carries out its duties in a cooperative manner by means of quorum sensing. Biofilms are also created for shelter and procurement of food by means of cooperative behaviour such as foraging (Nadell et al., 2008). *Myxococcus xanthus* is a well-studied soil bacterium, that demonstrates social behaviours as part of its life cycle which includes vegetative growth, predation and development. These bacteria move in a coordinated manner to form organized groups as part of swarming and arrange themselves in stacks. When the swarm encounters a prey, they kill and lyse the cells using lytic enzymes by a technique called as ‘rippling’ which helps the bacteria to effectively lyse and absorb the nutrients of the prey (Velicer et al., 2000; Berleman et al., 2008). A similar type of social behaviour is also seen in enteric bacterium *Proteus mirabilis*, which uses the swarming technique for movement of the colony and for collective preying (Wang et al., 2006b). There are several other behaviours in bacteria that have evolved over time as a means to survive and sense the environment in a solitary as well as collective manner. In a group, bacteria are known to survive and multiply through collective sensing, inter-bacterial communication, distributed information processing, joint decision making and dissociative behaviour which have been closely observed in several studies (Popat et al., 2015, Visick and Fuqua, 2005, Bourret and Stock, 2002).

Multifaceted features such as the flagella help the bacteria to pick up and process information about their environment to decide on several actions that need to be taken to survive (Shapiro, 2007). *Escherichia coli* is the most studied flagellated bacterial strain which is known to show complex cooperative behaviour in food foraging and chemotaxis. Environmental condition plays an important role in motility for this bacterium where the flagellum is formed only during unfavourable conditions as a means of protection and survival (Zhao et al., 2007). Under oxidative stress, *E. coli* is known to form colony structures such as spots, stripes and rings which is triggered due to colonial cooperative behaviour to overcome the stress (Budrene and Berg, 1991). *Caulobacter crescentus* is a flagellated bacterium which uses its flagella for swarming behaviour under stress, attaches to a substrate and loses its flagella to become a functional productive stalk, which produces more swarmers as a means of survival (England and Gober, 2001). Some unique behaviours are also seen in cyanobacteria which are known to exhibit a division of labour in relation to food procurement and nitrogen fixation, wherein some bacterial cells convert themselves to heterocysts which are capable of nitrogen fixation but lose their ability to reproduce (Fiore et al., 2010). Heterocysts like structures have been found in fossil records which are 2 billion years old which suggests that this behaviour of differentiation and division of labour existed in earlier prokaryotes (Zhang et al., 2006).

Bacterial parasites are known to demonstrate cooperative behaviour of cheating, during the foraging and swarming phases along...
with several myxobacterial species which usually prey using their chemotactic methods and in the process, social parasites cheat, by consuming the partially digested food without utilizing their energy resources e.g. cheating behaviour of *Myxococcus* and *Dictyostelium* (Dao et al., 2000). Chemotaxis and migration are social behavioural responses which bacteria use to find nutrients, avoid toxic chemicals, sense pH and support symbiotic relationships (Shapiro, 2007). Migratory behaviour is also a well-known social behaviour which bacteria use to cope with adverse and varying environmental conditions and also use it to develop an intricate mode of communication. This kind of behaviour has also been observed in mixed bacterial biofilms which show a complex form of interaction and behaviour (Stoodley et al., 1999). Bacteria constantly record information from inside and outside the cell and are aware of their being, and are in a position to raise a conscious thought and record it. In behavioural studies observed in higher beings, movements or reactions performed by an individual due to its sensitivity in response to the environmental changes constitute the behaviour of the individual and the response the individual makes for the environmental changes follows a constant pattern for that individual, thus each individual has its own characteristic behaviour.

Bacterial intelligence is a form of minimal intelligence, which works without a neural system but provides a bacterium the ability to store, modify and execute adaptive processes by means of cooperative multicellular-type behaviours. Conscious decisions help the bacteria to communicate and self-organize into colonies and films which form the basis of multicellular life. The evolution of multicellularity in bacteria may be a possibility, as it has been observed independently in bacteria such as actinomycetes, cyanobacteria and myxobacteria (Bonner, 2001) and can be correlated to a behavioural based activity that needs further evaluation.

5. Social behaviours in unicellular Eukarya

Many unicellular eukaryotic organisms are known to demonstrate social and intelligent behaviours and these forms of conscious behaviour as we know, is meant to survive and divide. But there definitely exists some more reason for these organisms to depict such behavioural responses, which are slowly being evaluated in the field of microbial ecology. Some of these behaviours are known to supersede complex cognitive functions performed by the brain and could be a collective effort demonstrated by the organisms using the most primitive form of consciousness that exist within an individual (Baluška and Mancuso, 2009). Slime moulds or protists are the best examples that demonstrate behaviour similar to neurologically sophisticated organisms e.g. *Physarum polycephalum* (Latty and Beekman, 2010). Physarum polycephalum is a protist or slime mould which uses a spatial memory system to navigate through a food maze and is known to find the shortest path using its foraging techniques (Nakagaki et al., 2001). This organism can also memorize the location and avoid the areas of high risk and relocate to areas which are unexplored (Dussutour et al., 2010; Reid et al., 2013). Slime mould *Dictyostelium discoideiini* or *Dictyostelium dicodium* is known to form a multicellular slug under conditions of nutritional abundance and upon starvation; cyclic AMP triggers the differentiation of cells and initiates the formation of stalk cells (Bonner, 2008). Risk related avoidance is purely a cognitive behavioural function and is always associated with the neural system but these slime moulds clearly demonstrate the capability of performing such high level conscious behaviours, utilizing their spatial memory capability in the absence of a brain (Adamatzky et al., 2013).

*Amoeba proteus* is a well-known protozoan, known to show several social behavioural responses e.g. regulation in the rate of reproduction based on availability of food, encapsulation, etc (Anderson, 1988). Pseudopodium is a highly defined energy mediated structure formed in amoeba and supports behavioural responses associated with procurement of food as well as exhibiting a choice for food. They also demonstrate the capability of differentiating between inorganic and organic food and can isolate an unknown object from an engulfed food particle (Parsons, 1926; Mast and Hahnert, 1935). Division of labour among the organelles in amoeba is evident when compared to higher organisms, where the food cup resembles the buccal cavity; the food vacuole resembles the gut, the pseudopodia the legs and the contractile vacuole the urinary bladder (Bonner, 2009; Jeon, 1995). Amoeba has no structures for reception of stimuli but the protoplasm is aware and responds to a stimulus, which gives it the ability to perceive and recognize its own kind and engage in cooperative behaviour.
Cognitive smartness and intelligence in these organisms, supports social behaviours related to learning, memory, anticipation and risk management (Gregor et al., 2010).

Euglena exhibits behavioural responses to various stimuli that are highly sensitive to the stimulus of light. These organisms are known to group themselves in a location where there is a balance of light and darkness and uses its flagellum in rotator manner to organize itself. In unfavourable conditions it undergoes encystment by losing its flagella and secretes a cyst (Diehn, 1973). The protozoan parasite Trypanosoma cruzi, demonstrates similar behavioural patterns in the blood of vertebrates (Noireau et al., 2009). Vorticella convallaria is a stalked ciliated protozoan that exhibits a sensitive behavioural response to mechanical stimulus and is known to coil instantaneously into a tight spiral with the slightest impact which is caused due to a membrane depolarization (Shiono and Naitoh, 1997). Volvox is a colonial flagellate and shows a transition between unicellular to multicellular form. The flagellar movement of each of the cells in the colony help in the movement of the whole colony which is a mutual colonized social behaviour demonstrated by these organisms as a means of protection and movement towards light (Solari, 2011). During unfavorable or shortage of food, ciliated protists such as Loxophyllum meleagris demonstrates a social behavioural response. These organisms cease to feed and then seek out another of the same species; mutually inspect them and then join to form a pair by fusing and exchange nuclei in a microbial embrace (Holmes, 2005).

Elphidium excavatum clavatum or Polystomella crispa are known to use behavioural instincts to build their protective structures by seeking out the correct frustules, identifying them and cementing them together as a shell (Schonfeld and Numberger, 2007; Murray, 2012). Tintinnid ciliates show a similar behaviour and gather fragments of rock and tiny particles of quartz and cement it together to make the lorica or protective chamber in the shape of a bell (Durmus and Balkis, 2014). Locating, sensing, identifying and selecting mineral fragments into a delicate shell are complex behaviours beyond the understanding of biologists (Ford, 2004). Clark studied the mating behaviour of Spirostomum ambiguum, which is a ciliated organism that is known to advertise mating fitness to suitors during courtship. In his study, he defined fit suitors as, conspicuous consumers and less fit suitors as prudent savers and demonstrated that both these types of suitors learn to switch between forms to optimize mate selection through behavioural responses (Clark, 2012). Paramecium is another organism that has been widely studied for its behaviour. Movement is performed by metaboly, body contortions or by cilia and if the organism is touched by a pointed object, it becomes conscious, the ciliary beat reverses and the animal moves backward by rotating in a conical path (Jensen, 1959; Harvey and Bovell, 2006). Generation of a conscious moment in paramecia is depicted as a behavioural response or a sense of awareness to a stimulus which helps the organism understand its surroundings (Jennings, 1905/1962; Hameroff, 2012).

Understanding and reasoning forms the basis for intelligence in many unicellular organisms which survive, based on the ability to perform cognitive functions without the presence of a neural system (Shapiro, 2007). This kind of intelligence cannot be compared to the intelligence observed in higher organisms, but does show some overlap in areas of mental activity, memory and learning (Westerhoff et al., 2014). Eukaryotic microorganisms demonstrate the presence of intelligence in its lowest form, which has evolved to a higher state as a form of adaptation by means of cell division and cell differentiation in higher organisms depicted by similarity in social behaviours (Marijuan et al., 2013). Further evaluation of studies in the area of behavioural sciences in eukaryotic microorganisms would help evaluate the possibility of a correlation of cognitive behaviours observed in higher and lower organisms from an evolutionary standpoint.

6. Conclusions
In a cell or a group of cells e.g. a microbial mat or a developing embryo, the cells always demonstrate an involuntary behaviour programmed through genetic makeup which appears as a habit and may not be due to consciousness per se but the reason to behave is act of learning which may originate through consciousness; for a cell needs to be aware for it to learn and behave and therefore even though behaviour and consciousness are two separate entities, they complement each other. Therefore, in case of a formation of a microbial mat or a developing embryo, the cell or cells are aware; aware of its surroundings; aware of the
need for cell division; aware of organizing themselves into mats; therefore, behaving as per will. Sentience or conscious behaviour is prevalent in all three domains of the unicellular kingdom and in comparison to the neural system, is in lower form, but by division of labour in cells it propagates and attains a higher state, as observed in higher organisms.

Whether unicellular or multicellular, we all depend on our past experiences and observation and use this for several actions that need to be performed in our day to day life, which is managed by the conscious decisions that we take, which may be new or retrieved from memory. The protoplasm in the cell of all organisms is unique and for microorganisms it holds the ability to store and retrieve memory, acting as a store house of intelligence. It has the ability to make an organism conscious of its surroundings and its main effort is to gain a clear perception to associate and recognize favourable and unfavourable conditions, just like the brain in higher organisms. Acquisition of knowledge is based on sense-perception, which in microorganisms is acquired as a conscious moment and with time, becomes a reflex moment that gets repeated as per requirement e.g. foraging for food (Radnitzky et al., 1993).

Quantum based consciousness computed in microtubules via the ORCH-OR theory of Hameroff and Penrose (Hameroff and Penrose, 2014) originates within every cell of all unicellular and multicellular organisms and therefore forms the support mechanism for important functions managed at a cellular level such as cell proliferation and differentiation, apoptosis, DNA synthesis, RNA transcription, protein expression, ATP synthesis and metabolic activity. Quantum consciousness enables animals to understand and judge perceptions, which gives the animal a prospect to behave as per will. Social behaviours in microorganisms whether present or fossilized, have helped answer several questions in relation to conscious and intelligent decisions in absence of neural systems. Whether this type of consciousness is primitive, proto or simple needs to be evaluated but it is definitely some type of consciousness that microorganisms use, to survive. Future research in this area is needed which could provide a better understanding about, how consciousness is generated and propagated in microorganisms of all domains of life. Consciousness or conscious behaviour is an awareness of the external world and cannot be restricted to neurons or the neural system.


Shapiro JA. Bacteria are small but not stupid: cognition, natural genetic engineering and socio-bacteriology. Studies in History and Philosophy of Biological and Biomedical Sciences 2007; 38: 807-819.


Shapiro JA. Bacteria are small but not stupid: cognition, natural genetic engineering and socio-bacteriology. Studies in History and Philosophy of Biological and Biomedical Sciences 2007; 38: 807-819.


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Direct Determination of Radiation Dose in Human Blood

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ABSTRACT
In this work, it has been shown that it is possible to determine the radiation doses in human blood exposed to internal or external ionizing radiation treatment, both directly and retrospectively. OSL counts from the waste blood of a patient injected with a radiopharmaceutical for diagnostic or treatment purposes and from a blood sample having a laboratory-injected radiation dose were both used for measurements. The dose values obtained for the bloods were found as ~0.46 Gy for the 1-5 Gy dose range and as ~0.51 Gy for the 0.143-0.858 Gy dose range using the optically stimulated luminescence technique. The blood aliquots from a healthy person were exposed to different external laboratory doses. The dose values corresponding to a 10 Gy laboratory dose from the aliquots exposed to external radiation were found as 10.94 ± 3.30 Gy for Disc 3 and 10.79 ± 3.28 Gy for Disc 1. This study shows that the dose received by a person can be measured simply and retrospectively, using only a very small amount of blood. The results may have important ramifications for the medicine and healthcare fields in particular.

Key Words: ionizing radiation, human blood, optically stimulated luminescence, retrospective dosimetry
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Introduction
It is common knowledge that ionizing radiation is being used more and more in the field of medicine. Patients are exposed to internal radiation doses in various ways, such as ingestion or injection for the diagnosis or cancer treatment. Martin states, “an internal radiation dose can occur due to inhalation or ingestion of radionuclide, a direct injection for diagnosis or treatment of disease, a puncture wound, or skin absorption. Internal radiation doses cannot be measured; they must be calculated based on an estimated/measured intake, an estimated/measured quantity in an organ or an amount eliminated from the body” (Martin, 2011).

It is well known that the dose is defined as the deposited energy per unit mass of the target. The calculations of internal doses are based on certain assumptions, such as the homogeneously distributed activity on the target organ or the target organ being treated as the source organ. In medical applications, cumulative activity is defined using the values for the activity and time, and the absorbed dose is given as: \[ D = A \times S \] (Target→Source). Here, A is the cumulative activity, \( S(\text{Target}→\text{Source}) \) represents the combination of the energy deposit parameters with the transformation constants; the S-value is fixed for a given radionuclide (Martin, 2011). These processes do not provide a direct measurement to determine the internal radiation dose.

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doses received by a person. The knowledge of the dose that will be given to the target volume is the most important factor affecting the success of therapy when using ionizing radiation for diagnosis and/or treatment.

In the field of radiation therapy, the dose that will be given to a patient is planned using a treatment planning system. However, how much dose had a patient already received? It has not been possible to answer this question accurately. The retrospective dosimeter method is needed to determine the dose already received by a patient.

The optically stimulated luminescence (OSL) technique has been used in radiation dose measurements (Tanır et al., 2012; Pradhan et al., 2008). Some studies showed that the luminescence signal from halides, such as NaCl and KCl, that exist in crystallized blood are very bright (Tanır et al., 2007; Tanır and Bölükdemir, 2007; Polymeris et al., 2011). The OSL technique has been suggested for inorganic material, with studies on the OSL of organic materials such as bone, coral skeleton and shell (Barnes et al., 2003; Meriç et al., 2008). However, no work has been reported on the direct measurement of internal radiation doses using a blood sample. In this study, the OSL dosimetry technique, which is becoming increasingly important in the field of radiation physics, was used to determine the dose given to blood samples.

**Basics of the OSL technique**

The OSL technique was first introduced by Huntley et al. for dosimeter (Huntley et al., 1985). This technique is based on measuring the luminescence signal from a sample that has been exposed to ionizing radiation. The optical luminescence concept has been described as using an energy band model of solids, applied to retrospective dosimetry (Aitken, 1998; Botter-Jensen et al., 2003). The ionizing radiation produces electron-hole pairs in the crystallized structure, and thus they are trapped. When the crystal structure is stimulated by light, the electrons can be removed from traps and can go into the conduction band. From the conduction band, they may recombine with holes trapped in hole-traps, and then luminescence signals are emitted. The luminescence intensity is proportional to the number of trapped electrons, and the number of trapped electrons is proportional to the dose of ionizing radiation absorbed by the material. The basic representation of radiation induced luminescence is shown in Figure 1. It is known that radiation-induced luminescence is different from other luminescence phenomena, such as photoluminescence and phosphorescence, which are not dose dependent, and thus not relevant to dosimetry.

**Figure 1.** Luminescence arises from the optical stimulation of crystal exposed to ionizing radiation. During exposure, radiation energy is stored in crystal lattice, such as halides; T: electron traps; H: holes; and R: recombination center.

The blood samples used in this study were dried, and thus were crystallized. Regarding the atomic components of the blood, it can be seen that the crystallization of NaCl and KCl will be much more than that of other halides. Furthermore, it is known from previous studies, that more luminescence signals are obtained from NaCl and KCl, in solid form or recrystallized, than from other halides.
the cause of luminescence signals from blood samples must be due to its crystallized structure.

Materials and methods

The luminescence signal from blood samples was read using the ELSEC 9010 OSL system (Spooner et al., 1990) as well as the Risø TL/OSL-DA-20 automatic system (Nutech, Technical University of Denmark). The photomultiplier (PM) tube used in the experiments was bialkali EMI 9235QA for ELSEC 9010 and EMI 9235QB15 for Risø TL/OSL systems. The total power from the LEDs (blue, 470 nm) in the Risø TL/OSL-DA-20 system was approximately 80 mW/cm² at the sample position. A Hoya U-340 filter was incorporated to minimize the amount of directly scattered blue light reaching the detector system.

Blue-green light LEDs (420–550 nm) from Osram were installed in the ELSEC 9010 OSL system by the Nuclear Sciences Institute of Ankara University, which have a power output of about 6 cd at 39 mA. A long-pass Schott UG11 filter was fitted in front of the blue LEDs to minimize the amount of directly scattered blue light reaching the PM photocathode. In 24 LEDs, the total power delivered to the sample was measured as 24 mW/cm² at a distance of 16 mm. The irradiator was a ⁹⁰Sr/⁹⁰Y beta source with a 1.48-GBq activity. The dose rate at the sample position was approximately 0.143 Gy/s for both systems.

All of the samples were settled onto 1 cm diameter Al discs using paraffin oil and protected from light between the irradiation and OSL measurements. All of the blood aliquots prepared were ~3 mg. The blood aliquots were left at room temperature (RT) at our institution for 72 h. All of the signals were measured at RT and under red light. None of the aliquots were preheated. The background counts of the OSL systems were measured as 20–30 counts/s.

Experiment 1

The waste blood sample of a patient undergoing radioisotope treatment was taken from the Nuclear Medicine Center of Ankara University. For dose calculation, the natural luminescence counts (from aliquots not given doses in the OSL laboratory) were measured. The background counts were subtracted from the total luminescence counts. Natural luminescence measurements were repeated using different aliquots. One of the aliquots was exposed to four different laboratory radiation doses, ranging from 1 Gy to 5 Gy, using a ⁹⁰Sr–⁹⁰Y beta source. The other aliquot was given five different laboratory radiation doses in the 0.143–0.858 Gy range. The algorithm for the measurements was as follows: the natural luminescence counts were measured for 50 s; the bleached aliquot was exposed to a dose and its luminescence counts were measured for 50 s. That is, the time gap between the irradiation and readout was ~50 s.

Experiment 2

The blood serum that was not subjected to radioisotope treatment was put into a tube that was 1 cm in diameter and 3.5 cm in length. As the next step, 1.530 ± 0.103 mCi of ⁹⁹mTc was injected into the tube. The mixture was left at RT for 72 h in a dark room. The serum with ⁹⁹mTc was dropped onto the Al discs as follows: one drop on one of the discs, two drops on another disc, and three and five drops on the others. These aliquots were dried at RT and shielded from sunlight. The activity of one drop was calculated assuming uniform distribution. The activities of the aliquots were 17 μCi, 34 μCi, 51 μCi, and 85 μCi. The integrated luminescence counts were measured for 50 s.

Experiment 3

The aliquots from the healthy blood sample were prepared by dropping onto 1 cm diameter Al discs. Four aliquots from the blood sample were prepared carefully, as identically as possible. They were left at RT for 72 h and shielded from sunlight. The signals from the aliquots were measured before laboratory irradiation (for 0 Gy). Next, 1, 2, 3, 4, 5, 10, 15, 20, 25, 50, 100, and 200 Gy laboratory beta doses were given to each aliquot, and the luminescence counts were measured. The algorithm for the measurements was same that as in Experiment 1.

Results and discussion

First, blood that was not subjected to radiation exposure was tested to determine whether a OSL signal exited or not. The blood was found to have no luminescence signal (Figure 2). In this study, three different experiments were carried out, and
although the sample preparation was similar for all of them, the algorithms for dosing were different.

**Waste blood sample from a patient**

The natural OSL decay curves from two different aliquots prepared from the waste blood sample of a patient are shown in Figure 3. It is indicated that the blood aliquots include the given ionizing radiation, and that it is possible to measure the luminescence signal from the blood sample that received a radiopharmaceutical. If such a curve could not have been obtained, then one would not be able to use the OSL technique to measure the dose received by the sample. The decay curves from the aliquots irradiated by 1–5 Gy and 0.143–0.858 Gy laboratory doses are shown in Figure 4 and Figure 5, respectively. The bleaching time was considered as about 3 s from these decay curves.

![Graph](image1)

**Figure 2.** Signals from the blood sample that was not subjected to radiation did not contain luminescence signals. As seen, they were only background level.

The graphs in Figure 3, 4, and 5 are sufficient to prove that it is possible to determine the paleodose using a blood sample given radioisotope treatment. That is, these graphs show that the luminescence counts increase with an increasing laboratory dose and the internal radiation dose can directly be determined using the OSL technique.

![Graph](image2)

**Figure 3.** OSL decay curves (natural counts) from two different blood aliquots injected with a radiopharmaceutical in the nuclear medicine center.

![Graph](image3)

**Figure 4.** Decay curves from the blood aliquot received radioisotope treatment for laboratory doses of 1, 2, 3, and 5 Gy.

The dose-response graphs corresponding to the decay curves in Figure 4 and Figure 5 are seen in Figure 6 and Figure 7. The dose-response graph obtained using the maximum luminescence counts (for 0.2 s) was found to be linear ($y = 1545x - 676.17; R^2 = 0.9985$ for Figure 6). When the dose-response graph was plotted using the integrated counts (for 3 s), the equation obtained was $y = 2189.2x - 659.8; R^2 = 0.9978$ for Figure 6. The internal dose from a blood sample can be determined using the dose-response equation by interpolating the natural luminescence count on the dose-response graph. The natural
The natural luminescence count was measured as 33 for 0.2 s and 347 for 3 s. Using these values, the internal doses from Figure 6 were found as 0.4590 Gy and 0.4598 Gy, respectively. The natural luminescence count was measured as 515 for 0.2 s and 2068 for 3 s from the other aliquot. When the same calculations were made by making use of Figure 7, the internal doses were found as 0.22 Gy for the maximum counts and 0.51 Gy for the integrated counts. Figure 6 and Figure 7 show that the internal dose can be determined by considering either the integrated counts or the maximum counts. The dose response curves for each decay curve were found to be linear for the blood aliquots. The difference between the slopes of the dose response curves for different doses was attributed to the difference in the blood aliquots.

KCl, CaCl₂, etc.) are more concentrated in blood serum than in whole blood, as expected. Thus, it is recommended to use blood serum rather than whole blood for internal dose determination rather than to use whole blood.

The blood serum

The decay curves from the blood serum aliquots are shown in Figure 8. The integrated luminescence signals were corrected by applying the mass normalization. Since four different aliquots were used, the activities given to each was different. The activity-response curve corresponding to the decay-curves is shown in Figure 9. The linearity of Figure 9 was realized by making mass normalization. It is seen from Figure 8 that the luminescence counts from the blood serum are higher than those from the whole blood (see Figure 3), since the halides (especially NaCl, KCl, CaCl₂ etc.) are more concentrated in blood serum than in whole blood, as expected. Thus, it is recommended to use blood serum rather than whole blood for internal dose determination rather than to use whole blood.

Blood sample exposed to external radiation beam

In Figure 10, the luminescence signals from the blood aliquot that was not exposed to a laboratory dose and the decay curve for the same aliquot given a 50-Gy laboratory dose are seen. Healthy blood has no luminescence signal (Figure 10a). Figure 10b shows that it is possible to measure the luminescence counts from blood exposed to...
external radiation. The signals were integrated in 5 s.

Next, the decay curves from two aliquots (Disc 1 and Disc 3) for different radiation doses were obtained and shown in Figure 11 and Figure 12. Because the luminescence counts were relatively weak up to 10 Gy, the decay curves were plotted for doses higher than 10 Gy. The maximum luminescence counts were 26, 38, 52, 85, 100, and 113, corresponding to 0, 1, 2, 3, 4, and 5 Gy doses, respectively.

![Figure 8](image1.png) **Figure 8.** Decay curves from aliquots injected to 17 µCi, 34 µCi, 51 µCi, and 85 µCi.

![Figure 9](image2.png) **Figure 9.** Activity-response curve using the data in Figure 8.

![Figure 10](image3.png) **Figure 10.** (a) Background level signals from the blood aliquot not exposed to external radiation dose (b) Luminescence decay curve from the blood aliquot exposed to a 50-Gy external radiation dose.

![Figure 11](image4.png) **Figure 11.** Decay curves from the blood aliquot (Disc 1) for different doses.

The dose-response curves obtained using signals from the two aliquots are plotted in Figure 13 and Figure 14. The luminescence counts from Disc 1 were measured as 467 counts/5 s when a 10-Gy dose was given. By inserting this value into the Equation in Figure 13, the dose was calculated as $8.54 \pm 2.92$ Gy. The luminescence count from Disc 3 was measured as 459 counts/5 s and then inserted into the Equation in Figure 14. The dose was calculated as $8.01 \pm 2.83$ Gy.

Figure 15 and Figure 16 were also plotted for the 1–5 Gy dose range for Disc 3 and Disc 1.
respectively, since the dose-response graph was expected to be linear for low doses. The dose value was calculated as 11.02 ± 3.30 Gy for Disc 3 from \( y = 36.8x + 53.4 \), by inserting 459 counts/5 s corresponding to 10 Gy. The dose value was calculated as 10.79 ± 3.28 Gy for Disc 1 from \( y = 18.68x + 22.286 \), by inserting 224 counts/0.2 s corresponding to 10 Gy.

**Figure 12.** Decay curves from the blood aliquot (Disc 3) for different doses.

**Figure 13.** Dose-response curve for Disc 1. The count for 10 Gy was not included in the curve.

**Figure 14.** Dose-response curve for Disc 3. The count for 10 Gy was not included in the curve.

**Figure 15.** The dose-response graph for the low doses (1–5 Gy) for Disc 3.

**Figure 16.** Dose-response graph for the low doses (1–5 Gy) for Disc 1.
Conclusions

This study shows that the ionizing radiation received by a person can be measured directly and retrospectively using only a very small amount of blood with the OSL technique. This process should be applied before the biological life of radioisotopes and/or immediately after external irradiation. This application of OSL is important because it can prevent patients from being given the wrong dose when undergoing treatment. Moreover, the dose thought to be the cause of frequent cancer cases in certain regions can be determined, and necessary precautions can then be taken. It can be concluded that this application of OSL will be very illuminating in such fields as health care, medicine, and radiation protection.

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Role of Bose-Einstein Condensate and Bioplasma in Shaping Consciousness

Adam Grzegorz Adamski

ABSTRACT
Quantum mechanics is capable of contributing to the development of psychological knowledge by creating new models to explain the mechanism of perception as well as the nature of mental processes. This knowledge will in turn facilitate the combination of electronic and information systems with the human biological system in robots. Such an arrangement, in the form of mutually coupled systems, can contribute to humans’ becoming considerably more intelligent, acquiring better social skills, developing a universal management system, being provided with a wide range of language learning opportunities etc. It will pave the way for new educational systems, based on quantum computer science and artificial intelligence. In an electronic model of life, the biological system is understood to be a system composed of piezoelectric and pyroelectric devices, protein semiconductors, nucleic acids and melanin. In this system control is effected through a network of electron, photon, phonon, spin and soliton information channels as well as bioplasma. Each of these channels can in itself be a carrier of information, or they can function collectively as a group in the bioplasma system.

Key Words: bioelectronic processes, bioplasma, Bose-Einstein condensate, biocomputer, consciousness


1. Bose-Einstein condensate and the part it plays in creating consciousness

In 1924, Sir Jagadish Chandra Bose predicted that in certain extraordinary circumstances numerous particles might be aligned in a “uniform” manner, ordering, e.g., spin axes “upwards”. Such synchronization of particle spins can produce such phenomena as superfluidity, superconductivity and emission of polarized light (laser). In his book The Quantum Self (1991), Danah Zohar put forward a thesis that Bose-Einstein condensates not only behave as a whole, they become whole, as the many voices of a choir that merge to become one single voice make up the whole composition of singing. If you stimulate a Bose-Einstein condensate with light, the bosons will emit polarized light.

All physical particles, not only elementary ones but also complex atoms or molecules, can be classified according to whether or not wave functions are symmetrical with respect to an exchange of two particles in a set. Particles whose wave functions are symmetrical are known as bosons and those that have anti-symmetric functions are called fermions. Whether or not a given object is a fermion or a boson is determined by its angular momentum. Reference is here made to total angular momentum which, in relation to
composite particles, is the sum of the spins of all the components. Bosons have integer spins, so they equal 0, 1, 2, while fermions have half-integer spins, that is, 1/2, 3/2, 5/2, ... (expressed in terms of Planck's constant). The most important consequences of this classification become apparent when these particles have quantum properties – i.e. they behave as waves of matter. Atoms are either fermions or bosons, depending on their mass number (the total number of electrons and nuclei (Domanski, 2010).

By using an optical device such as a laser, it is possible to slow down (cool) atoms. In respect of atoms in the gas phase, where there are various directions of atom movement, illumination with laser light may result in global atom movement. This is a mechanism for slowing down the movement of atoms or cooling of gas. Thus, at the expense of its kinetic energy, an atom emits more light energy than it absorbs, and gradually reduces its speed, and therefore the gas cools (Szczechkowski et al., 2009).

In a Bose-Einstein condensate quantum processes exhibit a high degree of orderly arrangement and of unity. Each particle in a Bose-Einstein condensate fills all the space, all the time, and regardless of various impacts such particles behave holistically as one particle. A key feature of Bose-Einstein condensates is that particles which make up an ordered system will not only act as a whole, but will also "care" for such an order, and there will not be any interference between individual particles. The particles do not lose their individuality within the whole. Condensates are described with a single wave function. This means that the entire object has one solid phase. A number of important experiments using Bose-Einstein condensates have been carried out. The wave-like nature of condensates (Esslinger et al., 2000; Bloch et al., 2000; Ritter et al., 2009; Kohl et al., 2005) has been demonstrated; and interference between two independent condensates has been observed (Andrews et al., 1997; Alekseev, 1999; Dziarmaga and Karkuszewski, 2003). Vortices have been shown to exist in condensates (Matthews et al., 1999).

Numerous analogies have been observed in relation to non-linear optics as the existence of dark and bright solitons (Burger et al., 1999; Khaykovich et al., 2002; Dziarmaga, 2004; Carr and Clark, 2006; Matuszewski et al., 2005). It was noticed that a soliton can generate an electromagnetic wave, or swallow it, which contributes to the creation of conductive continuum and transmission of information over long distances (Salasnich et al., 2002; Muryshev et al., 2002; Burger et al., 1999; Denschlag et al., 2000; Bongs et al., 2003), and to the mixing of four waves (Deng et al., 1999; Hagley et al., 1999; Simsarian et al., 2000).

The Josephson effect has been observed (Cataliotti et al., 2001; Burger et al., 1999). A molecular condensate and a condensate of Cooper pairs have also been created (Regal et al., 2004). Domański (2010) in his lectures proposes the presence of BEC of magnons. Elementary excitations in magnetic materials (so-called magnons) obey boson statistics. Elementary excitations in magnetic materials (so-called magnons) obey boson statistics due to total spin. If the life of these quasiparticles is sufficiently long, this enables coherent BEC condensation of magnons to occur. This phenomenon is manifested by: spin supercurrent - transport of magnetization, Josephson effect - interference of condensates, critical current, quantum vortices – used to model de Witten's cosmic strings. If we were to regard Domański’s scientific theses as true, we would need to accept that melanin and neuromelanin, whose function is to control spins in free radicals, can contribute to the formation of Bose-Einstein condensates of magnons. Studies have shown the ability of a Bose-Einstein condensate to condense at room temperature within an organic polymer (Plumhof et al., 2014; Stöferle et al., 2015) as well as the occurrence of magnon pumping in Bose-Einstein condensates at ambient conditions. Bose-Einstein condensation can also take the form of "macroscopic quantum coherence".

The 1968 theory of Herbert Fröhlich assumes that nerve cells have the ability to create a Bose-Einstein condensate. Fröhlich is of the opinion that a large number of quanta can condense into a single state called a Bose-Einstein condensate. This status allows for communication over long distances and for correlation between dipoles. Fröhlich concludes that the condensate phenomenon occurs along the actin filament line (part of the cytoskeleton), creating the quantum coherence of waves which are responsible for the formation of consciousness (Fröhlich, 1968).

In 1967, Horoomi Umezawa and Luigi Maria Ricciardi proposed a model of consciousness based on quantum field theory (QFT). This model draws on Fröhlich's publications about Bose-Einstein condensates. According to Umezawa, consciousness is the result
of the sum of quantum processes, with the role of the nervous system being limited to transmitting macroscopic signals; it is Bose-Einstein condensates that are responsible for the stability and consistency of consciousness.

One of the major supporters of the quantum theory of consciousness is the contemporary British physicist Roger Penrose. In his opinion, consciousness must be a quantum phenomenon, because ions are too big and biochemical processes are too slow to quickly provide information to cells. Inside a neuron there is a “cytoskeleton” which provides cell structure. The cytoskeleton consists of “micro-tubules” with a diameter of 25 nanometres. Penrose believes that consciousness is a manifestation of quantum operations of the cytoskeleton and of the links between quantum and classical levels of cell activity. Penrose’s theory is similar to a theory propounded by the American psychologist Stuart Hameroff. Microtubules are composed of subunits: proteins and tubulin dimers. Dimers of tubulin have hydrophobic pockets that are 8 nm apart from each other. They affect the delocalization of “pi” electrons. Tubulins include polar regions, rich in “pi” electrons, separated from each other by about 2 nm. Hameroff proposes that these electrons are sufficiently close and are able to start quantum processes by forming a state known as a Bose-Einstein condensate. According to Hameroff, this phenomenon not only takes place within a single cell, but it also extends to other nodes located in synaptic slots, thus forming a macroscopic quantum function across the whole brain. Hameroff postulates that the activity of these condensates is the source of gamma wave synchronization in the brain, and a consistent feature of consciousness (Hameroff, 1982; 1987; 1989; 1990; 1994; 2006).

2. Biophoton emission in a biological system

All organisms, ranging from bacteria to human beings, constantly emit extremely low-intensity light, in the range of 200-800 nanometres, referred to as biophotons or ultra-weak biochemical luminescence. Such light corresponds, for the most part, to the visible electromagnetic spectrum, but also partly overlaps ultraviolet and infrared radiation. So the processes of life and light are inseparably interrelated, because of the same electromagnetic nature. Light performs essential roles: information, energy and regulatory roles in living organisms in the ecosystem, e.g. in photosynthesis, vision, and biological rhythms etc. However, the information and regulating role of very low-intensity light is less understood than the energy-imparting role for biological systems. Therefore, scientists do not evaluate or use information potential, if any, in biogenic radiations (Sławiński, 1990).

According to Sławiński and Popp, biogenic radiation is a very weak radiation. A single living cell, for example a yeast cell, or a white blood cell (leukocyte) emits an average of one photon per minute. So the probability of photon emission by a healthy and living cell or an organism is extremely low. It seems that light generation processes are strictly controlled and reduced to a minimum. The human organ of vision, or the eye – brain, is not capable of detecting such dim light under normal conditions. In order to measure such low-intensity light special optoelectronic, ultrasensitive devices need to be used. In a healthy, normally functioning body, at the lowest, constant intensity (I) and fixed frequency (N) or the wavelength λ of the scale of the spectrum, these processes are stabilized. These parameters will change in medical disorders - biophoton light emissions and their frequency are increased. It should be concluded that ultra-weak light signals can serve as a communication channel between cells, tissues, organs and the whole biological system (Sławiński, 2003; Popp, 1979; 1983; 1992).

Life and consciousness exhibit characteristics of an electromagnetic field. At death, biological matter, having exhausted all adaptive reserves of a living system, has light separated from it. Such matter remains organic, but is abiotic. Both components of life proceed to their natural conclusion - matter re-enters the chemical elements cycle, while the other component, which is light, chooses space (Sedlak, 1987: 111).

Watson and Crick published their paper on the helical structure of deoxyribonucleic acid in 1953. After the discovery of the genetic code, it was quite quickly established that all known life forms contain a “recipe”, included in the code in the form of complex sequences of biochemical reactions. This blueprint in the genetic code determines the structure and function of organisms, as well as the development of specific forms of life at a given stage of development and the way they reproduce. It seems that life came
into existence when such a blueprint was created containing specific genotype and phenotype patterns, patterns for perception of the world, for responding to stimuli, styles of behaviour, manner of thinking, etc. All information about the human body is to be found in half of all X and Y sperm (i.e. those that contain an X or a Y chromosome; each female oocyte contains complete information about the genotype and phenotype of the human being, and a human being can be recreated by using the ‘cloning’ technique (Muc-Wierzgoń et al., 2001).

All doctors are aware that at the end of life, human mental resources are greatly reduced. In old age, certain diseases are accompanied by “consciousness” being significantly diminished or even lost. What would one have to do at this point of one’s life in order be as fully aware of oneself as in one’s youth? One would have to have access to an earlier version of the recipe for one’s body which recipe, however, has already disappeared. One’s nervous system would have to be rebuilt according to such a blueprint, and the brain would have to have the original information input in it and a programme would have to be run to implement one’s development. Then one would be able to say, “I’m now what I used to be in my youth”. An important role in this process would be played not only by the recipe for one’s body, but also by the carrier of information – or events taking place in one’s life.

Let us analyse this issue from the perspective of a computer and its information simulation. It is an interesting case! Organized information always needs material support. An information carrier can be an electromagnetic wave, an acoustic soliton, a spin wave and a bioplasma wave. Numerous computer programs contain different instructions. The computer that defeated chess champion Garry Kasparov had a set of program instructions that had been entered into its memory by the individuals preparing this computer for operation. This collection of information is intangible, but it needs a material carrier - a processor, neurons, the brain, floppy disks, pen-drives, etc.

The clinical death of an organism causes a weak signal to be sent to hyperspace. The bioelectric activity of the heart and brain manifests itself by electromagnetic waves. The cessation of electromagnetic wave transmission by an organism can be detected using medical equipment, but there is also a weaker signal which comes from genes, recorded in the DNA code, which terminate communication with life transmutation patterns. The signal is probably soliton, spin and bioplasma waves. In order to append a message to these first two weak signals it is necessary to use a transmitter, one that transmits on Bohm wavelength, Bose-Einstein condensate and bioplasma wavelength. Such a transmitter can be created by a “group of persons” who, because of a certain psychological motivation, decide to synchronously connect their Bose-Einstein condensates and bioplasma on an interference basis and become a carrier transmitting information to hyperspace. Bringing together a large number of people provides conditions for obtaining a coherent “wave function” in a macroscopic coherent Bose-Einstein condensate which is a type of a transmitter-receiver system outside space-time (Deutsch and Lookwood, 1994).

Coherent wave functions are not subject to the principle of locality. They are part of the so-called hidden order of the universe. These wave functions can establish a kind of communication with that hidden order and can determine whether or not a given item of information is sent to space-time. So one can assume that neuronal microtubules and DNA of our brain also handle waves other than electromagnetic waves, the waves to which the Einstein-Podolsky-Rosen argument applies, or waves that are not subject to the principle of locality. These are the waves that lie in the so-called Hilbert configuration space, “superimposed” on space-time.

David Bohm has demonstrated a break-up of a particle with zero spin into two particles with spin - for example, an electron and a positron. These particles fly in opposite directions, they reach points A and B that are spaced a certain distance apart. John Bell devised his famous theorem which claims that the predictions of quantum mechanics on cumulative probability of particle spins measurements at these points A and B are contrary to the assumption of local realism, that is, the assumption that the electron at point A and a positron at point B are two independent objects. The adoption of such a hypothesis leads to the conclusion that the cumulative probability of obtaining various measurements of A and B is different than that given by quantum mechanics. Bell’s theorem is of significant theoretical importance for science; subsequent measurements, especially those carried out by Alain Aspect in Paris, show that non-local effects...
have no counterpart at the level of classical physics (Bohm, 1980; Bohm and Pribram, 2003; Bohm and Hiley, 1984; 1993).

In addition to the state of "existence" and "non-existence" there is a third state that is intermediate between two existing particles. A particle, in fact, may be in a certain region of space or may not be there or it is in an undefined position (Heisenberg, 1927). Ingarden (2000) believes that open systems in quantum physics are represented as objects in the sense of quantum logic, but in macrophysics they are usually described by classical logic and mathematics in the form of Boolean algebra and theory. This is an improper implementation, as classical logic and mathematics refer to closed rather than open systems. In the 60s of the last century a tool was invented for open sets, i.e. a fuzzy sets theory was developed (Kauffmann, 1972; Drewniak, 1984).

When investigating the nature of consciousness, quantum logic should be a basic research tool, because it takes into account an entangled state of two quanta that cannot be reduced to a description of individual quantum states. Bell's theorem means that at the subatomic level, various components of the universe are connected by a direct and immediate relationship independent of time and space. One can conclude that this relationship can be applied to the functioning of human consciousness, which works with the Cosmos. Consciousness can follow the laws of quantum mechanics, and can exist in a certain region of space, or it might not be there or its location is undetermined. That indeterminacy is significantly different from existence and non-existence, it is self-organizing, without time and without a spatial dimension (Ingarden, 2000; 2001; 2002).

Our bodies exist in reality, but are not made of passive matter, they are relevant complex sets of information received via the brain as real bodies of specific individuals. Microscopic systems, consisting of several or more interacting particles, exhibit a characteristic such that the superposition of the possibility of such a system is usually very complicated. Quantum theory claims, and experience confirms, that individual particles of a system cannot be assigned their own possibility superpositions, because they subsist in a complex relationship with possibility superpositions of other particles, even if they move away from each other over long distances. Such relationships are called correlations. When a particle, after a measurement has been made, is observed in a certain region of space, this causes an immediate change (propagating at a speed greater than the speed of light, and maybe even an infinite speed) in the superposition possibility of all the particles correlated with the particle observed. This refers to a mysterious, yet extremely important feature of quantum theory, i.e. its non-locality (Jacyna-Onyszchukiewicz, 1999; 2008). This non-locality can be a major attribute of consciousness and its deeper understanding presents a challenge for science in the coming years.

3. The role of bioplasma in the process of functioning of consciousness

Sedlak acknowledges that bioplasma is an integrating factor in a biological system, while Penrose, Hameroff, Fröhlich, Zohar and others are of the opinion that it is Bose-Einstein condensates that are responsible for the consistency of a biosystem. Bioplasma is a state in which fields and particles with positive and negative charges are connected to each other in an organic semiconductor, interacting with each other. Bioplasma is to be found in protein semiconductors, piezoelectric or organic compounds. In order for charged particles and excited states to exist both in plasma and in the body, it is necessary to provide energy in various forms. In the first case, it is accomplished physically by providing external energy that is received by the human senses. In the other case, energy is provided via a chemical process – by chemical energy being released through metabolic processes. Bioplasma dies off due to the loss of energy as it is emitted. The ageing of an organism is the result of destabilization of bioplasma expressed through the disappearance of the plasma state. Bioplasma is a material centre of life and an underlying layer of consciousness. It constitutes a whole within the body. Bioplasma attributes include not only electrical and magnetic symmetry but also the symmetry of subsistence and annihilation as well as degradation and generation. Plasma does not subsist, it is created and disappears. In this process, an important role is played by external energy factors (Sedlak, 1970; 1972).

Plasma exhibits many properties which are not visible in other physical states. One of the most important attributes is the collective response of the entire group of particles to
According to Sedlak, bioplasma would therefore operate as a generator of information, an information coordinator and carrier and transformer. Bioplasma integrates and transmits information to prepare a comprehensive picture, it creates unity out of different bits of information and produces a comprehensive picture of reality together with the identity of a specific person. Plasma is precisely such a state of matter that is unity in diversity and has a distinguishing feature of an information integrating factor. A change of information refers to changes in temperature, pressure, gravity, electric and magnetic fields, chemical, acoustic and optical changes. Any such energy delivered to plasma increases electrical symmetry, imparts speed to particles, prevents destabilization processes or bioplasma degradation (Sedlak, 1979: p.265).

Sedlak believes that bioplasma is passed from parent to offspring organisms. Bioplasma is a “master” (Sedlak, 1979). The idea of bioplasma may have an effect similar to that of Jungian archetypes. According to Jung, the basis of our psyche is a central force that exists in all living beings, it is that which penetrates and connects everything. In terms of Jungian archetype, it is intended to mean a prototype, the main idea, a standard defining human development and it also contains laws controlling this development. Archetypes are patterns of experiencing the world, oneself and others, they are imprinted in our psyche, are a link between us and our ancient ancestors. They are also what the human race has taught us over tens of thousands of years of its existence (Jung, 1976). Archetypes never had a beginning in terms of organic life, they appeared together with life and are the common heritage of humanity (Jung, 1976; Jung, 1993).

Jung’s and Sedlak’s words can be traced to biblical terminology, stored in the form of poetry: “In the beginning was the Word ...” From the point of view of physics, it is programmed information, accurately recorded in original quantum plasma, which is a legacy for all generations of mankind. Primary bioplasma is eternal and pervades the whole cosmos. To some extent, it is being fine-tuned by conscious inhabitants from the humanity’s entire existence in four-dimensional space-time.

The ultimate goal of humanity is to achieve such a degree of development of knowledge of the world and technology in order to participate in the formulation of a new version of bioplasma using...
the 'tools' inherent in the hidden order postulated by Bohm. The aim of bioplasma is supposed to be the creation of a new face of the four-dimensional universe in which there will be room for a new Man - *homo electronicus*.

**Conclusion**

In science there is an established view that light emission accompanies all changes in nature, from the smallest nuclear fission, of cell division, fertilization of the egg to the death of a multicellular organism. The primary base of biological life is electromagnetic processes occurring at the molecular, cellular and general body level: electrical activity of neurons, electric and magnetic field of the heart, of the brain, muscles, transcription of the genetic code and all biochemical reactions.

In Einstein's theory, the speed of light is the maximum permitted speed that we find in nature; this is intended to mean that the processes of life can only be made in such a dimension that is dictated by light. Bohm's theory states that the energy of morphogenetic fields, both in movement and at rest is zero, so for them there is no breakdown of space into a temporal and spatial part. The energy pulse tensor, as a four-dimensional vector assuming zero value, is found in all areas of space. Thus, the speed of signal transmission by means of these fields can vary in the range from zero to infinity, depending on the physical phenomenon causing these fields to exist. This implies that life includes an area of quantum processes that occur at the speed of light, but also those that go beyond the speed of light (Molski, 2005). Bell's theorem means that at the subatomic level, the various components of the universe are connected by a direct and immediate relationship independent of time and space.

Science is faced with a new challenge - to learn more about the operation of Bose-Einstein condensates in human biological systems, about solitonic waves and their information function for biological systems, and to investigate bioplasma, which, in particular, is responsible for human psychosomatic states.
References


Albert DZ. Alternatywna mechanika kwantowa. Świat Nauki 1974; 7:34-42.


Hameroff S, Penrose R. Conscious events as orchestrated space-time selections, J Conscious Stud 1996. 5: 34-45.


Hameroff S. The entwined mysteries of anesthesia and consciousness. Anesthesiology 2006; 105 (2): 400-412.


Origin of Consciousness and Zero-Point Field

Tapan Das

ABSTRACT
Yukawa coupling of scalar fields of Nambu-Goldstone bosons and Dirac fields of electrons creates interference pattern. Nambu-Goldstone bosons emerge from the quantum electric dipole field of the brain triggered by small energy of brain wave. The electrons come from the axons of neurons initiated by ions. The collapse of the interference pattern creates consciousness. This consciousness merges with supreme consciousness which is zero-point energy of super universe that includes our universe. It has been experimentally proven that zero-point energy exists even at absolute zero temperature. The author postulates that this zero-point energy not only exists in our universe but also outside our universe in the super universe and was there even before Big Bang which created our universe. The author postulates that our universe was created from zero-point energy. This zero-point energy is the supreme consciousness where our consciousness merges after every event.

Key Words: consciousness, OrchOR model, quantum field theory, Yukawa coupling, zero-point energy


Introduction
In my previous papers (Das, 2009; Das, 2015), I mentioned that the theory of consciousness as a manifestation of a complex net of electric impulses within the brain is now discredited. I have proposed that Yukowa coupling between Nambu-Goldstone boson scalar field and electron Dirac field in the brain is the basis of consciousness. I further proposed that tubulins in the microtubules in the brain are involved in the activities of consciousness.

Penrose and Hameroff Objective Reduction Model
Penrose and Hameroff have worked extensively on quantum consciousness and have proposed a model called Orchestrated Objective Reduction (Orch OR model) (Hameroff and Penrose, 1996; Hameroff and Penrose, 2003). They suggested that quantum vibrational computations in microtubules were "orchestrated" ("Orch") by synaptic inputs and memory stored in microtubules, and terminated by Penrose "objective reduction" ("OR"), hence "Orch OR."

Microtubules are self-assembling hollow crystalline cylinders as long as 50 micrometers whose walls are hexagonal lattices of subunit proteins known as tubulin. In neurons, microtubules self-assemble to extend synapses and dendrites and form synaptic connections. Tubulins are peanut-shaped dimers with two connected monomers and can undergo several types of confrontational changes. Hence two possible states of a tubulin can represent one bit of information. If they are superimposed and exists in both states simultaneously then they represent a qubit and has the possibility of constituting a quantum computer.
Orch OR model works in the following way.

1. Internal quantum events lead to confrontational states in tubulins in microtubules.
2. Quantum coherent superposition leads to quantum computation among tubulins. This will continue until the threshold for objective reduction is reached.
3. According to Penrose, the threshold for objective reduction is given by: \( E = \frac{\hbar}{2\pi T} \), where \( \hbar \) is Planck constant. For \( T = 25 \text{ ms} \), \( E \) is roughly the superposition of \( 2 \times 10^{10} \) tubulins.
4. Each brain neuron contains about \( 10^7 \) tubulins. If 10% of these tubulins become coherent, then Orch OR of tubulins within roughly 20000 neurons would be required for a 25 ms consciousness event.

Penrose suggested that at the Planck scale curved spacetime from Einstein’s Theory of Relativity is not continuous, but discrete. Penrose postulates that each separated quantum superposition has its own piece of spacetime curvature, a blister in spacetime. Penrose suggests that gravity exerts a force on these spacetime blisters, which become unstable above the Planck scale of \( 10^{-35} \text{ m} \) and collapse to just one of the possible states of the particle. The rough threshold for OR is given by Penrose’s indeterminancy principle: \( T = \frac{\hbar}{2\pi E} \), where, \( T \) is the time until OR occurs, \( E \) is the gravitational self-energy or the degree of spacetime separation given by the superpositioned mass and \( \hbar \) is Planck constant.

Orch OR was harshly criticized from its inception, as the brain was considered too “warm, wet, and noisy” for seemingly delicate quantum processes. However, evidence has now shown warm quantum coherence in plant photosynthesis, bird brain navigation, our sense of smell, and brain microtubules (Hameroff and Penrose, 2014). The recent discovery of warm temperature quantum vibrations in microtubules inside brain neurons by the research group led by Anirban Bandyopadhyay at the National Institute of Material Sciences in Tsukuba, Japan corroborates the pair’s theory and suggests that EEG rhythms also derive from deeper level microtubule vibrations (Phys.org, 2014). In addition, work from the laboratory of Roderick G. Eckenhoff at the University of Pennsylvania suggests that anesthesia, which selectively erases consciousness while sparing non-conscious brain activities, acts via microtubules in brain neurons.

New Theory Quantum consciousness

In quantum field theory (QFT), photons are quanta-ripples in a field. Similarly, fermions like electrons are excited states of field. According to quantum brain dynamics (QBD) brain is considered as spatial distribution of quantum electric dipoles making it a quantum electric dipole field (Ricciardi and Umezawa, 1967; Stuart, Takahashi and Umezawa, 1978; Vitiello, 2003). In the quantum electric dipole field, Nambu-Goldstone bosons emerge due to breakage of symmetry triggered by arbitrary small incoming energy. This small energy is created by the wave in the brain according to Planck constant \( h \) and frequency \( v \) given by \( h v \). Also, electrons coming from the axons of the neurons create Dirac field. The Yukawa coupling between Nambu-Goldstone scalar field \( \varphi \) and Dirac field \( \psi \) is given by,

\[
V = K \varphi \psi \varphi'
\]

Where \( K \) is the Yukawa coupling and \( V \) is the energy transfer due to Yukawa interaction. The wave function \( \varphi(x) \) of the Nambu-Goldstone boson is given by,

\[
\varphi(x) = \rho(x) e^{j \theta(x)}
\]

Where \( \rho(x) \) is the local density of the condensate and \( \theta(x) \) is the phase.

The Dirac field \( \psi \) for an electron is given by, \( \psi = m_e e^{j \omega t} \)

Where \( m_e \) is the electron mass.

Hence \( V(x) = K m_e^2 \rho(x) e^{j \omega t} \)

These energies come from different couplings and will have different phases. Calling these different energy levels \( V(x_1), V(x_2), (x_3), \) etc., then these energy levels will create an interference pattern.

\[
V(x) = V(x_1) + V(x_2) + V(x_3) + \ldots
\]

\[
= K m_e^2 \left[ \rho(x_1) e^{j(\theta x_1)} + \rho(x_2) e^{j(\theta x_2)} + \rho(x_3) e^{j(\theta x_3)} + \ldots \right]
\]

\[
= \sum_k K m_e^2 \rho(x_k) e^{j \theta(x_k)}
\]

This interference pattern generates an image. When this interference pattern collapses, it creates consciousness. Ultimately, this consciousness merges with the supreme consciousness.

Supreme consciousness and Zero-point Energy

Zero-point energy is the energy of a system at absolute zero or the lowest quantized energy level of a quantum mechanical system. The origin of
zero-point energy is the Heisenberg uncertainty principle which reflects an intrinsic quantum fuzziness from the wave nature of the quantum fields. Liquid helium-4 is a great example. Under atmospheric pressure even at absolute zero, it does not freeze solid and will remain a liquid. This is because its zero-point energy is large enough to keep it as a liquid (Huffingtonpost, 2011).

Casimir effect is another example of zero-point energy (Calphysics, 2011). In this experiment two conducting plates in vacuum are placed parallel to each other. Although there is no applied electromagnetic field, the two plates will attract each other, the pressure being more and more as they move closer. In quantum field theory a vacuum is full of fluctuating electromagnetic waves that can never be completely eliminated. These waves come in all possible wavelengths, and their presence implies that empty space contains a certain amount of energy, an energy that we cannot tap, but that is always there. Now, if two plates are placed facing each other in a vacuum, some of the waves will fit between them, bouncing back and forth, while others will not. As the two plates move closer to each other, the longer waves will no longer fit, the result being that the total amount of energy in the vacuum between the plates will be a bit less than the amount elsewhere in the vacuum. Thus, the plates will attract each other, just as two objects held together by a stretched spring will move together as the energy stored in the spring decreases. S. Lamoreux verified Casimir force in the 0.6 to 6μm range within 5% of the agreement of the theory (Calphysics, 2011).

Planck proposed his second quantum theory, in which he introduced the zero-point energy. He found that the average energy ε of an oscillator is,

\[ \epsilon = \frac{h \nu}{2} + \frac{h \nu}{e^{\frac{kT}{\nu}} - 1} \]

Where, \( h = \) Planck constant; \( \nu = \) frequency; \( k = \) Boltzmann constant; \( T = \) absolute temperature.

It can be seen that at \( T = 0 \), there is still a residual energy \( (h \nu)/2 \) which is the zero-point energy. Each wave has represented a propagating mode of the electromagnetic field. So each mode of the field must have \( (h \nu)/2 \) as its minimum energy. This is a tiny amount of energy in each mode, but the number of modes is enormous and increases as the square of the frequency per unit frequency per unit volume. The product of this tiny energy per mode and the huge number of modes produce a very theoretical zero-point energy density per cubic centimeter. The density of this energy depends on the frequency where the zero-point fluctuations cease. It can be argued that zero-point fluctuations will end at Planck frequency \( 1.8 \times 10^{43} \) Hz. In that case the zero-point energy density will be greater than the radiant energy at the center of the Sun (Calphysics, 2011). However, the lifetime of a zero-point energy photon corresponds to an average distance traveled of only a fraction of its wave length. Hence the energy density is not as much as thought but still needs lot of research work to properly understand and interpret this area.

Zero-point energy has been directly measured in current-biased resistively shunted Josephson tunnel junctions as a current noise up to 500 GHz (Koch et al., 1982). Having seen enough proof that zero-point energy exists, I will now expand my theory of consciousness with zero-point energy. I will call the observable universe as our universe which is part of much larger universe which I call super universe and our universe is expanding into the super universe according to Hubble’s law. The diameter of our observable universe is 93 billion light years and the mass is \( 1.46 \times 10^{53} \) kg. The universe is also expanding at a rate proportional to the distance according to Hubble’s law;

\[ v = H_0 r \]

where \( v = \) velocity, \( H_0 = \) Hubble’s constant, \( r = \) distance.

Hence the expansion of our universe is accelerating. This has led to the concept of dark energy which is a resurrection of Einstein’s cosmological constant. According to latest evidence, our universe consists of 70 percent dark energy, 25 percent dark matter and 5 percent ordinary matter e.g. hydrogen, helium and heavy elements. There is a current theory that dark energy is zero-point energy. But nobody knows yet the actual amount of zero-point energy per unit volume, whether it ranges up to Planck frequency, and its properties. Hence the theory of dark energy as zero-point energy is under lot of debate without any experimental proof.

According to Bing Bang theory, the universe was created out of nothing. Now the following questions arise.

1. How could something be created out of nothing?
2. What was there before Big Bang?
3. What is the universe expanding into?
4. What lies beyond our universe?

Based on the facts given so far, the author is making the following postulations.

1. Zero-point energy is everywhere inside our universe and super universe.
2. It has been there before our universe has been created.
3. Our universe has been created out of zero-point energy. Hence the assumption of Big Bang theory that our universe was created out of nothing is not true.
4. Zero-point energy is supreme consciousness.

In my theory of consciousness (Das, 2009; Das, 2015), I have stated that Nambu-Goldstone bosons emerge due to breakage of symmetry in quantum electric dipole field in the brain. The neural pulse is created by electrons tunneling into ion channels and subsequent capture of ions by synapses (Burger, 2013). Yukawa couplings between the Nambu-Goldstone scalar fields and electron Dirac fields create an image of interference pattern. The collapse of the interference pattern creates consciousness. The energy of the interference pattern is transferred to consciousness as zero-point energy. After that consciousness merges with the supreme consciousness which is the zero-point energy of super universe.

Conclusion

Consciousness obtains energy from zero-point energy to interpret the interference pattern of the energy levels generated by the Yukawa coupling of scalar fields of Nambu-Goldstone bosons and Dirac field of electrons before it collapses. Nambu-Goldstone bosons emerge from the quantum electric dipole field of the brain triggered by small energy of brain wave. The electrons come from the axons of neurons. The collapse of the interference pattern creates consciousness transferring its energy. Consciousness merges with the supreme consciousness which is the zero-point energy of super universe. It has been experimentally proven that zero-point energy exists even at absolute zero temperature which is contrary to the third law of thermodynamics. The author postulates that this zero-point energy not only exists in our universe but also outside the universe and was there even before Big Bang which created our universe. Big Bang theory assumes that universe is created from nothing. Since something cannot be created out of nothing, the author postulates that our universe was created from zero-point energy. This zero-point energy is the supreme consciousness where our consciousness merges after every event.

References


Lamoreaux SK. Demonstration of the Casimir Force in the 0.6 to 6 μm Range. Phys Rev Lett 1997; 78, 5.
The Third State: Toward a Quantum Information Theory of Consciousness

Scot D. Forshaw

ABSTRACT

The question of how our perceived reality is constructed and subsequently how our mind has evolved such that we are able to both perceive and subsequently alter our own causality or even our own evolution within this reality has been a long running open question. Referred to as “The Hard Problem”. There have been many theoretical interpretations on the nature of causal self-observance – hereafter referred to as ‘consciousness’. The current paper introduces the reader to the indeterminable operator - “The Third State”. The Third State is a term used to describe space itself in relation to the position of all things. As the paper shall show, The Third State is a required omnipresent and universal operator in the otherwise binary realm of data → information. The Third State augments the accepted binary operators to produce the required ‘tristate’ condition that facilitates the required probabilistic nature of the conscious manifestation. Secondly the Unity Magnitude [Um] scale, which facilitates the bounding of quantum probabilistic memory in a finite model. The paper further introduces the reader to a model and experimental theory that suggests all things we perceive as physical reality can be fabricated from primitive components of data, bits – matter / antimatter / something or nothing. That facilitated by the Third State, our immediate present reality as we experience it and theretofore consciousness is a simultaneous product of the current physical configuration of the frequency stable systems of which we are comprised, interpreted past reality, self-predicted future provided by cyclic frequency stable systems and the immediate physical and sensory state including recursive imagination systems generated by the output of these perturbed frequency stable systems in the cyclic feedback process - ultimately perturbed by, but as one unified with the stochastic processes in relation to the quantum cosmological domain.

Key Words: information theory, chaos theory, non-linear systems, quantum consciousness, probability theory, quantum cosmology

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“At any arbitrary scale there is a finite number of discrete observables.”

Introduction

When in relation to a microcomputer you ask the valid question: “How many electrons are required to make a 1 state?” you quickly realise the scale of the question quantum information theory hopes to address. How a continuously moving and indeterminable quantity of atomic particles can be held – or remain, in a state that can be used to convey universal meaning to the observer. If one ever needed to emphasize the role of frequency stable systems and quantum information theory in the world we find ourselves at one with, one need look no further than the simple binary bit. It is not my intention to school the reader in the basics of elementary electronics and electron flow but as much contention has arisen from the many

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attempts to introduce the quantum realm into the consciousness debate, it is important to
demonstrate with clarity the simple concept. The microcomputer is built for the most part on the
principles of Boolean logic. Information is represented as binary truths 1 or 0 in the logic gates
manufactured from semiconductor junctions.

Semiconductors are chemically doped sandwiches of selected material elements (often silicon), in one state the electrons simply move around on one side of the junction never making the jump to the other side. In another state – in which more electrons are introduced, enough electrons make the jump from one side to the other in order to let current flow and form a circuit. Whilst the foregoing is rudimentary and clearly is harnessed with great elegance to allow microcomputers to hold a discernible binary truth (1 or 0, flow or no flow) what is also evident is that the whole system whether in the conducting or non-conducting state, is moving. Not a little, but rather moving a lot. That brings about the question of what is a bit? On the one hand a bit can be described as a 1 or a 0, but if one is to try and 'quantify' the bit with some rigorous mathematical method, it becomes quickly apparent that unless one introduces a scale of observation, there is no way to quantify a single bit as 1 or 0.

When the reader now considers information theory below bit scale, one cannot avoid but conclude that the quantum scale is at work in all things. And furthermore that at chosen scales of observation, no stable state (i.e. a binary bit) can be conclusively quantified as truth or not. So to "observance" itself becomes an important factor. If we consider answering the question posed at the beginning of the chapter, one is now faced with the challenge of counting a moving target. A target whose aspect and position (although intrinsically stable as a collection of physical particles in the form of a "touchable" transistor in your hand), is internally moving in complex ways. Add to this the introduction of external noise, heat, magnetic radiation and before long the task of simply trying to say with any conviction "This is a binary 1" seems like an impossible task. This is the world of quantum information theory, the domain of the Qubit. This paper will address the aspects of quantum information theory as they may apply to the wondrous manifestation of causal self-observance. Causal self-observance is the authors preferred name for what otherwise is popularly known as consciousness.

The axiomatic basis of quantum consciousness

Before quantum information theory can successfully be assimilated by the quantum consciousness community, and for that matter quantum consciousness science accepted by the quantum mechanical fields, there has to be an axiomatic acceptance of some rudimentary facts that give rise to the validity of the study. That for me should begin with one of the most important and glaringly obvious conundrums that biology presents to the information theorist, that is the finite nature of the brain itself. There is a simple, unavoidable truth, and that is - “From a biological perspective the brain is a finite phase space. There are only N molecular or cellular structures in any single brain. In a classical sense it has a theoretically provable finite entropy that can be used usefully”.

The finite brain

"Quantum Consciousness science will remain in scornful isolation until we accept the fact that the brain is classically finite and move on to the important question of why it is so.”

The physically finite capacity of the brain introduces a difficult problem for the information theorist and the student of consciousness alike. How can something with N configurations memorise and retrieve accurately what appears to be an almost limitless amount of information?

As with any other classical data storage medium one would imagine that in order to separate data so as to be able to retrieve it in any reliable fashion as meaningful information, then the laws of information theory (Shannon, 1948) would dictate that some redundancy and separation scheme is required. However, adding redundancy to an already finite capacity system would certainly seem illogical in a purely classical sense. If indeed we are expected to accept (the author strictly does not) the Darwinian theory of evolution (Darwin, 1859), that survival of the fittest gets rid of waste leaving only the most economic systems, we would really have a problem. If we for a moment disregard the illogical and just accept the simplest truth, we can better consider the pivotal questions that give birth to the entire field of quantum consciousness.

“Why then is the brain finite? And furthermore -being finite in physical terms, how then is it seeming capable of near limitless...
memory recall, concept generation and that most wonderful of nature’s creations – imagination?

**Postulate:** In classical terms the brain is and must be for obvious reasons an informationally finite storage space. And therefore in order to exceed the physical limits of its storage capacity, a scheme of compression must be used. There is no classical compression scheme that can escape the laws of information theory and so the author puts forward the assertion that a form of quantum probabilistic compression is used.

**The quantum brain**

“To deny that the brain is affected by quantum processes is as it is to deny that the Earth orbits the Sun.”

There have been many clashes of opinion on the use of the phrase “Quantum Consciousness”. Physicist often keen to dismiss anyone who uses the term as “pseudo-scientific heretics”. Conversely the quantum consciousness community is equally to blame through its often liberal use of neologisms or hi-jacking of accepted terminology that without agreement or contextual narratives invite attack, speculation and skepticism. So the second axiom that requires agreement is whether the brain is a system that is affected by the quantum domain or not. What do we mean by a “system affected by the quantum domain”? I would break this down two ways. Firstly, are there any aspects of the brains function that use the principles of currently understood and studied quantum mechanical theory? Answer: Yes. The brain demonstrably operates using electrical signals. Electric signals are comprised of electron flow. Electron flow is well established as a quantum mechanical affect. Secondly, is there any proof that the brain is affected by external non physically attached quantum processes. Answer: Yes, put your head in the path of a high energy X-Ray machine and the effects will become quickly clear. Conclusion: The brain is both a system that uses quantum mechanics in its day to day business and secondly is able to be perturbed or even damaged by external processes that without quantum mechanics would be otherwise invisible to the observer.

These claims do not however amount to the rather different proposition that the brain is “a quantum computer” which implies that the brain uses the phenomenon of quantum entanglement in order to accelerate computation.

**The quantum cosmos**

“If you were in any doubt as to the role of the cosmos with respect to life on Earth, ask a dinosaur.”

Having shown in certain terms both quantum mechanics and quantum consciousness fundamentals do indeed share at least some axiomatic lineage, the final field of study that comes into frequent question is quantum cosmology. Quantum Cosmology is the high priesthood of theoretical physics that traditionally looks to unify Einstein's General Theory of Relativity with Quantum Mechanics. It is also a fertile area for pseudo-scientific speculation and misinterpretations. The simple question I want to answer is this - “Is the cosmos quantum”? The importance of the answer cannot be downplayed. For as much as quantum consciousness is a part of quantum mechanics, quantum cosmology sits above these as the method to fundamentally tie the domains together with a coherent mathematical, rigorous and therefore scientifically acceptable theory. I am not going to provide example of how the cosmological realm is quantum, rather I shall let the hundreds of millions of dollars spent annually in astrophysics, particle accelerators and plasma research answer the question for us.

**Toward a Quantum Information Theory of Consciousness**

The brain is quantum mechanical, and quantum mechanics is present across the cosmos therefore the underpinnings of quantum cosmology hold the key to the information theory of everything. More specifically the focus of this paper is how a unified theory of quantum information (the theory of the laws of how data becomes information and how it is preserved in a low entropy stable state or reverts back to high entropic states) might shed light on the consciousness we experience whilst simultaneously assisting the interdisciplinary research that currently has no common axiom – at least none they are willing to share. The justification for thermodynamic references in relation to quantum information theory is centered around the belief that if the brain is in part quantum mechanical in nature, then there is a symbiotic relationship between the physical configuration of mind and the field of energy in which it resides. If the foregoing is true, then it follows that any universally holding rules of
quantum information theory will be manifest in all macro systems that are derived from them. Therefore, quantum information theory should in the authors' opinion not give rise to observed states that violate thermodynamic law – this is quite separate to classical information theory which I believe describes only the information theory of post quantum scale complex systems.

Typically, when we approach any mystery, the first thing one may attempt to find are commonalities between the various pieces of information you have at your disposal. Mathematicians may seek to equalize and cancel like terms of two sides of an equation. A criminal investigator may look to establish links between places, people and times to uncover motive. No matter what the problem, the discovery of a common theme, value or particular outcome is a primary goal.

The paper is concerned with information theory so it is pertinent to define some globals:

**Data:** The smallest discernible element(s) at the current scale of observation.

**Information:** A collection of Data that together form a pattern to convey something more than is possible with a single piece of Data.

An example of data is the binary value 1.

An example of information is 101010.

From the former example one instantly recognises the string of 1's and 0's as the digits in a binary number. Taking this a step further we might take 2 of these binary strings and place them together like so: 1010110101.

Now we clearly have a new piece of information, but it’s true meaning becomes less clear. There is a problem introduced that makes the understanding of the information difficult. Simply concatenating the information, whilst preserving the Data, has actually lost the information. What is missing is something that makes up the larger percentage of both our own bodies, the Earth on which we live and the universe that we call home – that missing element is quite simply “space”. Not zero, not the '0' bit but utter and complete space.

**The Third State (Omni present understanding and limitless creativity)**

Between data and information lies “The Third State”. A universal value that is the only common symbol across all domains of information, the symbol that brings order to chaos and meaning to the meaningless. This third state is both Alpha and Omega, superposed and interchangeable through any scale of observance. It exists only because it separates data packets, means something only because of the meaning it brings in relation to the data it separates. The third state is the universal building blocks of “semantics and understanding”. A metaphorical “Joker in the pack”, The Third State assumes multiple identity, is omnipresent, one of the same but each individual. The Third Space completes a trinity of elementary data quantities that breathes life and understanding into the universe.

In the example earlier the binary value 10101 was concatenated with 10101 form the value 1010110101. A new compound value that has lost any sense of the 2 values of which it is comprised. If however we add space [...] like so: 10101 [...] 10101, we now have 2 discernible values. This space is found across the domain of all things. From galactic and planetary scale structures down to continents and geographic constructs, to language, writing, speech, biology, nano technology, DNA, quantum and dare we speculate “sub-quantum”. Space is the only truly universal numerical operator that exists in all realms and all scales of information, matter and life. In the very words of this paper space brings meaning to nonsense:

> forwithoutspace this would be very hard thing to comprehend

> "The past has non to low probability of exerting influence on the future nor can we recover it with any deterministic high probability. For all mathematical and practical purpose – it does not exist."

**Considering the Past**

We often hear the phrase “to know who you are you must first know who you have been”. As will be explored, this concept is highly flawed, however despite this has a particular habit of appearing to be true because of the bias we apply to it. The classical view is that the past predicts the future, also neither can it be changed. This view may have some truth after our classical human bias is applied, but in quantum terms nothing could be further from the truth. In order to
demonstrate the futility of reliance on the past to predict the future the author presents a simple thought experiment:

**EXPERIMENT:** Step 1 - Predict the state of the weather 1 week ago based only on the data you can recover that describes the weather in the last 1 second. Step 2 - Then using the results obtained in step 1, predict the weather today using the predicted weather 1 week previous.

**RESULT:** At best accuracy of your prediction will fall proportionately with time. Or put another way - the further you go back into the past to predict the future the entropy of the prediction will increase.

**CONCLUSION:** The author concedes that the experiment may raise more questions than answers, however there are some interesting possibilities. According to the 1st law of thermodynamics the energy in a closed system (in this context the cosmos is implied) remains constant. If the past has any effect on the future surely it must first exist. If every version of past exists this would either bring about a violation of the first law, or imply that the cosmos is not a closed system. If every version of our individual past exists, then a large proportion of the available entropy in the universe would be held in increasingly low entropic stable state (as memory) (however this is in violation of the 2nd law of thermodynamics). If therefore the past does indeed not exist, then what in fact do we base our immediate short term predictions upon and what do we actually see when we apparently remember our past?

The author postulates that the past is merely held as a set of quantum probabilities compressed within the finite physical configuration of the minds apparatus. That through the process of wave function collapse against the generally cyclic and stable local system, one can recover with high probability accurate measurements of memory. The concept of how memory can be stored in finite states and recovered by a remote quantum field was demonstrated experimentally in 2015 by Willard Van De Bogart and Scot D. Forshaw (Van DeBogart and Forshaw, 2015).

**Fixed Unity Magnitude, scale and redundancy**

The preceding chapter makes reference to compression of memory into a probabilistic or unobserved quantum state. Classical physics often uses the word scale in relation to observations of systems. A problem with this word when used in the quantum mechanical realm is the bias we already have to its meaning. Specifically - with respect to quantum information theory, scale is not sufficient a term to describe the observational conditions of a quantum state, why? - simply because it offers no information as to the resolute entropic capability of the observer in relation to the observed system. Trivially, in order to observe quantum states, they must be collapsed, at which point they become real or fixed. If one, simply uses scale to describe the conditions of observation there is a real possibility that one runs into infinities. To overcome this one needs to extend the definition of scale to incorporate the simultaneous reframing of the phase space resolution so that no matter what scale is employed, the resulting collapsed state returns the desired probability with respect to a universal time reference. In an effort to resolve this we shall introduce the concept of a new term - “Unity Magnitude” [Um]. Um is the quantum information equivalent of scale.

To understand its role, it is helpful to describe a real world example, here we use the non-quantum medium of the Latin alphabet. Taking a simple sentence of two words “for any” we might say that it contains 6 letters and 1 space. At an Um of 7 the entire sentence is visible [for any]. At a Um of 1 only a single letter is observable [f] (or any other we might observe). For a model of quantum consciousness working in a finite mechanism such as the brain, this has serious implications for the containment of infinities. As the Um increases the maximum entropy. This takes precious available space from our limited storage capacity. The author postulates that any storage scheme capable of the seemingly endless storage that is demonstrated by the brain, must 1. employ a compression scheme, 2. that the compression scheme used must be probabilistic and therefore quantum in nature, and furthermore that compression scheme will operate with a fixed Um. That means that regardless of the input size, a fixed output size will be stored. Even if the input is smaller than the fixed Um storage space. By this method, additional “information independent” redundancy in the form of “space” is added and compressed along with the information. If for example, we look at the input string at a fixed Um of 16 we shall see [ for any].
By the employment of fixed Unity Magnitude in the sampling of sensory data for example, one is able to 1. phase lock information to a steady clock that is independent of space time and 2. introduce a means by which the quantum probabilistic state can be bound to finite limits thereby avoiding infinities related to scalar values rising in sympathy to entropy. Another way to look at U is to think of it as a resolution independent vector that describes the magnitude of a phase space in which the entropic ceiling is the maximum number of discreet observables possible. In human terms, we use the Um constantly in our daily lives. If we cannot make out a distant object, we simply adjust the Um by moving closer to it until it makes sense. But the most important concept to understand is that as the Um scales, so to the entropy is bounded accordingly. The concept of the Um scale is not new. Having been studied at length in the field of genetics. The genes found within all living things have their own Um scale provided by the Ribosome. The Ribosome traverses the RNA strand to decode DNA and ultimately rebuild proteins according to an otherwise indecipherable stream of data. Within a species such as humans, Ribosomes decode this knowledge in 3 base pair steps Khorana, 1965 – redundancy in DNA is used to great effect to ensure the propagation of accurate information.

The scale of observance

The importance of scale can be demonstrated with what might be referred to as “The not so thin blue line”. It is a play on words, relating to the famous photographs of the Earth atmosphere that depicts it as a thin blue line separating space and Earth like some protective shield. It conjures a picture of a sharp edged cover, a semi-permeable barrier allowing the good stuff in and keeping the bad stuff out.

Can a finite data state space generate all information that may exist?

ANSWER: Yes. This is a trivial but important fact. One need not expand to all permutations to make rigorous proof, but to clarify the claim consider this. In the context of a computer system, all information that can exist can be represented by just 2 bits – 1 & 0. Given an arbitrary state space, let us say 1024 bits, anything that can be represented in 1024 bits can be quite obviously represented. As the scale of a state changes it is a simple step to understand that all that can be represented, indeed can be represented. It is
however important to understand that it is equally not possible for every configuration of a compressed phase space to exist distinctly as an uncollapsed wave function. Quantum information theory shows that some quantized states will carry the same probability of representing multiple final observations (in information terms the wave function before collapse is superposed). It therefore follows that in an uncollapsed state, the compressive effect may give rise to theoretically identical states that represent different final observed outcomes.

The preceding observation is in line with the rules of Shannon's information theory. One may consider this a distinct disadvantage when the considered aim of memory is accuracy. However according to the results of the Neuroplasticity Demonstrated in Quantum Neural Networks (Forshaw, 2015), these potential errors are actually fundamentally helpful to a quantum consciousness model, allowing a probabilistic system to form intrinsic semantic relationships in sparse neural networks by allowing the formation of redundancy in the cyclic feedback of a system. Forshaw states that "errors in the recovery of probabilistically stored information creates new collapsed states, these states when cyclicly recompressed and stored, facilitate the recovery of new previously unknown information or permutations of sensory information, and at such time as a systems configuration is completely mapped – at this point all imagination and creativity ceases to be". The process of compression into a quantised probabilistic state using fixed Um scaling will after a sufficient number of cycles produce a probabilistic memory map that is capable of understanding and even interpreting itself when collapsed against a suitably loaded register of sensory data.

**When data becomes information all by itself**

A simple thought experiment helps one to see how stochastic and sometimes chaotic data may form self-replicating systems.

Imagine a simple computer program such as the Mandelbrot set. The loop is designed to take input from its last output. Each iteration creates more data that is stored in some medium. When executed the program begins to generate information.

Now let's look at the creation of the program itself. The Mandelbrot set generator is a very small program, typically it can be written in less than 100 characters. Imagine now a square phase space of say 200x100 bits.

Next take a random function and begin to populate the phase space. When the space is populated, present the result to the computer and ask it to run it. There is a probability (howsoever small) that one permutation of the phase space will in fact be the executable program described earlier. At which point the computer will begin to execute the instructions in a perpetual iterative loop, creating information.

The example above of course takes no account that there is in existence a computer in the first place and so one may conclude to ask the question “where did the computer come from". Fortunately, this is a semantic issue and one that is easily resolved.

A computer is simply a mechanism that moves data. One could replace the computer with anything capable of moving data. Data in this context is taken to mean at the most rudimentary level, matter and antimatter, followed by particles, molecules and ultimately elements. In this way one can classify: The Wind, Sun, Ocean, Plasma and Universe as computer systems. They move data and sometimes information continuously. The interactions of data and information has a probability of creating new results at some scale of observance. Some of those results will form new stable systems.

**Frequency is the most primordial form of data manipulation and the foundation of reality as we understand it**

Everything runs to time. From the earliest movement of the universe, frequencies were the first information to manifest. Initially manifest in the stochastic but discreet collisions of matter and the first elementary particles to form. If one were to be able to find a recording of this, one might hear a seemingly random white noise as countless collisions took place. Amplitudes changing as particles grew in size and complexity. These cosmic scale interactions are discussed by Mae Wan Ho in her paper How the electric plasma universe creates galaxies and stars (Ho, 2015).

If we replace the computer in the preceding example with the motion of the universe and bits with elementary data, the 'stuff of the universe', the same rules of information theory apply. Eventually, stuff will coalesce into things, things...
that reject (filter) or compliment other incoming data – data in the form of particles, elements and ultimately magnetic and energetic waves of many kinds. Eventually and with a low yet certain probability these things will form symbiotic systems that become themselves 'information producing' in their own right. Over eons, data will form into particles, matter and objects. By the laws of non-linear systems, chaos theory and driven later by thermodynamic processes fuelled by heat and energy that are spontaneously created by the process, eventually the frequencies of some systems become stable.

![Image](https://via.placeholder.com/150)

**Figure 2.** All information has a 'sweet spot' - a scale at which it makes sense.

The beginning of intelligence begins with the first stabilisation of frequencies as a result of particle evolution into self-similar structures. By the same process, the birth and rotation of stars such as our own Sun, created accurate clocks by which systems could evolve in a more repeatable way. There is of course however a point at which a system might become self-regulating and no longer reliant on external frequency influences entirely. This is due thankfully to the preceding fact that at some scale, finite phase spaces may indeed form anything that can exist within the provided entropic bounds and so will with some probability be capable of forming equally competent data and information generative systems.

In Figure 2 it can be seen that the farther away the subject is, the more intelligible it seems to become. However most critically, at some point the information that was once contained in the sentence is lost as it once again becomes a single point. In essence, the information is reborn as data that once more can enter the cyclic system of information creation.

### Cyclic Frequency Stable Systems

The author introduces the term "Cyclic Frequency Stable Systems" which contribute to the creation of pseudo-cooperative self-organising and self-similar structures. One can define a Cyclic Frequency Stable System as a collection of complex units with one or more inputs and one or more outputs that by happenstance actions one upon the other to form a stable system that is resistant to external influence. For example: If one is to take a sample of simple molecules, (molecules whose size is increased by light falling upon it, and furthermore such a molecule also emits light as a diminishing proportional function of its size) and then place the molecules together in a protected enclosed space, it is simple to predict that with little difficulty the molecules will by a process of feedback summarily arrange themselves into some form of order or 'equilibrium'. As a molecule receives light it grows in size, pushing its neighbours away, simultaneously its own emitted light diminishes and so its effect on its neighbours reduces as the received light falls. This is one of many simple ways to demonstrate how stability can be created. As the number of inputs or outputs grows, or as two systems with compatible but different input/output come together, the number of ways to develop stability grows. The system described is also resistant to some perturbation. Consider if there is introduced for a short period an external light source acting on the entire system. Here the collective sample grows together. However, when the light is removed the system will recover quickly to equilibrium. These principles are indeed used with great effect in everyday technology such as semiconductors, in which free electrons move from free hole to free hole in the covalent bonds of silicon atoms.
From self-similarity at scale is born the notion of classification and symbols

Referring to Figure 2 again, we can see that at some scale of observance the sentence would quite literally become a dot, a point – ‘a bit’. At that scale we would be able to classify it. With hindsight and understanding that the ‘bit’ in our example is in fact a sentence, we can make some observations about the nature of data and information. The observation is simple: “Sometimes the same unit of data can represent multiple versions of information. Another way of saying this is that the scale of observance may at times have a compressive effect”.

The author believes this is intrinsic to the nature of the conscious apparatus. This is based on the previously determined fact that the brain is finite, yet has a seemingly infinite capacity to recall information upon demand in response to sensory experiences – whether external or internal by way of the cyclic mental workspace of the imagination.

Communications and non-purposeful signals

Communicating is defined as purposeful information exchange between 2 or more parties. At its current state of evolution, it is one of the richest cosmic creations most of us take for granted. A large amount of fruitful research is conducted in the theory and understanding of the written and spoken word, but language at our current stage of evolution is a highly convoluted and diverse system comprising many layers of already complex data relationships, so what comes before it?

“Xenolinguistics does not begin with the search for a new language, but rather the rediscovery of the language of creation that resides in us all. For here, in the simplicity of the before and hereafter is the binding code that runs through all of the cosmos.”

The language we use today whilst seemingly far removed from the simplicity of rudimentary and stochastic binary operations in space time still bears the hallmark of an information based evolution. Stories reduce to paragraph, paragraph to sentence, sentence to word, word to letter, letter to phoneme, phoneme to sound wave, sound wave to verbal motion, verbal motion to electro biological process, electro biological process to quantum mechanics, quantum mechanics to quantum thermodynamics, quantum thermodynamics to quantum information theory... finally theory to cosmology. It is the authors opinion that no complete science of consciousness is complete without adequate room for the science of Xenolinguistics. Language like all things is interwoven in to the fabric of evolution by the Third State. Space is present in all languages, sound, music and written word. Space brings meaning to otherwise meaningless symbology.

The primordial nature of sound and music to move the emotions and affect the mind need little explanation. The wondrous way that a major chord can give you Goosebumps whilst a minor chord invoke melancholy, or the way a scream of fear is understood no matter what language the speaker bears testimony to the deep rooted nature of frequency in the role of perception and consciousness. When we are touched by these most basic of nature’s communications – seldom is translation necessary.

Highly evolved communications may take the form of speech and symbols, but the most primordial information exchanges develop early on in the feedback cycles of discreet stable systems as they come together. However else you want to classify it, the repelling force of opposing magnetic poles, the expansion of a gas or the annihilation of a proton and electron to give birth to light are all forms of signal. Signals differ from communications by their lack of reliance on a response. They can be unidirectional, they can be unintentional, they can be uninformative. One might conclude that a signal is of no use unless it is observed, however most certainly its power as a communications tool is limited until the recipient of the signal might respond. Simple mathematical formulas such as a logistical formula shown in equation (1) and used frequently in population modelling are an easy way to understand the feedback process involved as 2 or more systems capable of signal generation and or reception come together.

\[
\frac{dn}{dr} = n(1-n)
\]

The continual feedback of n will model the output curve of “boom and bustiness” of a system. The output is fed back to the input and a new value is produced. The process can be modulated by variance of the variable r and for some cases a steady state can be achieved. If the output n is translated to a physical output and r the input received from another system, then causal
communication is created between the two systems. The output \( n \), might be anything from a sound, increase in heat or size. The input \( r \) may be a systems response to heat, light, sound or electromagnetic radiation. In isolation two discreet systems would normally reach equilibrium. Only when a third system is introduced (this may be a system with a monopole or unidirectional output signal) is this equilibrium disturbed. A pulsar of light falling upon the system, may cause the two systems to escape equilibrium and begin to increase and decrease in size in a oscillatory fashion for example.

**Embodied memory: The fallacy of Darwinian survival of the fittest**

The Darwinian notion of survival of the fittest implies that long term evolutionary success is attributable to some measure of intentional self-preservation. By contrast the notion put forward in this paper is that there is no intention required for evolution to take place. Consider: There are traditionally only two states of life: Alive or Dead. Success is life, Death is failure. The choice is binary. If therefore the choice is binary, it shall be governed by the laws of information theory set down by Shannon. The only addition to this binary model is what the author calls "The Third State". The Third State is simply “space” or more understandably "redundancy". In this sense Life might be seen as a point between “space (nothingness) and Death (a state not of nothingness but simply a change of state into energy that is reused by new systems)". As a system (a life or any stable structure) evolves to become stable, countless predecessors did not. It is not so much that the successful system was “fitter” or somehow “knew better”. It is rather that there were just many failures. The successful system has no "memory" of its past success or the failure of its predecessors. It simply is the current state space of a systems evolution which has reached a point of stability. There may be much to learn from the systems that did not make the finish line (Genetics, Biological engineering and chemistry are now the fields of study that are able to resurrect these failures, modify them and produce new synthesized stable systems). One could say that the memory of survival is embodied in the system itself, whilst the memory of all the wrong ways to do it are stored in the nothingness of failure (there is no past). Whilst the end result is the same as the Darwinian idea, the process is simply a matter of stochastic process governed by cosmological information change. There may be those who question this view and argue that there are some systems that have an aggressive quality. Whilst this may be true, one cannot escape the certainty of mathematical and information theory that provides the apparatus for a finite state space that allows indeterminable entropy to appear, live and die. Therefore, it is perfectly reasonable to deduce that sometimes, some systems may have aggressive or communicable ability. It is not however reasonable to assume that the evolution of all systems “depends upon it – nor even have knowledge of it”.

**Many memories stored in one place: microtubule**

It is the nature of the brains formation that it be capable of using sensory information (internal or external) to mathematically reconstruct many varying phase spaces from a single entry of information according to the input phase space and the frequency of the memory stored in the biological apparatus (i.e., microtubules, protein and other structures found in the cellular construction of the brain). Imagine that a biological structure such as a Microtubule has a nominal degree of accuracy of 512 discreet values. One may imagine that the limits of information storage are bound by that figure. However, whilst the limit of sensory information is finite in nature at the time of observation, the phase space of all possible sensory configurations is indeed infinite when viewed across all scales: for example, an Orange viewed from 100 meters is little more than a dot, at 1 meter it is clearly an Orange, at 1mm it is something altogether different. If for the sake of simplicity, we assign the value 123 to our microtubule and subject it to an iterative function to which the input is both the external sensory information, as well as the mental imagery being constantly produced by the function - then allow the output of the function to populate a finite phase space we can see that even a single discreet value is capable of producing near infinite versions of reality in a finite phase space at any chosen scale of observance.

In 2015 Van De Bogart/Forshaw published the results of an experiment that sought to store the memory of a photograph in a quantum probabilistic state (Van De Bogart and Forshaw, 2015).
2015), then using the information captured from an audio composition by the same artist attempt to reconstruct the original memory using the Toridion Algorithm developed by Forshaw -see equation (2). Where \( a \) is an array distribution of quantised values that were obtained by a proprietary quantum annealing processor. The result was the collapse of the quantum compressed memory into a highly recognisable representation of the original memory (Figure 3).

\[
I = r + \left( \sum_{n=0}^{a \neq 0} \sum_{k=2}^{12} 1(2^{12}) \right) (p^{pl}).
\]  

(2)

Forshaw’s formula used to reconstruct memory recovered from probabilistic storage by simulated quantum tunnelling. Where \( a \) is an array distribution of quantised values that were obtained by a proprietary quantum annealing processor.

Figure 3. Probabilistically stored memory data printed in a 3D format was used to visually stimulate a quantum tunnelling algorithm to recover a complex memory engram of an image stored in 16 bytes of data.

**Quantum Deterministic non-periodic systems**

A common argument against determinism is that the classical understanding of it precludes freewill. If the universe is a deterministic system, then that would imply that our fate is fully mapped out. What is certain is that some systems are clearly deterministic whilst other appear to be either random or self-directing, whether or not that self-direction is conscious or intrinsic to the system in question. The ability for apparently deterministic systems to produce unexpected output conditions or 'bifurcations' has been extensively studied. Yorke in his 1975 paper 'Period 3 Implies Chaos' (Yorke, 1975) built heavily on the work of Lorentz and his discovery that some systems demonstrate a high degree of sensitivity to initial input conditions - later fondly referred to as 'The Butterfly Effect' (Lonrenz, 1963).

"Determinism does not preclude freewill as far as freewill is intrinsically bound by the limits of itself."

An information theory of quantum consciousness as proposed by this paper suggests that sometimes stable systems develop and sometimes they do not. However, because at the quantum scale the exact state of the quantum information that makes up the classical information is in fact "uncertain" then the interaction of these systems is probabilistic rather than deterministic, but not random – quantum probability allows for stable systems that can demonstrate a high degree of classical resilience to perturbation whilst still producing irregular permutations that are neither deterministic or random. Rather that there is a strong case for systems whose cyclic rhythm is tied to the feeding back of its own output and also the output of other systems that may or may not modify both the outbound and inbound.
communication that the system has access to. As a symbiotic systems composition grows into a macro system and eventually an ecosystem, it is probable in statistical terms that some systems may develop that are able to both filter and react to these signals in such a way as they could be classified as 'causally self-observant. A complex ecosystem whose stability is reliant on the complex interactions with many others will grow in capability and entropic possibility whilst at the same time remaining inside the bounds of the matrix that contains it.

“...The introduction of causal self-observance in quantum deterministic stable ecosystem is the birth of the consciousness and rational freewill...”

Once causal self-observance is attained, freewill is permissible, but not without limitation. Freewill is mistaken to mean that all things are possible. The author strongly postulates this is incorrect. Freewill can only operate within the degrees of freedom that are bounded by the entropic ceiling of the larger ecosystem in which it resides. For example, whilst we might like to think fondly of popular inspiration in the form of "You can achieve anything you set your mind to" - it is clear this is nothing more than folly. Rather you can imagine many things such as growing wings and flying, but clearly the laws of gravity in your parent system say otherwise. The author then seeks to reframe freewill to mean simply: "you have freewill to do anything that the laws of science and the universe will permit at that point in time and space". A quantum information theory of consciousness has more than enough room to accommodate freewill in these terms. To escape determinism one needs probability in the equation.

Those who would argue that we might fly by imagining an aeroplane and subsequently building it in order to take flight, only then to attribute that act to freewill are missing the point. Our ability to extend our entropic possibilities by extending our own system by the manufacture and interaction with another system is not limited by quantum determinism – crucially however, the act of discovering artificial flight is not itself an act that either extends our separate capability to fly as a standalone system without assistance from another.

Conclusion

The conclusion is that the brain is both biologically constructed and operationally dependent on many of the accepted principles of quantum mechanics. That due to its finite biological size and complexity, the maximum classical storage capacity of the brain has a ceiling limited by classical information theory. To exceed this limitation, the molecular structures of the brain use a probabilistic form of memory storage and retrieval and that this method allows not just for more efficient storage, but more importantly avoids low entropy stagnation by constantly pruning and redefining memory units in a probabilistic fashion. Probabilistic memory schemes as discussed and demonstrated by Van De Bogart and Forshaw facilitate the storage of many memories in a small number of locations in such a way that they can be recovered selectively by another field (or stimulus) that approximately created them. In simple terms Van De Bogart and Forshaw demonstrated that a single uncollapsed quantum memory state could be collapsed into many equally valid recognisable constructs (or system outputs) depending on the object or stimulus currently in view (Van DeBogart and Forshaw, 2015). Additionally, the paper proposes that reality is a function of the present configuration of physical mind, feedback created in the mind and the stochastic information that is received in the form of sensory information (whether through the understood sensory channels or otherwise by way of indeterminable forces, for example 'Electromagnetic Radiation'). The author postulates that the self can influence the state of the wider quantum field by its actions and subsequently the implication is that consciousness resides both within and outside the mind. Furthermore, that the present state of mind whilst it is a product of past interactions, it has no relationship to it other than the present. In that sense, every second is a clean slate in terms of self, giving rise to indeterminable possibilities.
References


Forshaw S. Neuroplasticity demonstrated in a Zero Logic Quantum Neural Network. 2015.


Ho MW. How the electric plasma universe creates galaxies and stars. 2015.


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Suppressed Intuitions, Large Number Coincidences, and a Mathematical Foundation for Life and Consciousness

Maurice Goodman

ABSTRACT

A brief examination of the natural sciences reveals that we are still under the influence of pre Copernican intuitions. These have only been suppresses and not supplanted. This is why we appeal to such things as large number coincidences in the hope that the mathematics, which unlike us does not suffer from naive beliefs, will lead us in the right direction. However, we need to be extremely careful as it is easy to create these coincidences and over interpret their significance. In the 1980’s work on these coincidences did lead to a mathematical formulism which seems to have relevance in our universe. This led to a suggested link between the biological cell, the weak force and the electron neutrino and suggests a new approach to consciousness studies that is gradually gaining ground. The mathematical formulism also suggests a new arrangement for the natural sciences which is more appropriate in a post Copernican world.

Key Words: natural science, large number coincidences, uncertainty principle, electron neutrino, weak force, biological cell, consciousness


1. Introduction

The front cover of the March (2015) edition of National Geographic proclaims that there is a “war on science”. In a related article in that issue Joel Achenbach (2015) points to our intuitions, and the realization that scientific knowledge only suppresses but does not supplant earlier intuitions (Shtulman et al., 2012), as the cause of this war. This means that these old intuitions are still there deep in our subconscious mind and are the source of this continual confrontation. That, in turn, raises the question as to whether earlier intuitions, long since discredited, are still influencing how we view science today.

Before Copernicus we believed: (1) that the earth was the centre of the universe and (2) that human beings were the most significant species at that centre (Anthropocentrism). After 500 years are these discredited intuitions influencing how we currently view science? Below, in Figure 1, you can see how we arrange the fundamental natural sciences to this day.

The first thing to notice is we still consider earth science (believed suppressed) despite the fact that there are tens of billions of earth like planets orbiting at earth like distances around sun like stars in our galaxy. It, in turn, is only one of billions of galaxies in our universe. In summary, earth science is a natural science but it is not fundamental.

More significantly, without good reason we divide the natural sciences into two main branches, life (biology) and physical. This suggests that life science is somehow special (belief-2 suppressed) and is not physical (of matter) even though biological structures are clearly made of matter. The effect of this is to cut...
life science off from any physical or mathematical underpinning which is preventing progress in a whole host of life sciences from cell biology to consciousness studies (Goodman, 2015). A mathematical and physical underpinning must be found so that theories supporting these sciences are built on solid mathematical foundations instead of relying on discredited intuitions and baseless conjecture. The motivation for looking at large number coincidences is to provide a mathematical foundation for, not just the life sciences but, all the natural sciences, structures, particles and forces in our universe.

2. Large Number Coincidences

A recent paper in this journal (Roy et al., 2015) wondered if Dirac's large number hypothesis could be related to consciousness as the ratio of the time scale of 40Hz oscillation in neuronal systems in the brain and the Planck time was \(10^{40}\) like other large number ratios found in nature.

Large number coincidences began with Hermann Weyl (1919) and were taken up by Arthur Eddington (1931). Our intuition tells us that the reoccurrence of large numbers of similar size in nature must point to some underlying physical or mathematical principle. In 1980 my intuition told me this must be the case also and I was bewitched by these coincidences. However, such intuitions can be right or wrong so much care and experimental verification is needed before any conclusion can be arrived at. These large number coincidences are what prompted Paul Dirac to write a short letter to Nature (1937) proposing the large number hypothesis in the first place. This hypothesis became very influential in the first half of the twentieth century because it intuitively seemed reasonable. However, the hypothesis is not yet proven and hence it would be unwise to use it as a basis for building a theory of consciousness.

Also it must be remembered that when this hypothesis was being developed only two of the four forces of nature were known. This meant only one possible ratio could exist between “large” gravitational structures and “small” electromagnetic structures and therefore this hypothesis only included the known natural sciences of Astronomy and Chemistry. It is a minimum requirement that any valid hypothesis developed from such coincidences must apply to all four forces of nature. In summary, we need to be extremely careful when considering old unproven hypotheses and attaching significance to any such ratios found in nature.

Following from this, the appearance of a ratio of \(10^{40}\) between 40 Hz oscillations in the brain and the Planck time is not in itself significant. It is easy to create these ratios. For example, the following ratios are also all approximately equal to \(10^{40}\):

\[
\frac{M_{\text{star}}}{M_{\text{pl}}} \approx \frac{R_{\text{Ceres}}}{R_{\text{pl}}} \approx \frac{M_{\text{elephant}}}{M_{\text{neutrino}}}
\]

where \(M\) is mass and \(R\) is size. Ceres is the largest asteroid in our solar system, \(M_{\text{pl}}\) and \(R_{\text{pl}}\) is Planck mass and length respectively and \(M_{\text{neutrino}}\) is the soon to be measured electron neutrino mass which is \(~10^{-37}\) kg. However, none of these ratios are likely to have much significance either.

It is even easier to over interpret the significance of these ratios. For example, any ratios that involve Planck mass, length or time intuitively leads to the association of that ratio with the gravitational force and quantum gravity. This is because the gravitational constant \((G)\) forms a part of all three Planck parameters. It is what, I believe, happened to Hameroff and Penrose (1996) whose need for quantum non-computability in consciousness was at the base of their reasoning. Appealing to the Planck scale, and hence gravity, was the only conceivable way, at that time, to draw quantum mechanics into a non-computable model of conscious thought. This, I believe, is also happening in the paper of...
Roy et al. (2015). In their conclusion they have already stated that there is a need to study the effect of gravity on synchronized oscillations in the brain. That does not logically follow from what appears to be just another arbitrary ratio involving the Planck time and hence gravity.

The main problem with such an association with brain processes and consciousness is that the length and time scales associated with the Planck parameters that characterize quantum gravity are $10^{-33}$ m and $10^{-43}$ s respectively. These are way too small to be associated with the relevant dynamical scales in brain processes either from a multicellular dimensional (> $10^{-5}$ m.) or millisecond time scale perspective.

However, it is still a legitimate question to ask if there is any significance to these ratios and more importantly do these coincidences lead to new ideas that can be applied to the universe as a whole i.e. not just two but all four forces in the universe and all structures found in the universe and maybe ultimately to life itself. This idea was explored in detail during the 1980’s and the findings published, against a background of substantial resistance (Goodman, 2001) from mainstream science journals, in the 1990’s (Goodman, 1994; 1997) and a brief summary is given here.

3. Maths underpinning large number ratios

The large number coincidences formulated by Eddington that attracted Dirac’s (1937) attention were the ratio of the electric ($F_E$) to gravitational ($F_G$) forces, between a proton and electron, and the ratio of the mass of the universe $M_U$ to the mass of a proton $M_P$ which happened to be the square of the first ratio. These ratios are also equal the ratio of the radius of the Universe $R_U$ to the radius of the proton, $R_P$. That is:

$$\sqrt[2]{M_U/M_P} \simeq R_U/R_P \simeq F_E/F_G$$

eqn. (1)

The question is, do these ratios imply something fundamental that applies to the universe as a whole? This question is complicated by the fact that the numerator in the first two ratios is ill defined. After all, the universe is made up of all the structure we know and all we don’t know. However, the first two of these three ratios seem to imply that there may be a general relationship between the mass of structures found in the universe and their size as follows:

$$M \simeq kR^2$$

eqn. (2)

Where, $k$ is constant. If this equation is to have any relevance it must apply to all masses in the universe. This, to good approximation, turns out to be the case (Figure 1 in Goodman, 1994) with $k$ having a value of ~0.5 kg m$^{-2}$. All structures found in the universe lie along or close to the $M \simeq kR^2$ line.

Also relativity sets the maximum speed at c(speed of light) in the universe. This means that the maximum uncertainty in momentum any mass $M$ can have is $Mc$. The momentum/position version of the uncertainty principle therefore implies there is a minimum mass that can be confined to any region of space ($R$) given by:

$$M \geq \frac{\hbar}{Rc}$$

eqn. (3)

where $h$ is Planck’s constant. Taking eqns. (2) and (3) together (Goodman, (1994; 1997)) an infinite series of minimum masses can be calculated with each mass defining the next mass in the sequence given by:

$$M_n = M_\infty (M_0/M_\infty)^{(-0.5)^n}$$

eqn. (4)

where $n$ has any integer value 0, ±1, ±2, etc.

$$M_\infty = \hbar/cR_\infty$$

and

$$R_\infty = \frac{\sqrt{\hbar/kc}}{c}.$$
nature (Figure 3 in Goodman, 1994). A recent portrayal of that figure is shown in Figure 2 below.

![Diagram of mass series linking structures, particles, and forces](image)

**Figure 2.** The mass series links structures, particles and forces in a very precise way (Colour version of the content from Figure 3 of Goodman, 1994).

Note that in this arrangement Physics is not considered a natural science as it is not the science of any particular structure found in nature. Instead it acts as an interface between mathematics and all the natural sciences. This allows us, for the first time, to begin to build a science of Biology and hopefully a science of consciousness eventually with a mathematical and physical underpinning.

**4. Implications for life and a proposed model for consciousness**

This mass series requires there to be a link between the electron neutrino mass, the weak force, and the biological cell and predicts the mass of the electron neutrino to be $\sim 0.16 \text{ eV/c}^2$ that is soon to be verified (Goodman, 2015). My intuition at the time told me this prediction could not be right. This was a result of my indoctrination during my undergraduate studies which had led me to believe that the weak force could not build any structure found in nature and could only be responsible for radioactive decay. However, over the last twenty-five years the arguments against such a link have weakened substantially and the arguments for such a link have continually grown ever stronger (Goodman, 1994; 2015).

The second and third large number ratios, in eqn. (1) also suggest that the relative strength ($S$) of the force keeping a structure together is inversely proportional to the size ($R$) of the structure. As previously stated this relationship, to have any significance, must apply to all forces of nature in the universe and must apply over our entire range of experience from the largest of structures (galaxies) to the smallest of stable structures (nucleons) i.e.

$$S = \frac{\text{Constant}}{R}$$

The constant in eqn. (5) turns out to be $R_\infty$. This leads to a relative strength for the force associated with the biological cell of $10^{-9}$ which just so happens to be the relative strength of the weak force.

Furthermore, the general form of a force ($F$) operating in a three dimensional universe is given by:

$$F = \frac{Shc}{2\pi r^2}$$

where $S$ is the relative strength of the force and $\hbar$ and $c$ have the usual meaning and $r$ is the distance. The binding energy ($E$) is then given by:

$$E = \int F \cdot dr = -\frac{Shc}{2\pi r}$$

Thus the decoherence time for the collapse of the wave function of a quantum superposition over a distance $r$ is given by:

$$\frac{\hbar}{2\pi E} = -r/5c$$

This leads to a decoherence time for the weak force over cell distances ($10^{-5}$ m.) of $10^{-4}$ s and over brain dimensions (10 cm plus) of 1 second. Those time scales correspond precisely to the relevant dynamical timescales of brain processes once again suggesting that the weak force and the electron neutrino are intimately associated with life processes and biology in general. In so doing
it also brings quantum effects up by six orders of magnitude from the atomic to the cellular and inter-cellular domain by virtue of the fact that the uncertainty in position of the electron neutrino, given that it's predicted mass is of the order of 0.16 eV/c², will be \(10^{-5}\) meters. These quantum effects will also be at least six orders of magnitude more subtle than electromagnetic quantum effects in atoms and hence are likely to be very difficult to observe directly. This would explain why we have not noticed such quantum effects in biology before now.

The value of the work summarised in this and the previous section is, after a quarter of a century, finally being recognised as potentially important in the area of consciousness studies in Chapter 13 of a new book by Nunn (2016).

5. Toward a model for Consciousness

It has been proposed (Goodman, 2015) that nucleons will be able to swap spin over cellular and intercellular distances through weak interactions as follows:

\[ \text{Figure 3. Possible mechanism for spin swapping, via a neutrino/antineutrino pair, between nucleons over cell and intercellular distances (Goodman, 2015).} \]

What this Feynman diagram shows is that two nuclei could interact over cellular distances, without violation of the uncertainty principle, by virtue of the fact that the electron neutrino has such a small mass. This \(Z^0\) interaction involving the emission of a neutrino antineutrino pair is already known to exist. Therefore, such a proposal seems reasonable.

Ignoring, for one moment, all the electromagnetic effects of neurological processes in the brain, the brain will consist of a 3d matrix of approximately \(10^{24}\) equally spaced (\(\sim 10^{-10}\) m) nuclei. These could interact with each other over cellular distances via the weak interaction with spin up and down corresponding to the 0's and 1's of a normal computation and the nuclei themselves corresponding to the computers components that flip between 0 and 1. In this way the electron neutrino via the weak force may mediate the 'back action' of the conscious mind on the brain's neurology (Nunn, 2016). A brain could potentially process up to \(10^{24}\) floating point operations per second. This is Yotta flop scale computing which is a hundred million times more powerful than the Tianhe 2 computer (the most powerful supercomputer in existence today). However, this analogy with computing must not be taken too far as brain processes and conscious thought are believed to be non-computable.

\[ \text{Figure 4. Arrangement of the Natural Sciences based on large number coincidences, relativity and the uncertainty principle.} \]

6. Conclusion

It is quite shocking to think that, after 500 years, our current thinking on the natural sciences still suffers from pre Copernican intuitions. These discredited intuitions are causing us to arrange the natural sciences as we do today. This is preventing a physical and mathematical underpinning for all the life sciences and related sciences such as consciousness studies. A theory built, in the 1980’s, from large number coincidences leads to a completely new arrangement of the natural sciences. The theory, to good approximation, predicts the key masses and structures, all known fundamental particles and all known forces of nature in a very
precise way. The theory also insists on a link between the weak force, the electron neutrino and material self-organization in general and the biological cell in particular which is an outstanding example of such self-organization. It also provides for the correct dynamical time and distance scale which correspond to those actually encountered in the brain. This theory also leads to the following new arrangement of the natural sciences.

The fundamental natural sciences are astronomy, biology, chemistry and nuclear science with the other life sciences and earth science being no more/less important than any other of the myriad of specialized branches (fields) of natural science. It is only when we can accept this, will we finally be free of our pre Copernican naive intuitions. This new arrangement reinstates Biology as a physical science. But, there is no place for Physics as it is not the science of any particular structure found in nature. Physics acts as an interface between mathematics and all the natural sciences. In this way we have a mathematical and physical foundation for all the natural sciences. The new arrangement also suggests that if any science deserves the title of fundamental it is nuclear science as no structure (atoms, cells, galaxies etc.) would be possible in the universe without the existence of the nucleus inside the atom.

Finally, this theory allows us, for the first time, to begin to build a science of Biology and ultimately a theory of consciousness based on the weak force and electron neutrino that has a solid mathematical and physical foundation.

References
Roy S. Bhattacharya S. Sreekantan BV, Dirac’s Large Number Hypothesis: Is it related to 40 Hz Gamma Oscillation or consciousness. NeuroQuantology 2015; 13(3): 253-258.
Mushroom Sacraments in the Cults of Early Europe

Carl Anton Paul Ruck

ABSTRACT
In 1957, R. Gordon Wasson, a professional banker and amateur mycologist, inadvertently launched a profound cultural change that has come to be called the Psychedelic Revolution, by publishing an account of his experience with a Mazatec shaman in Hautla de Jiménez in the mountains of central Mexico. The article appeared in Life magazine and was intended as publicity for his forthcoming Russia, Mushrooms, and History, in which he and his Russian-born wife Valentina Pavlova pursued their lifelong fascination with their dichotomous attitudes toward fungi, which had led them to suspect a cultural taboo upon a sacred object. In 1968 he traced this taboo back to the Vedic Soma, which he identified as a psychoactive mushroom. The identification, if correct, implied that there should be evidence for a similar sacred role for the mushroom in other regions in antiquity where the migrating Indo-European people settled. In 1978, he proposed such a role for the visionary potion that was central to the mystical experience of the Greek Eleusinian Mystery, that was celebrated annually for two millennia at a sanctuary near Athens. The possibility that the ancient Greeks indulged in chemically altered consciousness is antithetical to Europe’s idealization of Classical antiquity and the proposal was largely ignored. Mushrooms, however, were fundamental to social norms and religious observances in the celebration of Dionysus, and figured in other Mystery cults and in the foundational traditions of many cities, including Mycenae and Rome. The Soma sacrament as the Persian haoma was proselytized to the West by the Zoroastrian priests of Mithras and became a major cohesive indoctrination for the Emperors, army, and bureaucrats who administered the Roman Empire. It survived the Conversion to Christianity in the knighthoods of late antiquity and the medieval world, and was assimilated to the Eucharist of certain of the ecclesiastical elite.

Key Words: mushroom, ergot, Dionysus, Apollo, Mithraism, Renaissance art, prehistoric rock art

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Marital Crisis
In Mushrooms, Russia and History (Wasson and Wasson, 1957), R. Gordon Wasson and his Russian-born wife Valentina Pavlova pursued their fascination with fungi, dating back to 1927, when upon their delayed honeymoon they first became aware of their dichotomous attitudes to something so simple and fundamental as mushrooms. The subject had never arisen in their five years of courtship. In a walk through the forested Catskills before supper at a friend’s loaned mountain chalet, she discovered that the path was strewn with lovely mushrooms that he considered all loathsome toadstools. As a marital
avocation while they each engaged in their separate careers, hers in medicine and his as an investment banker, they began collecting occurrences of mushrooms in European folklore, literature and art, which culminated in the deluxe two-volume compilation published just shortly before her death.

They had come to suspect that the difference, which they termed mycophobia and mycophilia, betrayed some religious taboo upon a sacred substance, traceable back to the earliest prehistory and somewhat mysteriously still surviving into modern times, perhaps as some kind of archetypal folk memory. The mushroom's sanctity is reflected in the absence of a name for something too sacred to name (Ruck, 2010). The natural growth, which can be classified as neither plant nor animal, is designated by metaphors or distanced as foreign words imported into the language. Among the mycophilic Slavs, there are more than forty designations, while the mycophobic Anglo-Saxons have only four, the foreign imports, fungus from Latin as metaphorically a 'sponge' and champignon from the French as a product of the 'field.' Mushroom is similarly an import from Late Latin through the intermediary of French mousseron. It, too, is ultimately a metaphor, derived from the verb mussare, which is onomatopoetic for making the sound of mooing or bellowing cattle, and hence a bovine zoomorphism of the mushroom (Ruck, 2015a). The only truly Anglo-Saxon name is the toadstool, describing it as a folkloric chair upon which is seated a loathsome toad, secreting the psychoactive toxin bufotenine, which it shares with certain fungi.

The intermediary status of the mushroom's classification, moreover, is reflected in its abundant occurrences in folkloric tradition, where it functions as the ultimate mediator between oppositional forces and concepts (Toporov, 1985). This dichotomy inevitably suggests the divide between the realms of life and death, and the mushroom lends itself readily to zoomorphism and anthropomorphic materializations as guides or modes of transport across the intervening frontier.

**Ps ychedelic Revolution**

This suspicion of the mushroom's primordial sanctity had led the Wassons in 1953 to the southeastern Mexican village of Huatla de Jiménez in the mountains of Oaxaca, where they were introduced to the diviner Aurelio Carreras and his mother-in-law María Sabina. Gordon and Valentina participated as outsiders in a mushroom ceremony, an evening rite or velada, that had been kept as a carefully guarded secret of the indigenous people. The Wassons included an account of the events in _Mushrooms, Russia, and History_, but intentionally buried in the text, where it generally escaped notice and elicited little attention. Gordon innately abhorred sensationalizing his discoveries. In 1956, he read a short carefully worded paper before an association of Classical scholars in Philadelphia describing his experiences in Mexico, but in the ensuing discussion he intimated that the mushroom cult might shed light upon the Greek Mystery religion of Eleusis and the name of the city of Mycenae. One of the metaphors for the mushroom in Greek is mykes, as slimy and 'mucous.' Shortly later he received a letter from a friend of some thirty-five years advising him to keep his focus on Mexico and avoid implicating Classical antiquity. Nevertheless, there is a mythical account that a Greek hero Perseus plucked a mushroom at the site of the ancient city, and the monster Gorgon Medusa, whose head he similarly harvested as a golden apple with a pruning hook, was recognized in antiquity, in hermetic funerary contexts, as a mushroom (Ruck, 1978).

The pursuit of this same intriguing suspicion of a mushroom cult in Europe had already brought Wasson and his wife in 1952 to the Plaincourault chapel in central France, where a Romanesque fresco of the Temptation episode in the biblical Garden of Eden had been suggested as early as 1911 as depicting the Tree of Knowledge in the guise of a psychoactive mushroom (Marchand et al., 1911). They were advised, however, by a noted art historian that the resemblance was purely fortuitous and that medieval artists customarily painted trees in the stylized likeness of mushrooms. If they had looked across the Chapel at the opposing wall by the entrance, however, they would have noticed a mysterious scene that is not without relevance to the interpretation of the Tree of Knowledge. Another mushroom hovers in the air, in the guise of a red blacksmith's hammer, labeled by an inscription in dialectal Old French as the key of heaven. The fresco depicts the miracle of Eligius, the Chapel's namesake and patron saint. The mushroom is identified as the miraculous steed.
that has brought the Lord to the blacksmith's smithy to shoe His horse's single foot. Eligius is named as the patron of the 'E lect,' those privileged to see the Lord (Ruck et al., 2007). The horse as the miraculous entheogenic transport occurs also in the birth of the flying Pegasus from the severed neck of the plucked Medusa's head. Wherever Pegasus touched down, a magical spring of inspiring waters burst forth, for which reason he is named as the 'Fountain Horse.'

Partly as publicity for the forthcoming publication of Mushrooms, Russia, and History, Wasson made public an account in the now legendary 13 May 1957 issue of Life magazine of his mushroom-induced visionary experience in 1955 with the Mazatec shamanic healer María Sabina, whose identity he attempted to mask under the pseudonym of Eva Mendez, thereby divulging and greatly popularizing the secret and inadvertently launching a flood of tourism to the remote mountain village and the ensuing cultural phenomenon that has come to be termed the Psychedelic Revolution. Albert Hofmann had discovered LSD in 1943, but it went without public notice until Wasson's magazine article, and within ten years Life published another article about LSD as a therapeutic drug that had gotten out of control. The patrician Wasson was a most unlikely person to play such a role and he distanced himself from the notoriety of the several leaders who rose to prominence in the resulting turmoil of recreational drug abuse, countercultural politics, and religious innovation.

Soma

Gordon retired from banking in 1963 and in the afternoon of his last day at work, he boarded a friend's merchant ship that sailed to the Far East, pursuant to the same theory of the mushroom's sanctity in the Old World that he and his wife had found among the indigenous peoples of Mexico. Two years later, he returned from the Orient and settled in Danbury, Connecticut, to work on the evidence he had gathered, resulting in the publication in 1968 of Soma: Divine Mushroom of Immortality, written with the aid of the young Indologist and Vedic scholar Wendy Doniger O'Flaherty, who now holds the Mircea Eliade professorial chair at the University of Chicago (Wasson, 1968). Wasson had heard of the reportedly intoxicating Soma as a teenager from his father, an Episcopalian clergyman, who wrote a book on God and alcohol and brewed spirits in his basement during the era of Prohibition.

Soma is an unidentified deified but not personified plant in the Vedic Sanskrit texts, carefully preserved as an oral tradition dating back as early as the mid second millennium BCE and committed to writing only after the rise of Buddhism, the earliest in the first century BCE, but mostly toward the end of the first millennium CE. The same sacred plant was known to the ancient Persians as haoma (sometimes deified), a dialectal version of the same name, described in the sacred texts of Zoroastrianism called the Avesta, which is so titled since they are the sole surviving examples of the Avestan language, a liturgical Old Iranian tongue closely resembling Vedic Sanskrit. The surviving texts where similarly transmitted by oral tradition dating back probably to the mid second millennium BCE, but finally committed to writing in the third century CE in the Sassanian era, which replaced the Parthian Empire and continued as the ruling dynasty until its overthrow by the Muslims in the mid seventh century.

Since Zoroaster is not so much a personal name as a profession meaning 'astrologer,' it is difficult to date the first occurrence of the priest who held the title, and some would place him a millennium later. The first Zoroaster (Zarathustra) is probably a figure of mythologized history. He revised the Hindu polytheism, elevating the solar deity Ahura Mazda ('Illumination Wisdom') to sole monotheistic primacy, with the heroic Mithras as mediator with the human realm. Many elements of the Mithras story coincide with the Greek hero Perseus of Mycenae (Ruck et al., 2011). Since the Zoroastrian priests or Magi proselytized their faith, their concept of monotheism may be the original source of the ensuing monotheistic religions, including the mid second millennium heresy of the Egyptian pharaoh Akhenaten.

Wasson proposed that the primordial botanical identity of this Soma/haoma plant was a mushroom, in particular the psychoactive Amanita muscaria, commonly called the fly agaric for its apparent ability to attract and kill flies. The physical characteristics of the divine plant as transmitted in the formulaic oral tradition are difficult to interpret since some may be metaphoric and others are open to a variety of linguistic interpretations, but remarkable for a plant, there seem to be no indications of a flower,
leaves, or roots, attributes unique to a mushroom. The Soma ceremony was specifically intended to induce a state of intoxicated ecstasy that produced spiritual health, renewal, and immortality through mystical communion with deity (Spess, 2000), and was an entheogen. The theory had a controversial reception, with some proposing other candidates, most commonly cannabis, opium, and ephedra (Syrian rue) (Flattery et al., 1989). Residues of all three have been detected in archaeological remains of temples were the haoma ceremony was performed in sites as early as the mid second millennium BCE, as well as indications that the may have involved animal masks in the ritual, implying initiatory experiences of zoomorphic transmogrification (Bennett, 2007; Sarianidi, 2007). The cannabis was apparently used to fumigate the chambers. It is probably ephedra that is depicted in ancient portrayals of the Magi priests carrying the barsom bundle of twigs, and it still is used along with pomegranate in living Zoroastrian practice among the Parsis today, where the ancient haoma is called hom. There is also a tradition in contemporary practice that the ritual is purely symbolic, with only commemorative token sub-threshold amounts of the entheogen administered. It appears to be a customary tendency for religions to revise their history in denying the ecstatic nature of the original rites (Ruck et al., 2013), which in all probability have continued unabated, restricted for certain groups of the elite, or survive among marginalized and isolated adherents of the religion.

Syrian rue (Peganum harmala) is a bright green, dense, twiggy herbaceous succulent with conspicuous white flowers that grows in arid desert conditions. It has established itself as an invasive foreign import in the American Southwest. Its acts as a monoamine oxidase inhibitor (MAOI) and hence can function in the preparation of brews like ayahuasca to prevent digestive destruction, but evidence of its psychoactive properties in isolation is sparse and debatable. It is the source of the dye called Turkish red, employed in carpet weavings.

Wasson argued that although a variety of surrogate substitutes were employed as the tribal migrations moved into new areas that did not present a suitable habitat, the fungus best matched the characteristics as fossilized in the transmitted oral tradition, including its transfer and persistence into the excreted urine in a more potent potentiated form. This latter characteristic can be interpreted as culturally pejorative, but it is documented in Siberian shamanism which employs the Amanita muscaria. There is also a tradition of therapeutic urine drinking in Ayurvedic medicine. Wasson would later discover the use of the fly agaric and its urinous metabolite among certain indigenous people of the New World, as disclosed to him by Keewaydinoquay, a shaman of the Anishinaabeg (Ojibwe) of the region around the Great Lakes (Keewaydinoquay, 1984).

**Mushroom Surrogates**

In 1975, the art historian Stella Kramrisch, a specialist in Indian art and Hinduism, who held the professorship of South Asian Art at the University of Pennsylvania and was a curator at the Pennsylvanian Museum of Art, demonstrated that one of the first surrogates for Soma was a mushroom, not a psychoactive variety, but chosen for its symbolism as a mediator between death and spiritual transcendence (Kramrisch, 1975). Its corpse-like putrid stench was transmuted into fragrance in the firing of a ritual clay vessel, which represented the decapitated head of the deity Makha, analogous to the fungal materialization of the Greek Gorgon. One of the earliest depictions of the Gorgons occurs on a colossal seventh-century pithos urn that once served as a grave monument along the sacred road to the Mystery sanctuary of Eleusis. It depicts them with pots for heads, suggesting that the pot-headed females were anthropomorphisms of the potion that was the original content of the vessel.

In 1982, Wasson similarly discussed a non-psychoactive mushroom that appears to have been a surrogate for the original Soma. Gautama, the first Buddha (sixth to fourth century BCE), did not die, but by his own volition, it was claimed, since he had achieved such complete control over his physical body, he simply ceased living, the Great Demise, as it is called (Wasson et al., 1982). As he was traveling with his entourage of monks to the place that he had chosen for this termination, he was offered hospitality by a blacksmith, who served them a meal of mushrooms. The role of a blacksmith as culinary host is an unlikely detail, except as mythologized history, and probably implicates the motif of the alchemical smithy (Ruck, 2015a). Brahmans can eat no mushrooms since they grow from unclean smithy (Ruck, 2015a). Brahmans can eat no mushrooms since they grow from unclean matter, but since all plants have a similar manner of growth, the prohibition betrays a probable taboo upon a sacred substance. Gautama decided,
at this critical moment of his life, that he alone could break the prohibition and accepted this last meal, that he denied his entourage.

**Eleusinian Mystery**

After the publication of *Soma: Divine Mushroom of Immorality*, and before the appearance of such confirmatory evidence, it was argued that if the Soma/haoma sacrament was indeed fungal, there should be indications of a similar sanctity of the mushroom in other regions that the Indo-Europeans occupied in their migrations, beginning at the start of the second millennium BCE, away from the central Asian highlands that was considered their ancestral homeland, mythologized in Greek tradition as the Hyperborean country of the people who lived in a Apollonian paradise beyond the North Wind. Wasson returned to his intimacy about the Greek Eleusinian Mystery and enlisted a team that included the Swiss chemist Albert Hofmann. In 1978, they published *The Road to Eleusis: Unveiling the Secret of the Mysteries* (Wasson et al., 1978). It has been reprinted three times in commemorative successive decades. Mystery religions in antiquity involved something that the initiates were bound to keep secret. Plato describes the experience as a face-to-face visionary encounter with deity. The Judaic Neo-Platonist Saint Paul of Tarsus employed the same metaphor in describing what he called the Christian Mystery (Ruck, 2014). At Eleusis, this happened annually, predictably on schedule simultaneously for groups of several thousand candidates on a single night after the drinking of a special potion, whose ingredients were well known: kernels of barley and a common insecticide called fleabane, 'stirred' or mixed in an aqueous solution, for which reason it was termed the *kykeón* ('stirred with a circular motion,' cognate with 'cycle'). The simultaneous access to face-to-face mystical vision for thousands on a single night annually for over a millennium would be difficult to interpret as anything but an experience of shamanic communion with divinity induced by a psychoactive agent, and in this case the precise formula is an element in the recorded tradition.

The fleabane would seem the most obvious candidate for a toxic substance, and it had been proposed already as early as the nineteenth century. It, however, is not visionary, nor is its toxicity accessible in the miniscule concentration in the *kykeón*. Its role is symbolic, representing a wild plant, in contrast to the hulled barley groats, which are the products of cultivation. The fleabane, moreover, was personified as the water nymph Minthe, fragrant with the scent of mint (for which she is named), in which person she was the perfumed whore of the netherworld lord Hades, abducted without the sanctity of marriage and hence the enemy of the matrimonial rite and civilized patriarchal culture. In Greek cultural tradition, the transition from matriarchal dominance to patriarchal revisionism marked the transition to Classical antiquity and the reign of the twelve Olympian deities, headed by the father god Zeus. Emblematic of that transition was the imposition of monogamous matrimonial control of the husband over his wife. The goddess Demeter vented her anger on this minty whore by grinding her with a mortar and pestle into a residue of despicable fragrance. In botanical nomenclature, fleabane is *Mentha pulegium*, where the specific name is an adjectival form of *pulex*, the Latin for 'flea.' In English it is commonly called 'pennyroyal,' where 'penny' is a corruption of *pulegium*. The honorific description of it as 'royal' (from the Old French *pouliol royale*) probably derives from its association with the Mystery.

In the year 415 BCE, it was discovered that numerous prominent citizens of Athens had been profaning the Eleusinian rite in their private homes by using the *kykeón* as a recreational drug with friends at their drinking parties. As parodied on the comic stage at the time, it was precisely evidence of the profane drinking of the potion that implicated the culprits. The accused were brought to trial and executed or else fled into exile, with the resultant confiscation of their properties for sale at public auction. The death penalty seems to have pertainned only to divulging the secret of the Eleusinian Mystery, and specifically for profane use of the *kykeón*. The ancient Greeks had access to many intoxicating herbs and substances to flavor and fortify their wines, as was customary, and fleabane certainly was not worth the formidable hazards of breaking the prohibition against the sacred drink. Socrates was parodied on the comic stage at the time in Aristophanes’ *Birds*, as profaning the Mystery in a rite of necromancy, in which he summons a troupe of fantastic anthropomorphisms that are easily identifiable as mushrooms. The most obvious is the tribe of Shade-foot creatures, who have but a single foot, with which they hop vigorously about until they
tire, whereupon they fall upon their backs and slumber under the shade cast by the broad uplifted single foot that resembles a parasol (Ruck, 1981). Another of these anthropomorphisms was the Tongue-in-bellies, with a bulbous head that comprised their entire body, supported on their conjoined legs like a single support. They, too, not only are easily recognizable as fugal creatures, but in this configuration they blasphemously resemble the hermaphroditic dwarf who first served the specified kykeón potion as the etiology for its role in the Mystery initiation.

**Ergot Mushrooms**

The Wasson team demonstrated that the psychoactive agent in the kykeón was derived from the complex of numerous toxins present in ergot (*Claviceps purpurea*), a fungus that is parasitic on grain. Hofmann proposed that the active chemical was ergonovine, which is the only one that is water soluble and thus easily separable from the other toxins, some of which are potentially lethal and responsible for ergotism, causing gangrenous dermal lesions, hallucinations, and convulsive muscular twitching. Ergonovine, however, is only slightly visionary, if at all. Nevertheless, ergot often figured in medieval potions and the common nucleus of the ergot alkaloids is lysergic acid. In 2000, Peter Webster and Daniel Perrine revised the theory, identifying the active agent as ergotamine, a vascular dilator commonly prescribed in sub-threshold amounts combined with caffeine for the treatment of migraine (Webster, Perrine, and Ruck, 2000. Ruck, 2006). Ergotamine by partial hydrolysis (i.e., combining with water, but not a dissolution) in an alkaline aqueous solution yields ergine (LSA, lysergic acid amide), which is the same substance known as the visionary *ololiuhqui*, extracted from the seeds of certain morning glories in the shamanism of the Maya and Aztecs of ancient Mexico. LSD does not occur in nature, but LSA resembles it and is a natural substance.

The mycelia (root-like growth) of the ergot invade the parasitized grain kernels, causing enlarged purplish red sclerotia (hard bodies), protruding from the sheaf like cock's spurs, for which it is named (from the French *argot*). All mushrooms have a similar mode of growth, with the mycelia permeating large areas of ground, sometimes, as is the case with the Amanitas, living in mycorrhizal symbiosis with the roots of certain trees. The mycelium of the sclerotium, when the ergot falls to the ground and absorbs moisture, enters its fruiting stage, yielding tiny mushrooms visible to the naked eye, thereby identifying the ergot-infested kernel as apparently the seed of the otherwise seedless mushroom. Mushrooms propagate by microscopic spores, which were not detected in antiquity. Hence ergot mediates between the totally wild mushroom and the cultivated grain.

**Primitive Grasses**

The alkaline aqueous solution would have been produced by the addition of wood or bone ash to the water. This, also, represents a mediation, since the ashes constitute the residue from burnt offerings, the remains of sacrifice. The intrusion of the phallic plowshare into the symbolic vulva that is the furrow of the plowed field, converting it from the natural wilderness to cultivated arable land, is a sexual affront upon the sanctity of Earth, which must be appeased by a compensatory offering. In mythical tradition, the first plowman was sacrificed in the field he plowed, and the rite was repeated symbolically at each annual first insertion of the plowshare in a special field allocated for the inaugural plowing (Ruck, 2015a).

The sheaves of cultivated barley represent the cultivated antithesis of wild inedible grasses. Such edible grains were hybridized from more primitive grains. The most primitive is spelt (*Triticum spelta*), so named because it fruits with spikelets consisting of only two ‘split’ red grain kernels. These spikes obviously resemble the ergots of *Claviceps purpurea*. Hybridizing, moreover, is an ongoing process. Without continual human intervention, the hybridized grain would regress to its more primitive grassy manifestations. This is clear, for example, in the hybridizing of Indian corn by the indigenous peoples of the New World. If the cob falls to the ground, the next shoots that sprout from the entire ear will crowd each other out, so that their stalks grow progressively weaker and shorter, reverting to primitivism.

Weeds similarly infringe upon the healthy growth of the cultivated grains. A common weed in fields of grain is darnel or tares (*Lolium temulentum*). Its botanic nomenclature defines its species as ‘drunken,’ although it contains in itself no intoxicating chemical. Its reputation in antiquity as an intoxicant that induces altered
eyesight derives solely from its common tendency to host the parasitic ergot, to which it is particularly susceptible. Darnel produced a cheap bread of proverbially poor quality, responsible for hallucinations. It threatened the cultivated crop, not only by competing for space, but also by contamination from its parasitic fungus. The ergot was called rust (Greek *erysibe*, Latin *robiga*) in antiquity, by which metaphor it not only designated its red color, but also likened it to the metallic oxidizing corrosion that causes the iron tool to revert to the natural ore. It is hence emblematic of cultural recidivism.

The grain goddess Demeter/Ceres bore the epithet of *Erysibe* and wore slippers of reddish purple. In folkloric tradition, the ergot is metaphorically a pack of grain wolves, led by the grain Mother, rustling through the sheaves of fruiting grain, leaving the protruding infested kernels as ‘wolf teeth,’ that are also the iron teats of the goddess, who seduces children to come and nurse, rendering them maddened. A red dog was the annual victim of choice in Roman times to ward off the threatened infestation of ergot. The redness of the dog not only matched the color of the rust, but also associated it with the fox, which was interchangeable as a canine with the wolf, and hence the red dog represented also the primitive ancestors of the domesticated canine. There is also a mythical tradition that the rust scraped from a sacrificial knife was the antidote for the sexual impotency of a boy who had feared that he was the designated human victim.

**The First Plowman**

The potion of the Mystery initiation thus combined the wild and toxic fleabane, with its connotations of primitive sexuality, and the grain of the cultivated field. The connotations of the latter represent the grain goddess Demeter, who in the etiological myth for the Mystery is reconciled to the marriage of her daughter Persephone to her former abductor, Hades, the lord of the netherworld. The seed of grain must similarly be entrusted to the earth, in order to be risen. The mother relinquishes her daughter to the household of her husband, and the lord of the realm of death becomes related as an in-law to the celestial realm of the mother and her fellow Olympians. At the moment of the vision in the Mystery, the candidates, who had journeyed in the spirit to the netherworld, resurfaced in the initiation chamber at the moment that Persephone ratified her marital union to the otherworld by giving birth to the Mystery child, who was ultimately the first plowman. In mythical tradition, the celestial daughter had taken a seed of pomegranate into her body as she exited the netherworld, thereby contaminating her ethereal nature with physical matter, rendering her a creature that belonged to both realms. The pomegranate was named for its seedy bloody red matrix as the fruit of the menstrual ‘flux.’ Ergot figured in the pharmaceutics of ancient midwifery both to stimulate uterine contraction and to control postpartum bleeding.

The ergot as the cultivated fungus was the multifaceted mediating agent in the potion. The efficacy of fleabane as an insecticide probably commemorates the similar toxicity of the fly agaric or ‘kill-fly’ (*fly-bane*, French *tue-mouche*). All noxious insects, moreover, lend themselves to identification with malevolent spirits. There were two stages to the Mystery, however, for which reason the rite is usually designated by the plural. The Mystery, like all the Panhellenic sanctuaries, underwent a patriarchal revision in the seventh century, reinterpreting rites of the Bronze Age, dating back to the mid second millennium, and probably even earlier. The Lesser Mystery commemorated not this patriarchal revision and the consummation of the marriage in the birth of the child, but the unsanctioned abduction, which in the mythical tradition was occasioned by the picking of a wild plant called the *nárkissos*, so named for the narcosis that it induced. This rite was enacted six months earlier and involved not the mediating ergot fungus, but its primordial identification as the wild mushroom. The sole participant for the Lesser Mystery was the noble woman who bore the titular role of Queen of Athens, attended by her female sisterhood of assistants, who prepared her in a secret ceremony for her sexual engagement with the deity in the guise of the bellowing mushroom in a sacred chamber called the bull stall, opened just once a year for this ceremony. The role for the so-called Queen dates back to the traditions that predate the patriarchal revision of Greek culture occasioned by the advent of the deities in their restructured personae as members of the twelve Olympians.

**Reception**

The reception of *The Road to Eleusis* was generally unenthusiastic, with one eminent scholar entertaining the theory, probably merely as a
curtesy to the Swiss Hofmann, but misunderstanding it and concluding that by all reports ergot poisoning was an unpleasant experience (Burkert, 1987). A recent book on the Bronze Age archaeology of the Eleusinian sanctuary (2015), in the obligatory initial overview of the religion, employs the word entheogen (which implies the acceptance of the concept that a psychoactive substance is animate with deity), but considers the argument speculative and concludes that the best explanation of the kykeón is that it offered a fortifying refreshment to end the daylong preliminary fast of the candidates, who had walked the exhausting twelve miles across a mountain pass along the Sacred Road from Athens (Cosmopoulos, 2015). A couple of groats of uncooked barley stirred in an aqueous medium with an insecticide is an unlikely nutritional boost. As recently as 2013, an article on ritual vision at Eleusis that promises a summary of ‘learned reconstructions’ of what it calls ‘scopic regimes’ includes no mention of entheogens or The Road to Eleusis (Petridou, 2013). A new textbook of Classical Mythology, makes no mention of the kykeón in its summary list of the different possibilities proposed for the Eleusinian Mystery over the centuries, and although it claims to place the ancient myths in the context of cross-cultural traditions and contemporary debate, it censors the subject of drugs and dismisses Mithras in half a sentence as something popular in the second and third centuries CE (Maurizio, 2016). Classical scholarship is resistant to the notion that drugs played a role in ancient society. Similarly, an exposé of drug expertise in Classical culture has caused its author to be shunned in the profession (Hillman, 2008).

Wine and Mushrooms

The mushroom, however, is not confined to the Eleusinian rite in Classical antiquity. It is fundamental to the symbolism and rituals of the god Dionysus, the deity of wine, drama, and the ecstatic communion with divinity. The ritual emblem for the mountain revels was the thyrsus, the hollow stalk or peduncle of a giant reed, stuffed with ivy leaves. Magical plants must be gathered with rituals that address their indwelling potencies as entheogens (Geniusz, 2009). This often involves fantasies of sexual engagement and birthing. The thyrsus is the receptacle for the gathered plants. Thus it was interchangeable with the nartex as a term. This latter lends it name to the giant fennel (Ferula communis) or nartex. The Latin botanical nomenclature classifies it as a ‘rod,’ and the Greek nartex has the obvious etymology as the ‘narcotic container.’ Several ancient compendia of medicinal herbs were titled Nartex. When Perseus plucked the Gorgon head at Mycenae, he placed it in a kibisis. This container has a similar significance. In ancient depictions, it is seen as a wide open-mouthed sack slung upon the arm. It is the bag, as still used today, for harvesting apples and other fruits, allowing the harvester to catch the fruits picked or pruned from the tree with the other hand (Ruck, 2015b). Because of its mycorrhizal symbiosis with the subterranean roots of its host tree, the Amanita mushroom was seen as a fruit of its tree, equally with the magical golden apples fruiting on its uplifted branches.

As with the wild growths that yielded to cultivation in the planting of barley and other grains, the grapevine had primitive antecedents. Most emblematic of these was the ivy, whose leaves and diminutive berries were intoxicating in their natural state, whereas the leaves and fruits of the grapevine are edible. Upon the crushed grapes, however, can be grown wine as a civilized intoxicant. The ivy leaves stuffed into the thyrsus represent the natural toxins that predate the evolution of viticulture. The other plants cited for the mountain revels had a similar symbolism. Among these are smilax (bindweed or wild morning glory) and bryony (wild cucumber). Like ivy, both physically resemble the grapevine and its clustered fruits, but they are toxic in their natural state. European folkloric tradition (Grimm, Muttergottesgläschen) identifies the morning glory as intoxicating, perhaps analogous to the ololiuhqui of the New World (Ruck, 2014). Sometimes the ivy atop the thyrsus/narthex is replaced with a pinecone. In this configuration, the rod symbolizes the ecstatic experience accessed by the gathered magical plants or entheogens. The pineal gland is so named for its resemblance to the pinecone and was identified in antiquity as the gateway of the soul for transcendence.

The grapevine, moreover, is obviously a cultivated vine since it requires annual pruning to fruit. In this regard, it is analogous to the olive, which is the plant most emblematic of civilization as evolved from chaotic primitivism. Hence, the olive branch is symbolic of peace, and a wreath of olive and an amphora of its oil were awarded to victorious athletes. Mythical tradition identified
the olive tree as the transmutation of a mushroom transported from the Hyperborean homeland in central Asia, and it was commemorated as such in the annual secret botanical offering supposedly sent from there to the sanctuary of Apollo on the island of Delos (Ruck, 1983).

The fermentation process was correctly recognized as a fungal growth. Mushrooms themselves were called a ‘fermentation of the earth.’ Significantly in ordinary culinary nomenclature persisting as late as the fourth century CE, the stipe of the mushroom was called its thyrsus, with the cap representing the psychoactive plants stuffed into its stalk. In the case of the Amanita mushrooms, the toxins are largely present in the cap. Prominent in the metaphoric accounts of the mountain revels is the encounter with the mooing and bellowing bovine zoomorphic manifestations of the mushroom. A fragment of a fifth-century tragedy about the hero Perseus describes the ground bellowing with fruiting mushrooms. Whatever the revelers did on the mountainside, the drinking of wine was never an element. The rite symbolized the ecstatic rapture encountered through the wild plants that predated the evolution of the grapevine. The mooing bovines in myth, moreover, are always in heat, stung by the bite of the cow fly (Tabinus bovinis), who was personified as the spirit of their herdsman prodding them with the sexual lusting of the estrus, sending them into wild dancing (Ruck, 2015a). The tradition survived into medieval Europe, spreading northwards from the Greek settlements in Southern Italy, where it was known as the tarantella, the mad dancing fever mimicking satyrs.

In Vedic and Avestan traditions, wine, although the most obvious intoxicating candidate, was never a surrogate for the entheogen, probably since it represents the antithesis of the wild mushroom. From the latest antiquity in the fourth or fifth century CE, Nonnus of Egyptian Panopolis in his Dionysiaca describes the fight between Dionysus, returning with his revel entourage from their conquest of the Indians of the Indus Valley, and the supporters of the Greek Perseus, a battle that epitomizes the antithetical contest between the wine triumphant and the aboriginal mushroom of Mycenae and the Hindu Soma (Ruck, 2014). The contest of Perseus versus Dionysus ends without victor since Hermes intervenes to reconcile the two brothers, both sons of Zeus. In this ultimate conflict, Dionysus employs the diamond as his weapon. It was reputed to have the power to repel all venoms, deflecting even the toxicity of the mushroom that was the Gorgon head. As an opponent of Dionysus, Perseus is fulfilling the same role as Pentheus of Thebes and Lycurgus of Thrace, who both opposed the advent of the civilizing gift of wine. Lycurgus, as the ‘Wolf-worker,’ has a name that associates him with traditions of lycanthropy, and Pentheus, as the ‘Suffering’ complement to the Joy of Dionysus, was decapitated by the revelers, who placed his head atop the thyrsus as the analogue of the ivy and the other wild plants gathered on the mountainside amid the mooing of mushrooms.
The Wine Mix

Like the mediating potion of the kykeón, wine was a mixture that honored the toxins that predated viticulture by adding them to the vinous medium. Thus wine was customarily drunk diluted with three or four parts water, but even diluted it was extraordinarily potent. As little as a pint of diluted 4% alcoholic content drunk over a period of several hours in a succession of rounds could induce extreme intoxication. Only four rounds could result in mental derangement, and further drinking ended in a brawl. Alcohol itself was unknown as the intoxicant in antiquity. Distillation of liquids was not discovered until the fourteenth century CE, when the distillate was named alcohol by analogy to the process for metallic distillates and equated to the quinta essentia (quintessence, the ‘fifth’ quality) that Aristotle had postulated as the element of the celestial bodies that permeated matter as the spiritual soul (Ruck et al., 2012). This clearly derives from the ancient tradition that the wine served a sacral function. Since the alcohol produced by natural fermentation is limited to around 13%, after which concentration the aqueous environment becomes too inhospitable for continued growth of the fermenting yeasts, the toxicity of the wine was due to these fortifying herbal additives. These included even deadly poisons like hemlock in sub-lethal dosages and venom milked from serpents. This tradition survives in the modern Greek folk wine of retsina and in the demotic naming of the drink not ‘wine’ (iwolinois), but the ‘mix’ (krasi). A recent archaeological discovery of an intact wine cellar from the mid second millennium BCE confirms the presence of psychoactive additives to the wine (Ritter, 2013). The tradition survives in certain rural wines of Europe today fortified with substances such as the dermal secretions of salamanders and toads.

The additives represent the toxins that predated viticulture. One of these additives appears to have been actually a mushroom. A Greek fifth-century red-figure hydria found in a cemetery of ancient Ainos (modern Enez, Turkey) depicts what is obviously a cultic scene, probably relative to the funerary rites performed for the burial of the deceased. A mushroom is highlighted as a special ingredient to be added along with other plants (perhaps bryony or smilax) to the mixing of a pithos urn of wine (Ruck, 2014).

Maronian Wine

The Thracian provenance of the hydria vase suggests that this particular wine was the legendary wine of Maron, a priest of Apollo and a descendant of Dionysus. In the Homeric Odyssey, Odysseus uses this wine to intoxicate the Cyclopes Polyphemus. It was so potent that it would have required twenty parts of water for dilution. In the Roman period, a vineyard was still marketing a version of this heroic wine. On the testimony of the Roman governor of the region, it still required eight parts of water to be drunk safely. The blinding of the drunken Cyclops is depicted on the neck of the Eleusinian pithos, above the scene with the jug-headed Gorgons. The two scenes are probably complementary. A single tear in the shape of a mushroom drips from the eye of the blinded Cyclops. Both scenes are decorated with graphic designs termed grecas, which are interpreted as representations of entoptic vision, the onset of chemically altered sight, where the eye begins to see the coursing of the blood flow across the retina (Wasson, 1986). Such whirling graphics are documented from prehistoric rock art. This mushroom-infused wine is particularly associated with Thrace, where archaeological evidence indicates that a mushroom cult existed dateable back at least to the generation before the Trojan War and the mythical tradition of Orpheus and the sailing of Jason with the troupe of Argonauts (Markov, 2008, 2014; Kiotsekoglou, 2014; Samorini, 2012).

In addition to the numerous megalithic natural rock formations that resemble mushrooms, a cave at Thracian Ismara/Maroneia that served as a sanctuary presents a fungal likeness in the configuration of its entrance, two adjacent openings like eyes with an overhanging rock configuration giving the impression of a stipe as nose supporting a mushroom cap as forehead, imparting a fungal face of the goddess to the mountain (Kiotsekoglou, 2014). The design resembles the fifth-fourth-century BCE marble bas-relief votive plaque of Eukrates found in the excavation of the Eleusinian sanctuary, the ex voto of a blind man who saw the vision; it depicts his eyes, with the goddess rising above against a hemispherical red cap as a sunrise. The same configuration of visionary eyes and fungal nose bridge occurs on silver and gold tablets found in the seventh-century Thracian sanctuary of Demeter at Mesimvria Zone. Persephone as a head rising from the ground was the essential vision at the Eleusinian Mystery sanctuary, and she is so
depicted, attended by satyrs, on Greek vases. The fourth-century coinage of Thracian Maroneia employs the motif of the bunch of clustered grapes in the configuration of a mushroom. The fungal head of Persephone bears comparison to the prophetic head of Orpheus, of which there were several in caves throughout Thrace, from which could be read oracular responses, interpreted from the enigmatic magical markings on its surface (Ruck, 2014). Like Penteus, Orpheus was decapitated in a Dionysian revel. Orpheus was cited as the founder of the Eleusinian rite, and although he belonged to the generation before the Trojan War in the mid second millennium BCE, he was also involved in the seventh-century patriarchal reorganizing of the rite, indicating that Orpheus is obviously a figure of mythologized history. There are two sources for the Mystery that combine and are reconciled in the patriarchal revision, one is from Minoan Crete of the goddess with the opium poppy, and the other is the Thracian Orphic origin, which involves the reciprocal complementary opposition of Apollo and Dionysus. Athens was a mythical relative of Thrace through the abduction of their princess Oreithya by the north wind Boreas as she was gathering magical plants with a group of maidens called the Pharmacists. The pre-patriarchal revision of the Eleusinian rite involves the wild plant cited as the nárkissos in the etiological myth of Persephone’s abduction. The actual plant is probably the sea daffodil, Pancratium maritimum, which is illustrated in Minoan frescoes and a gold signet ring, depicting women with bee-heads gathering flowers in a visionary context, and on Mycenaean sacral swords. As its Latin nomenclature as ‘all-powerful’ (as in the athletic contest of the pancratium) suggests, the daffodil is psychoactive. It is not difficult to see that the flower resembles the vulva surrounding the reproductive stamens and pistil. By the Roman period, this daffodil had become identified as an ingredient compounded with olive oil in an unguent used by the Magoi Zoroastrian priests of Mithras to confer grace and power. This inevitably involves it in the tradition of the haoma sacrament, for which reason it was also identified as an orange-red flower. The opium of the Minoan goddess was similarly commemorated in the transition to the patriarchal revision as the pomegranate that inseminated Persephone to engender the Mystery child, since the red fruit of the pomegranate resembles the capsules of the opium poppy, similarly filled with its profusion of seeds.

Common to all the Thracian megalithic sites is their proximity to a water source, a river or a fountain spring, often haunted by a nymph, whose male mate is the river. A similar motif occurs at the Eleusinian sanctuary with the Sacred Well that lies beside the great portal to the sanctuary. The water from this well was spilled from two urns in the ritual of the ‘full-pouring’ (Plemochóë) as the inauguration of the Mystery, accompanied by the words written on the wall beside the double-gated entrance, ‘Rain! Conceive!’ Thus the goddess was invoked to birth the Mystery child that would culminate the ceremony.

The megalithic Thracian monuments often served as markers for organized necropolises or cemeteries. Many Greek and Anatolian phallic tombstones from all periods survive in the shape more correctly recognized as a mushroom. The asymmetry of the glans is never shown, nor the urinal duct nor the testicles, and the knob is often flat or spherical. Both the duct as an ‘eye’ and the testicles, in contrast, were elements commonly included in the sculptural and painted representations of the phallus and its metaphorical deployment on the comic stage. As the scholarly authorities on Greek burial customs concluded, none of these tombstones bear the slightest resemblance to the organ which the Greek artists knew so well and the only group of objects which they all can be said to resemble is toadstools (Kurtz et al., 1971). In fact, ‘mushroom’ appears to have been a metaphor for both the erect penis and for the burial coffin or the tomb.

A tombstone from Dascylion in ancient Bithynia on the shore of the Black Sea presents a particularly fine example of these ancient mushroom tombstones. The deceased Lysandra is depicted seated between two butterfly Psyche souls, like Celtic fairies, in a niche carved into the cap of the mushroom. Hermes as the escort of souls is carved into the stipe as a herm-pillar with penis, flanked by dogs or wolves.

**Ionian Enlightenment**

The Greeks obviously came into contact with the Achaemenid Persians in the sixth century through the expansion of their empire, which ushered in the period known as the Ionian Enlightenment and would culminate in the two wars at the
beginning of the fifth century with the invasions of Darius and his son Xerxes ten years later. The sixth-century philosopher Pythagoras of Samos was initiated into the haoma rites while a prisoner in Persian-controlled Egypt. Ovid described what Pythagoras experienced as a journey in the spirit to the deities far-off in space to drink down with his eyes what Nature denies to human vision. In addition, disgraced aristocratic Greek politicians commonly sought asylum with Persian satraps and participated in their secret initiatory ritual (Ruck et al., 2011). Their haoma sacrament, however, was known much earlier at least by the mid second millennium as [h]ó̑momi, which is the original for the moly (mólu) of the Homeric tradition, the plant that Hermes gave to Odysseus as an antidote for the drugs of the sorceress Circe.

On the comic stage of Athens of the Classical period, this Persian sacrament was well known and associated with Thracians. In Aristophanes’ Wasp (422 BCE), it was visionary, inducing clairvoyance, and described metaphorically as a herded bull, and a lethal potion of its blood in a scene enacted by two Thracian slaves in an obscene routine of mutual fellatio, with the mushroom identified by its common metaphor as an erect penis whose ejaculate induced a Persian nodding sleep. It bellowed when strenuously erect with a snotty discharge, punning upon the mooing mykes and mucus (Ruck, 2012).

Among the Thracians, the mushroom cult was still empowering their kings as late as the first century BCE, as it did Darius, as witnessed by a Greek doctor assigned to the Persian court, in an intoxicated celebration of Mithras reserved solely for him. The cult also appears to have been the basis of lycanthropic rites binding their elite into a brotherhood of warriors. One of the Scythian contingents in the Persian forces was named the Saka Haomavarga, which means the ‘Haoma wolves’ (Gershenson, 1991). The lycanthropic transmogrification was known to the Homeric tradition, as narrated in Odysseus’ encounter with the Thracian horseman Rhesus in the Iliad. The event was also the subject of the Rhesus tragedy attributed to Euripides, when the dead horseman is cited as involved in Thracian Mystery rites (Ruck, 2014). Rhesus is probably a version of the Thracian god Sabazios or Zalmoxis. Darius’ troops also knew of the mushroom’s metabolite in urine. These are instances of a widespread cult better known among the Nordic berserkers of the medieval period, who materialized on the battlefield as wolves or bears, but which can be traced back to antiquity. The Emperor Trajan confronted it in his encounter with the Thracian Dacians, named for the ‘wolf’ and who bore into battle the ensign of their wolf-serpent Draco, bellowing in the wind. The Emperor was met by a Dacian shaman who read a warning to him off the markings on a mushroom cap.

Lycanthropy

The particular mushroom that fits the parameters of all these indications is the Amanita muscaria. It alone of the fungi is documented as inducing heightened physical strength and heroic fury in battle, and the scabby white remnants on its expanded cap allow a written message to be interpreted from its surface, and it alone is noted for its superior potentiated metabolite in urine. Many other Indo-European tribes were similarly named or associated with the wolf, and the common ritual indoctrination of the adolescent males into packs of wolves is documented among the ancient Spartans. The deity presiding over these packs as the assembly of his herd was the god Apollo, and he is the deity in Greek tradition involved in the motif of lycanthropy. As herdsman, he was invoked to protect the flock from the depredation of the wolves, but as the wolf god he also culled his flock as recipient of human victims.

In the evolution of Greek culture, Apollo was distanced from his darker persona and his lupine manifestations as the ‘wolf’ (lykos) were given a false etymology derived from the ‘light’ of the sun and its solar illumination. Lykios was fancifully associated with Latin lux for ‘light’ and Greek leukós for ‘white,’ and Apollo’s epithet was explained as derived from the ‘sun shining and making everything white.’ The god’s tenuous claim to the light of day, however, is reflected in the word for the dangerous marginal time of the dawn and the twilight as the ‘wolf-light’ (lykóphas). Similarly, the liminal threatening time when werewolves were abroad, the ‘wolf-walk’ (lykábas) was forced to mean the ‘path of the sun’ and glossed as a period of time, perhaps a year. The fulfillment of a period of time, however, implies termination or the temporal end, when the ultimate victim would be required. In the traditional antithesis between Apollonian and Dionysian modes of cognition, Dionysus assumes the burden of Apollo’s lycanthropic involvement, freeing his brother to preside over the transmutation of toxicity into the entranced
indoctrination of adolescents into the military

The homoeroticism was ritualized in the psychoactive or funereal plants (Ruck, 2015a). Cyparissus, who all metamorphosed into chosen victims, like Hyacinthus, Daphnis, and 1976). This is true also of Apollo’s tradition of them all invo
etymology of their names and the motif of the lore of entheogens, with both Ion and Iamos toxins, it is a beloved son like Asklepios, patron of druggist/doctors (iatroí), or Ion of Athens, eponymous ancestor of the Ionian tribal group, or Iamos, the founder of the brotherhood of shamans at the sanctuary of Olympia. The mythical tradition of them all involves them in the botanical lore of entheogens, with both Ion and Iamos providing opportunity for poetic elaboration on the etymology of their names and the motif of the iós arrow toxins derived from sacred plants (Ruck, 1976). This is true also of Apollo’s homoerotic chosen victims, like Hyacinthus, Daphnis, and Cyparissus, who all metamorphosed into psychoactive or funereal plants (Ruck, 2015a). The homoeroticism was ritualized in the indoctrination of adolescents into the military packs of wolves. There was a tradition that even the Castalian Spring was named for the maiden who was the first of the many victims tossed into its waters from the twin cliffs high above.

Orpheus of Thrace was another of these beloved victims (Ruck, 2014). Despite his devotion to the solar manifestation of Apollo, he is named as the ‘Orphan’ from the light of his deity and was harvested as a primordial psychoactive anthropomorphism in the Dionysian revel. In the case of Kyknos (Cygnus), named as the ‘Swan,’ his grieving sisters metamorphosed into trees whose tears fell as lumps of amber. Such resinous discharge of trees was the commonly supposed origin of mushrooms, and all of these figures have a similar involvement ultimately with the fungus (Ruck, 2015a). Kyknos himself metamorphosed into the swan, which as Apollo’s special bird, sings the swansong, the first and last utterance it ever makes, superlative, beyond all imagining, being the description of the paradise beyond this life to which the deity sends his victims.

Phrygian Cap

The lycanthropic motif is the origin of the Thracian/Phrygian cap. It provides the botanical name for the mushroom’s cap as the pileus, implying an anthropomorphized creature beneath it wearing it as its hat. It had a long continuance through medieval and Renaissance tradition until modern times as a marker for initiates into the secrets of the ancient Mysteries (Ruck et al., 2011). The Phrygian cap was originally a fox pelt, complete with snout and ears, sometimes the entire animal (Ruck, 2014). The Thracian reveling plant gatherers of the pre-viticulture Dionysus were named for this pelted cap. The fox is a canine analogue of the wolf, and its pointed snout and red color were stylized in the drooping felt versions known as the liberty cap, awarded to liberated slaves, although the original liberation freed the initiate from the restrictions imposed by the human condition.

The red cap is as ubiquitous as the little creatures that materialize in the lore of Europe, most notably in the tale of ‘Little Red Cap’ (Rotkäppchen), known in English as ‘Little Red Riding Hood,’ and the episode of lycanthropy and with a similar ultimately ethnobotanical referent (Ruck et al., 2007). The English title predates the Grimm brothers’ collection, and the ‘riding hood’ as a term for the Phrygian cap indicates that the

At Delphi, the original mid second millennium sanctuary was the Wolf Cave on Mount Parnassos, one of the largest subterranean cave complexes in Greece, with a succession of forty chambers leading deep within the sacred mountain. A rock formation within its entrance presents the likeness of a wolf. As the deity transitioned to his revised patriarchal Apollonian persona, the sanctuary was moved to its present location ever since the seventh century lower down the mountain, and the Cave above was entrusted to Dionysus or Hermes. The ecstatic revels there were still celebrated as winter rites of plant gathering well into Roman times, during which period Apollo would absent himself from the sanctuary. As a commemoration of his more ancient manifestations, he was forever linked, however, to the Wolf Cave since the oracular priestess would prepare herself for her ecstatic possession by the god in the below-ground chamber at the back of the Temple by bathing in the Castalian Spring that flowed from the subterranean lake within the Cave to surface at the base of the twin cliffs that loom above the present Temple sanctuary and she was named the Pythoness, after the former hermaphroditic serpent deity who once resided within the Wolf Cave as an oracle of Earth, instead of the Olympian Zeus as father of Apollo.

When it is not the brothers Dionysus or Hermes who assume the burden of Apollo’s displaced darker person and his involvement with deadly or mind altering wild and primordial toxins, it is a beloved son like Asklepios, patron of druggist/doctors (iatroí), or Ion of Athens, eponymous ancestor of the Ionian tribal group, or Iamos, the founder of the brotherhood of shamans at the sanctuary of Olympia. The mythical tradition of them all involves them in the botanical lore of entheogens, with both Ion and Iamos providing opportunity for poetic elaboration on the etymology of their names and the motif of the iós arrow toxins derived from sacred plants (Ruck, 1976). This is true also of Apollo’s homoerotic chosen victims, like Hyacinthus, Daphnis, and Cyparissus, who all metamorphosed into psychoactive or funereal plants (Ruck, 2015a). The homoeroticism was ritualized in the indoctrination of adolescents into the military
heroine of the tale is on a journey that will culminate in sexual awakening with her aged grandmother as initiator and a lupine transmogrification in the belly of the devouring wolf. Digestion is a metaphor with alchemical implications of transcendence. Nineteen-century illustrations of Little Red's encounter with the wolf often include the fly agaric growing in the woodland scene, which would seem to indicate that the illustrator was privy to the secret.

Eggshells

The etiology of the red cap was explained as the remnants of the egg from which the twin Dioskouroi (Dioscuri) were hatched, each wearing a half shell. As such they were cited as patrons of the Mystery of the Great Gods (Mégaloi Theoi) of Samothrace, which was second only to the great Eleusinian rite in antiquity in reputation and importance. The twins were inseparably bound to each other. Although only one of them was mortal, the son of Zeus, while the other was mortal, the son of their mother Leda's husband Tyndareus, they vowed to share their dual fate, dying together on alternate days, and returning the next. They obviously imply a similar aspiration and sometimes with wings, is the Greek version of the Mysteries for the initiates as they sailed the perilous voyage through life, and hence the twins were cited commonly as patrons of seafaring, although their true significance refers to a metaphysical journey. They could be represented as two adjacent amphorae vessels of the Mystery's Thracian wine of Maron, especially potent from its fungal additive, whose toxicity is indicated by the serpents entwining the vessels. Numerous drinking cups that were the property of the priesthood survive in the ruins of the Samothracian sanctuary, leading the archaeologist who excavated the site to conclude that excessive drinking to the point of intoxication was clearly an element in the Mystery (Lehmann, 1954). Similar rites involving the same complex of deities occurred elsewhere, and drinking from special sacred vessels was always an element, with the cups then shattered to exclude them from later profane usage.

The Dioskouroi could also be depicted as two posts, representing the half eggshells of the curved red caps, joined by a crossbeam, as if they were Siamese twins, before their separation. In this configuration, they resembled their cousins, the Moliones, who were similarly hatched from a single egg, but joined at the waist as Siamese twins (Ruck, 2015a; Ruck et al., 2001). They are the mythical prototype of the spherical primordial humans that were sliced in half like an egg in Aristophanes' tale of the Hermaphrodite in Plato's Symposium. This tradition of the Siamese twins encodes another attribute of the Amanita muscaria that identifies it as the magical plant that sprouted from the liver of the tormented Titan Prometheus that served as food for eagles (Ruck, 2015a). Eagles' fare is a version of raven's bread, a metaphor for the mushroom, because of the birds' fondness for the Amanita (Klapp, 2013). As food for the thunderbird, it occurs also in indigenous North American tradition. Medea plucked the Promethean mushroom to compound the dermal unguent that she entrusted to Jason (Iason) to fortify him with the superior strength that allowed him to yoke the fire-breathing bulls, with which he plowed the field to sow the primordial toxic crop that sprouted from the fangs of a monster serpent. He is named Jason, like Ion and Iamos, for his involvement with this iōs toxin.

Dumbbell

Medea cut the root of this Promethean plant amid the sound of bellowing and mooing from the earth, and it is described as growing with a double stem (kaúlos didúmos), not a branching stem. It is, more exactly, a 'twin' stem. The epithet of the Dioskouroi was the 'Twins, 'Didúmoi, and they became the constellation Gemini. This encodes a riddle since no plant grows from the earth with a twinned stem, side by side, except the Amanitas. As the subterranean nodule or egg that develops from the mycelium into the fruiting mushroom expands, the stem or stipe/trunk extends in both directions, pushing the base apart from the cap, shattering the eggshell, producing a shape like a dumbbell, easily recognizable when plucked from the ground. It is also the traditional shape of the sacred thunderbolt that inseminated the mushroom at its conception from the heavens, meshing celestial fire in the wet matrix of matter. The thunderbolt of Zeus in this dumbbell shape, often with conventional lighting flashes attached and sometimes with wings, is the Greek version of the vajra thunderbolt of Indra, and in Buddhism it is symbolic of the thunderbolt experience of Bodhi or 'awakening.'

The Mystery child could be depicted also as emerging from the cosmic egg, pushing the two hemispherical eggshells apart, marked with the signs of the Zodiac as indication of the milk.
transcendent return to the celestial realm (Ruck et al., 2011). This double-stemmed herb of Prometheus, moreover, was the same color as the plant involved in the rituals of the Wolf Cave at Delphi and in the birth of Ion of Athens in the cave beneath the Acropolis. In this version, the plant goes by the name of Krokos (crocus), chosen for the phallic appearance of the blossom as it emerges from the earth. In mythical elaborations, Krokos was anthropomorphized as another adolescent who fell victim to the deity, and he was linked with another lover called Smilax or ‘bindweed,’ and they both represent the primordial plants that predate the evolution of viticulture. The crocus is analogous to the nárkissos and Minoan frescoes depict both monkeys and maidens gathering it. The monkey was emblematic of little primordial humanoids, and they were mythologized in the figure of the Kerkopes, whose name designates them as having the appearance of a ‘tail,’ indicative of their fundamental phallic identity. They survived in European folklore as the German Kobald, the French gobelin, and the puck of England, ecstatic mischievous little creatures, like fairies, in the entourage of the Dionysian plant-gathering revel.

Phallic Grotesqueries

Although the Dioskouroi were depicted as idealized youths, they were analogues of them in the Mystery of Samothrace that made them dwarfish and ithyphallic, since the cult of the Great Gods encodes the secret that the divinities were actually great in power, but the opposite in stature. The Dioskouroi were warriors and a fanciful version of them occurs as the Kaulomykétes, little men comprised of the ‘stem’ (kaúlos) uplifting the mushroom caps as a shield above their heads. These creatures must obviously be no bigger than mushrooms themselves. This stem, moreover, was a common metaphor for the erect penis, which reduces the entire anthropomorphism to its phallic function as the ‘mushroom’ penis. As Kaulomykétes, the little warriors have an asparagus stem as their sword, a vegetable of choice for its phallic thrust and its noticeable effect on the scent of the urine (Ruck, 2015a).

In this configuration with uplifted shield, the Dioskouroi mushroom warriors are analogous to another of their anthropomorphisms in the Mystery of the Great Gods as the Corybants (‘helmeted-dancers’) and the Curetes (‘boys’). Although they, too, are idealized youths, they sprung from the fingers of Rheia, the mother of Zeus, as she grasped the ground in labor. The Cretan Caves on Mount Dicte and Ida, where Zeus was born, were equated with the sacred Zerynthian Caves on Samothrace and throughout Macedonia and Thrace as sites for the Mystery. The Corybants danced ecstatically, clashing their shields to drown out the sound of the baby’s birthing and are typically depicted with shields uplifted and standing on a single foot. The pose is symbolic and it appears also in depictions of Mithras, where it encodes the same fungal identity of the haoma sacrament (Ruck et al., 2011). Mithras himself is traditionally attended by two male torchbearers, who always stand with their legs crossed, making them essentially one-footed and also symbolizing the entrapment of the celestial fire in matter, emblematic of the sacred mushroom. The Dioskouroi often are depicted with these same crossed legs. The torchbearers always depicted with one holding his torch thrust downward, the other upward, on either side of the Cosmic Bull, signifying the entrapment and liberation of the celestial fire through the sacrifice of the bull.

As finger creatures from the digits of Rheia, plucking plants in ritual mimesis of birthing, the Corybants are analogues of the tiny creatures named for the ‘fingers’ as dactyls. They often occur as a brotherhood of five, African pygmies, a fistful of them, from Latin pugnus, cognate with pugilist for ‘boxer,’ which is probably responsible for the portrayal of the Dioskouroi as boxers, although the Greek pygmé is the measure of a forearm or cubit, making them approximately a foot tall. The actual five-foot Pygmies of Africa were named after their mythological etiology and were considered sacred and much in demand as holy magical curiosities by the Egyptian pharaohs. This tradition continued through the Renaissance in Europe with the dwarves in the entourages of the royal families and in folkloric heroes like Tom Thumb, only so big as a thumb, and swollen like the penile member that is his essential identity (Ruck et al., 2007).

Another version of them in the Mystery was the black-skinned Kábeiri, misshapen dwarves, the males with prominent erections. The sorceress Circe was depicted as such on surviving vessels from the Mystery as she compounds her potion for a Kábeiric ithyphallic Odysseus, sailing on a drunken amphora of the special wine of the rite (Ruck, 2015a). On the stage in Athens, the
tragedian Aeschylus depicted the Kábeiroi in an orgy drunk on the wine of Maron in his satyr play. In Aristophanes' Lysistrata (411 BCE), the divided chorus of combatting males and females was staged as dual troupes of Kábeiric grotesqueries in a parody of the Mystery as practiced on the island of Lemnos. The Kábeiroi were also imagined as crabs, wielding their pincer claws as henchmen of Hephaestus in the metallurgical volcanic crucible of alchemical transmutation, forging a cure for ordinary blindness. The metallurgist's pincers were called 'crabs' and Aristophanes staged them in the Wasp (422 BCE) as pubic lice impersonated by children, obscenely dancing around the erect phallic personification of the Persian haoma sacrament, with which the comedy had begun (Ruck, 2012). As the mythical figure of the Crab, the creature was involved in the motif of the toxins that anointed the poisoned arrows of the hero Heracles, and it was ultimately transported to the stars as the constellation of Cancer (Ruck, 2015b).

Penates

These Mystery figures were associated with the Etruscans, who were thought in antiquity, perhaps correctly, to have been Trojans who passed though Samothrace on route to Italy. Kábeiric may be an Etruscan word, and inscriptions in an Etruscan-like language are preserved on Lemnos. On Samothrace, portions of the liturgy were recited in a no-longer comprehensible pre-Greek or Pelasgian tongue (Cooper, 2000). These creatures of the Mystery were known to the Romans as the Penates, idealized adolescent males in historical times, although the original Penates that Aeneas carried out of Troy to the banks of the Tiber were probably Kábeiric. They were preserved there in historical times, probably as pious forgeries. It is significant, however, that the Penates as displayed in private houses were always statuettes or figurines, little people. The twin posts of the Dioskouroi joined by the crossbeam could be interpreted as an iconic glyph of a shrine or of the household placed under their guardianship, in which form the Spartans carried the emblem into battle as a standard in front of their army. The glyph was called the dökana, derived from the Greek verb délasthai, meaning 'to receive' (Waites, 1919). As a shrine, it represented the opened tombs in Sparta that hospitably received and released the twin brothers on alternate days, and it symbolized the brotherly love, mortal and immortal, that spans this world and the grave, open to receive and release its guests, binding the household to the other realm, under the sacrosanct obligation of reciprocal 'hospitality,' philoxénia or theoxénia. The Dioskouroi were summoned and expected to materialize as guests at the table of their host (Klöckner, 2010). A similar linkage of guest-friendship (xenia), the reciprocal role of host to guest, was the ultimate benefit promised to the initiates at Eleusis.

The Roman Penates were guardians of the household's store of provisions in the innermost recesses of the home, the penus. A small portion of the meal was thrown on the fire as a token offering at every dinner as a sacrifice to remove the taint of primordial toxicity, after which the attendant slave would announce that the food was now safe to eat. The etymological derivation from the 'innermost' was more significantly connected in antiquity with their phallic identity and the motif of 'penetration' into the secret shrine of the household's goddess of the central hearth and into the inner core of life, with connotations of sexuality and mystical vision (Bonnefoy, 199). The toxicity of the creatures that sprouted from the primordial intrusion of the plowshare into the vulva of Earth was mythologized in the tales of the Sown Men, the autochthons who sprouted from the serpent fangs. They were tricked into internecine strife, a battle that blamed them for their own fraternal sacrifice, leaving only a few remaining, whom the plowman took into his own family as in-laws.

Tages

The Etruscans had their own version of the autochthonous creature. This was the tiny male named Tages, who popped up out of the ground in the path of the plowman and founded their religion. People gathered around this miraculous apparition and in the presence of the entire populace of Etruria, what it said was written down from dictation as the holy book that was the foundation of the Etruscan science of divination. His father was Genius, the creator spiritus or 'creative spirit,' sometimes winged fairylike, that personified an individual's manifestation of divine nature, resident in all aspects of creation, including the observances of communal life, the norms of civilization and its ritual procedures, linking them to the realm of nature and the cosmos (Grimmond, 2006). Sometimes Tages is depicted as just a talking head emerging from the ground,
The special knowledge that Tages entrusted to the Etruscans was divination through the inspection of the liver of a sacrificed animal, haruspicy (hepatoscopy). It is an art of the inspection of the liver of a sacrificed animal, entrusted to the Etruscans was divination through the liver of a sacrificed animal, presented to the Emperor Trajan. Tages usually wears the conical red Phrygian cap, and his basic identity is phallic, wearing a pouch around his neck containing phallic objects as a protective amulet, such as was customary for Roman male children until puberty, and then stored as a memento and brought out again for display on special adult honorary occasions.

Tages is the Latinized version of his name, which in Etruscan would have been Tarchies, probably a variant of Tarchunus, the Etruscan version of the Latin Tarchon, the legendary founder of the Etruscan city of Tarquinia, north of Rome. Tarchon was the name of the plowman, which makes him identical with Tages, and they were customarily portrayed together, the little talking head and the plowman recording the dictation. The ancient Etruscan cemetery at Tarquinia dating from the eighth century BCE contains a number of stone urns containing the cremated remains of the deceased, covered with hemispherical covers, presenting the likeness of mushrooms. It is the pattern copied in the more elaborate Etruscan multi-chambered tombs, which are cylindrical and topped with a grassy mound, like the Mausoleum of Augustus, which are probably mushrooms with expanded stipes. As philhellenes, the Etruscans often placed Greek vases as funerary offerings with the deceased in these mausoleums. The placement in the tombs allowed them to survive until modern times. The vase depicting Perseus with the decapitated head of the Gorgon Medusa is one such vase. Mushroom shapes are prominent in many of these. One of them is a large fourth-century BCE platter, over two feet in diameter, depicting the abduction of Persephone, with the rim decorated in raised knob-shaped mushrooms, which are not intended as handles (Ruck, 2014).

The special knowledge that Tages entrusted to the Etruscans was divination through the inspection of the liver of a sacrificed animal, haruspicy (hepatoscopy). It is an art of the greatest antiquity that can be traced back to Mesopotamia and even earlier, with references both in the Bible and in Homer. The priest inspecting the liver is traditionally depicted with wings, indicative of his shamanic rapture, and standing with one foot raised and resting on a rock, mediating between earth and the celestial realm, and Etruscan mirrors portraying the ritual often have the winged Genius on the base handle.

**Cosmic Liver**

Since the liver is essential for life, the largest and weightiest of the entrails and containing the greatest amount of the life force in the form of blood, it was considered the center of personal existence. The markings of the universe could supposedly be read off its surface, and thus it was a microcosm of the vitality of the celestial realm. The haruspex, by manipulating the liver, could also influence events in the cosmos that it mirrored. Such power was seen as a threat to the established order, and astrologers were on occasion either banned or executed by a succession of Roman Emperors. The liver as food for the eagle was the organ that was the site of the daily torment of the chained Titan Prometheus as punishment for his creation of man and the theft of fire. He is the mythical prototype of the clairvoyant seer, named for his ‘Fore-thought’ or prognostication. The liver was considered the primordial organ of the body, the part that developed first in the fetus, around which the rest of the person grew in the womb. It is the organ that functions in hemolysis, the cleansing of the blood from toxins, and thus it is a motif in botanical agencies for shamanic rapture. Although it is unlikely that the ancients knew of the filtering function of the liver, it was thought to be the organ through which the digested food from the stomach entered the bloodstream. The liver would have the highest concentration of psychoactive toxins, reabsorbing what the kidneys did not eliminate into the urine. The theft of fire, hidden in the narthex, involves the motif of root-cutters and herb-gatherers. The bitter brownish or greenish-yellow secretion of the liver called bile or gall (Latin bilis, Greek cholé, both derived from the Indo-European root ghel- for ‘shine,’ yellow like ‘gold,’ with which it is cognate) is another element in this motif. It is listed as two of the basic humors of the body (melancholic, choleric) and was associated in Roman thought with rancor and madness. ‘Gall’ was further implicated in the motif of psychoactive toxins by its association with the
venom of serpents, which it was thought contaminated plants by contagion. Eating your enemy’s liver was equivalent to mastering his soul.

**Indigenous Foreigner**

The shared identity of the Tages and Tarchon, the autochthone and the plowman, makes the founder consubstantial with the foundation. This is often expressed by the motif of the founder as supposed foreign immigrant encountering himself in the personae of the indigenous autochthones, like Cadmus at Thebes, who slew the serpent to plow the field with its fangs and subsequently metamorphosed himself with his bride into serpents. In the exemplar of Prometheus, the creator of man is consubstantial with the primordial organ of the prognostic liver that serves as food for eagles, which implies that he is a fungal personification. In Corinth, there was a tradition that in former times men had indeed first sprouted from the ground as mushrooms swollen after a rainfall. On the comic stage of Athens, Aristophanes costumed Prometheus in the *Birds* (415 BCE) with his phallus unfurled as a parasol, in imitation of the Shade-foot fungal anthropomorphism (Ruck, 1981). There could not be a more blatant revelation of the mushroom’s central role in Greek tradition as the origin of all human intelligence and science, as catalogued by the Titan himself in the *Prometheus* tragedy ascribed to Aeschylus.

The mythical tradition of these little fungal creatures mediates the opposition between the realms of life and death in terms of the relationship between the primordial toxicity of the wilderness and the inaugural plowing of the agrarian field to plant the crops of civilized culture. Hence, it is fundamental to the founding of cities, an accord and covenant with the forces of primitivism. In narrating the arrival of the Trojan Penates to Italy, Virgil in the *Aeneid* was required to include a bizarre and enigmatic event recorded in the supposedly historical accounts. This involved the fungal identity of the plant most emblematic of the wilderness and as the haoma sacrament, most indicative of the transcendence toward culture (Ruck et al., 2013; Ruck, 2015a).

**Fairy Tables**

It was predicted that Aeneas and his men would be cursed to endure such extreme hunger before they founded the new settlement in Italy that they would be forced to eat their own tables. The curse was an item of arcane tradition, a brief riddling mention of a weird mythical event apparently recorded in some now-lost work preserved in the Alexandrine library, probably elaborating some ethnographic anthropological motif, which was a particular interest of the scholar-writers who presided over the library and its vast collection of texts. Virgil discussed it with historians among his friends, who were puzzled by its meaning. He, however, was required to include it, and he figured it out and transformed it into an innocuous surrogate, as suited the rational sobriety promulgated by his patron Augustus as a national agenda or at least as the virtue he claimed as destined Emperor.

The mythical precedent was the repulsive tables of food defiled by the excrement of the Harpies like a swarm of monstrous flies, which was all that the starving Thracian prophet Phineus had for food, but which also was responsible for his gift of clairvoyance, which to say, that the food was psychoactive or an entheogen. The Harpies were imagined to materialize as a whirlwind and to snatch people away, hence their name a ‘Snatchers,’ sometimes demonized as ornithological human hybrids, but also portrayed as beautiful women with wings. Like the fairies of Celtic lore, they were accused of stealing people away to their netherworld realm on a blast of wind, called an elfin eddy. A person was apt suddenly to disappear from sight in this world, in a fit of rapture, possessed in the clutches of these ravishing Harpy virgins. Hence, a visitation by the Harpies had orgasmic connotations of shamanic ecstasy, which is the common metaphor in Greek mystical vision. The edible tables are the folkloric motif of the fairy tables, a loathsome slimy red tabletop, supported on a pedestal and spread with the dainty morsels of the scabby white remnants of the Amanita’s shattered universal veil, and swarming with the flies attracted to the contaminated feast. The fairies also scatter round breads about the ground, but the food is cursed and should never be eaten, except in the times of severest hunger. Conversely, a piece of bread thrown on the ground was the surest amulet to ward off a blast of the dangerous kidnapping wind.

Virgil saves his hero by a ruse of paternal piety from partaking in the ecstatic feasting required for the primordial encounter with the new land that he as founder must settle. Without
knowing what he is doing, he follows the precise directions of his putative divine grandfather Jupiter/Zeus (the father of his mother Venus) as delivered from the oracle at Dodona, spreading rounds of primitive spelt bread upon the ground and heaping them with wild fruits, and after they have eaten them, the curse becomes merely a joke, as his son Iulus (the supposed ancestor of Julius Caesar) notes that they have eaten their tables. The only way to thwart a true prophecy is to enact it in some other way, and this Aeneas, pious as ever, has blindly done. There was no shortage of proper tables for use as equipment aboard his ships and thus the novel banqueting protocol was merely his uncomprehending adherence to the directive from Dodona.

Mithraism

The *haoma* sacrament was directly introduced into Rome in 69 BCE, just the year after the probable date of Virgil's birth, when the general Pompey took the Cilician pirates captive to the city of Rome. As a young man, Virgil probably knew of Mithraism, and a hundred years later, by the time of Nero, there were already well-established Mithraic lodges in the city for him to be the first of the almost continuous succession of emperors to be initiated in what was called 'magical dinners' (Ruck *et al.*, 2011). Earlier versions of the initiation lodges were already prevalent in Anatolia, traceable back to well before the sixth century. The lodges were small subterranean chambers, preferably with a natural source of water, imitating a cave in which the hero Mithras slaughtered the Cosmic Bull, and the initiates, like Pythagoras, experienced a transcendent journey of the spirit to the rim of the universe. The lodges spread throughout the Empire in Europe, Britain, North Africa, and the Near East, although rare in Greece since they already had similar rites associated with Perseus. It indoctrinated most of the emperors, and the army and male bureaucrats who administered the Empire, until the conversion of Constantine, who was himself probably an initiate. The seven sacraments of the Christian Church are modeled on the seven stages of the Mithraic rite. The sixth stage elevated the candidate to the persona of the Apollonian Solar Charioteer as the adoptive son of the Father, which was the seventh and highest grade. As adoptive son, he was pure from the Gnostic contamination of physical conception, correlating with the Platonic ideal of spiritual paternity, a role that Christ also played in the heresy of Adoptionism. Hence, women were excluded from membership in the lodges. It was the Charioteer's role to be offered as symbolic victim to usher in the final apocalyptic Conflagration, after which the cosmos would be renewed as the new age. This is obviously similar to Christ as sacrificial mediator of his Father with humankind, and the Second Coming, which was originally expected within the lifespan of the first disciples.

In Mithraism, the Solar Charioteer and the Father ratified their relationship by a banquet upon the meat of the Cosmic Bull in the form a loaf of bread, marked with a chiastic cross, representing the solar ellipse, which is segmented by the astrological glyphs of the zodiac, intersecting with the celestial equatorial belt, indicating that the bread was meant to symbolize the cosmic sphere, as something heaved up by the fungal leavening to form the heavens. The loaf of sacramental bread thus has the same symbolic relationship to the cosmos as the prognostic liver. The chiastic design was copied in the bread of the early Communion rite of Christianity. Virgil's 'fatal crusts' of round bread in the episode of the edible tables were similarly marked into quadrants, suggesting that the poet may have been a Mithraic initiate. The cross comes to signify the zodiacal marker for the sign that will preside over the new age occasioned by the precession of the equinoxes caused by the wobble in the Earth's axis, ushering in a new age about every 26,000 years. The cross thus also marks the time for the cosmic sacrifice, as time moved from the constellation of the zodiacal Bull Taurus to the Age of the Lamb Aries, and thus it also had implications for the cross of the Crucifixion. Aries as the Lamb also added new spiritual implications to the interpretation of the mythological tradition of Jason and the quest for the Golden Fleece of the sacrificed ram (Ruck, 2015a).

Raven’s Bread

The Mithraic bread was served to the two banqueters by the Raven, which was the lowest and first grade in the initiation, representing the sinful entrapment of spirit in matter, which would be released in the final stages of initiation. At the second stage, the initiate became the bride of the Father. The bread was Raven's bread, the common metaphor for the *Amanita muscaria* (Klapp, 2013), and called a bread by analogy to the spongy expansion of the fungus, the microcosmic version
of the universe, to which it offered transcendent return. The symbol of the Raven was the chalice, which suggests that the Raven’s bread was the fortifying agent in the sacramental potion, as in the wine of Maron, and the drink was metaphorically a cup of bull’s blood. Sometimes the Raven is shown handing the drink to the two banqueters in a bullhorn rhyton vessel, reinforcing the metaphor. It also was supposedly skewered bits of the bull’s roasted meat, although depictions show the Raven pecking at the meat, with the skewer held vertically above the clasped hands of the Father and his adoptive son, above the burning fire in the brazier, which would be quite unlikely in reality. However, the skewered meat presents a credible likeness to the mushroom for which it is the metaphor. Significantly, the sixth grade in the initiatory sequence was Perses, the Persian, who was the ‘keeper of the fruits,’ and his name suggests Perseus, who was the father of Perses, the etiological founder of the Persian people. The Mithraeum lodges were not banqueting clubs, nor are the tiny confined subterranean chambers appropriate venues for slaughtering a bull, disposing of the copious flood of its ensuing blood, roasting its butchered flesh, and serving an ordinary dinner. Other aspects of the ritual activity involved miming with animal masks, sexual humiliation, physical intimidation, and rowdy hazing, as is a common feature in initiatory admission to secret societies.

The tauroctony or ‘bull slaughter’ in Mithraism was a mythical event, often mistakenly equated to the Taurobolium, in which an actual bull was slaughtered on a grating above the initiate who was bathed in its blood. This was a rite in the religion of Cybele as imported into Rome in the third century BCE as the Great Phrygian Mother, in which the initiates represented Attis and practiced self-castration in their frenzied ecstasy. Attis was traditionally represented wearing the Phrygian cap and the frenzy of the rite may well have involved a similar fungal intoxicant. The remains of an ancient Taurobolium lie beneath the Vatican, but it was not the tauroctony of Zoroastrian Mithraism. Churches, however, were often also built above Mithraea, as in the Church of San Clemente, near the Roman Coliseum.

**Soldiers of Christ**

The Mithraea resemble drug dens, rather than banqueting chambers, sometimes with other rooms for rituals and indoctrination. Various psychoactive substances were probably involved in the successive grades of initiation, and the chamber was probably fumigated with incenses like cannabis, as seems to have the more ancient custom with the haoma cult indicated at archaeological sites, but the role of the Amanita muscaria as the bread served by the Raven in the religion explains to a large measure how the mushroom cult was promulgated throughout Europe as the supposed cohesive civilizing force until its official suppression by the Conversion. The third grade of Mithraism, however, was the Soldier, enlisted for the cosmic battle, and it seems likely that the concept of a brotherhood of warriors and its ritual indoctrination, like other aspects of Mithraism, was expropriated by Christianity, as was clearly the case with the sacrament of Confirmation, which made a Christian a soldier of Christ, instead of Mithras.

The haoma sacrament probably was transferred to groups like the Knights Templar and medieval knighthood. The ancient wolf sacrament continued, moreover, among the Nordic peoples and persisted in their berserker rites even after their conversion. It also continued in the Eastern Church among Gnostic sects like Manichaeism, whose Persian prophet Mani in third-century Mesopotamia, incorporating dualistic Gnostic elements of Zoroastrian religion with Christianity, and which spread to southern Europe in the tenth century and persisted in China until the nineteenth, where they were noted for their ecstatic rituals and their fondness for red mushrooms. Where Mithraism in the Middle East persisted in fringe peoples only marginally assimilated into Islam, Mithras was still celebrated as late as the twentieth century with a sacrament of the Amanita muscaria (Ruck et al., 2011). There were also numerous sects of early Christianity with a similar Gnostic dualism and a fungal sacrament which were suppressed as heresies even before the Conversion. In the mid first century, Paul reproached his congregation in Corinth for practicing the Eucharist in a manner that had caused the sickness and death of quite a few of their members (Ruck et al., 2013; Ruck, 2015a). A fourth-century Christian sanctuary uncovered beneath the eleventh-century Basilica of Aquileia north of Venice preserves a mosaic floor ornamented with baskets of Amanitas and snails. The chamber was an early Christian meeting hall or agape and the floor decoration is plausibly interpreted as a depiction of the...
hispani
Pasquale depicts mushrooms, probably millennium BCE) in Catalonian Spain at Selva 2000). Rock art from the Neolithic (sixth century and then mainly to improve economic converting to Christian places like Lithuania and Iceland, the latter remnants of Mithraism, but also apparently varia forms, was one of these, not only as identifiers anthropomorphisms of Amanita muscaria. Rock art of the San people of South Africa, and elsewhere, also indicates probable psychoactive agents for accessing shamanic rapture. The similarity of metaphors with traditions from Classic antiquity and with those documented in the New World suggests that the spirit supposedly resident in the entheogen communicates with the shaman, as is commonly claimed.

Old Europe
It was, moreover, only the urban centers under direct control of the bureaucracies and the Church that converted. The old religions continued in the countryside and villages (pagus), where the country folk or ‘peasants’ (pagani) preserved many aspects of pre-Christian tradition, called Paganism after them. The mushroom cult, in various forms, was one of these, not only as remnants of Mithraism, but also apparently because there were indigenous sources as well, predating the Roman Empire and dating back even to before the Indo-European migrations of the mid second millennium BCE. Shamanism involving mushrooms survived into the twentieth century in places like Lithuania and Iceland, the latter converting to Christianity only in the tenth century and then mainly to improve economic integration with the European mainland (Nichols, 2000). Rock art from the Neolithic (sixth millennium BCE) in Catalan Spain at Selva Pasquale depicts mushrooms, probably Psilocybe hispanica, as dancing anthropomorphisms, with a fresco of a bull delineating in greater detail a natural likeness suggested by the stone surface (Akers et al., 2011). It forms an element in a total rock configuration aligned and oriented as a solstitial marker and the site was clearly involved in sacred rites. Similar rock paintings in northern Africa, perhaps as old as the eighth millennium BCE depict shamans consubstantial with a fungal identity, as well zoomorphic transmogrification into an antlered deer and bees. Some depictions suggest consubstantial anthropomorphisms of Amanita muscaria. Rock art of the San people of South Africa, and elsewhere, also indicates probable psychoactive agents for accessing shamanic rapture. The similarity of metaphors with traditions from Classic antiquity and with those documented in the New World suggests that the spirit supposedly resident in the entheogen communicates with the shaman, as is commonly claimed.

Issenheim Altarpiece
Certain works of European art from the Renaissance suggest that a mushroom cult continued in elite societies of Christians. The most defining characteristic of the Amanita muscaria is the persistence of its potentiated toxin as a metabolite in urine, perhaps reflected in the ancient tradition of the second birth of Dionysus from the groin of his father. Between 1512 and 1516, Matthias Grünewald painted an altarpiece for the monastic hospital at Issenheim, in Alsace, now displayed in the Unterlinden Museum at Colmar (Ruck et al., 2007). The monastery claimed Saint Anthony of Egypt as patron and it tended patients suffering from the affliction of ergotism named Saint Anthony's fire after the saint. Prominent in its complex of images presented in three layers of unfolding panels is the depiction of the divine Infant's vase de nuit or chamber pot, above which is a transparent crystal vessel of ornate Persian design like a monstrance containing the amber fluid of the Baby's urine, above which, the Virgin, in heaven amid a consort of angelic and demonic musicians appears, wearing a crown of flames surrounded by an orange nimbus, as she blesses the sacrament. The risen Christ is depicted in the adjacent panel to the right rising from the tomb, surrounded by the same nimbus, his white legs trailing the white burial shroud and presenting a credible anthropomorphism of the Amanita muscaria. At the innermost third level of presentation, which
was visible only on the saint's day and for special rituals, two scenes with Saint Anthony, patron of mushrooms-seekers, flank a shrine with wood carvings. On the right, demons torment the saint. A poor deformed man, afflicted with the pustules of the disease, clutches a bible beside a tree trunk that is host for fungi. On the left, the saint is depicted entertaining a visit from the Hermit Paul of Thebes. For their meagre banquet, a Raven descends delivering two bits of Raven's bread, whereas ordinarily the saint was sustained by a single daily piece of the bread from the Raven. Beneath the Raven, a deer approaches, about to graze on some of the mushrooms for which the Cervidae are notably fond, including the Amanita's metabolite in urine. Another deer rests between Anthony and Paul, engaged in conversation, probably on the subject of their miraculous nourishment in the desert. The motif of the deer hunt in medieval and Renaissance art probably always had the gathering of the mushroom as its referent. Both Saints Hubertus and Eustatius experienced a vision of the Christ suspended between the antlers of a stag while out on the hunt.

**Bacchanal of the Andrians**

Between the years 1523 and 1526, while in residence with the Duke, Titian painted *The Bacchanal of the Andrians* for Alfonso I d'Este to decorate the antechamber to the bedroom he shared with his second wife, Lucrezia Borgia, daughter of Pope Alexander VI (Heinrich, 1995; Ruck et al., 2007; Ruck et al., 2012). The theme of the antechamber's art was depictions of ancient orgies or revels. The painting is now in the Museum of the Prado in Madrid. There are two levels of reality in the depicted scene, the islanders of the Greek isle of Andros, who held an annual revel to celebrate the arrival of the god Dionysus, at which time the rivers of the island flowed with wine. The other level of reality is the materialization of the god's nude male attendants, scooping up the wine from the river, drinking it, and carting it away. Shockingly nude in the corner that is host for fungi. On the left, the saint is depicted entertaining a visit from the Hermit Paul of Thebes. For their meagre banquet, a Raven descends delivering two bits of Raven's bread, whereas ordinarily the saint was sustained by a single daily piece of the bread from the Raven. Beneath the Raven, a deer approaches, about to graze on some of the mushrooms for which the Cervidae are notably fond, including the Amanita's metabolite in urine. Another deer rests between Anthony and Paul, engaged in conversation, probably on the subject of their miraculous nourishment in the desert. The motif of the deer hunt in medieval and Renaissance art probably always had the gathering of the mushroom as its referent. Both Saints Hubertus and Eustatius experienced a vision of the Christ suspended between the antlers of a stag while out on the hunt.

In front of the women in conversation by the riverbank is a piece of musical notation; the music is a perpetual canon or round whose text reads, "He who drinks but once and doesn't drink it again knows not true drinking." The reference is clearly to the child's pee, round and round, which is being poured into her cup and which appears again in the monstrance of the crystal pitcher. Another of the males from the mythical entourage behind the two conversing women is looking directly at the peeing child and knows full well that it is divine urine that he is scooping from the stream. The source of the river appears personified as a river god in the distant right above the reclining Ariadne. He is a white-bearded man, apparently passed out, the river's fountain issuing from between the legs of his nude body, ostensibly from his genitals as urine. Equally unconscious and in the same pose is the nude Ariadne, and she probably adding to the urine flowing in the stream. Beside the peeing god is an overturned large stemmed golden chalice, of probably ecclesiastical design, suggesting that the alchemical elixir of transmuted pee is the Eucharist.

The peeing homunculus or little man was a motif in alchemical depictions, releasing his urine within the alembic containing the potion of transcendence, and the alchemists riddled that the so-called stone that conferred the knowledge of philosophers was actually something despicable, common and everyday, tossed out as offal into the streets. Since both Grünewald and Titian were in residence for an extended period as they accomplished their patrons' commission, it is difficult to imagine that the artists had not partaken of the sacrament encoded in their paintings.
Ghent Altarpiece

In 1432, Jan van Eyck completed the Ghent Altarpiece (titled the \textit{Adoration of the Mystic Lamb}) that his brother Hubert had begun but left unfinished upon his death in 1426 as a commission from Duke Philip the Good of Burgundy, to coincide with the birth of the Duke's son from his third wife Isabella of Portugal and the inauguration of the warrior brotherhood of knights called the Order of the Golden Fleece (Ruck and Hoffman, 2012). The Duke was a great enthusiast of alchemy. Here in the outer level of the polyptych altarpiece, the urine appears in a transparent flask catching the light of the sun on a window ledge of the bedchamber where the Virgin, already pregnant, is receiving the news of the Annunciation. The dove of the Annunciation descending above her head was the traditional Flemish design for the ciborium containing the bread of the Eucharist, and the central panel of this outer level of presentation depicts the sacristy chamber where the priest prepared to administer the Communion.

The flask of urine is proof that the Virgin is indeed pregnant. Ancient and medieval doctors studied the effluents of the body as a clue to the inner workings of the patient's physical condition, and the urine as the most copious was of particular significance. Some doctors, called 'piss prophets,' claimed that they could determine pregnancy from the color of the urine, and there are published color charts that they employed as a guide. The flask of urine was also a metaphor elaborated by Saint Bernard and others to explain how the Virgin could conceive and yet remain \textit{virgo intacta}, with unbroken hymen. It was like a beam of sunlight penetrating the glass of a flask, imparting its color to the liquid, but leaving the vessel intact.

The Altarpiece originally was fitted with a mechanism of clockwork that daily opened the panels of the outer presentation, accompanied with mechanical music, to reveal the inner presentation for the Eucharist. Here the same model who served for the pregnant Virgin is portrayed on the right upper panel as the shockingly nude Eve, already pregnant, and also in the central panel as the Virgin now elevated to her role as the \textit{Regina Coeli}, Queen of Heaven. She is enthroned beside Jesus, now her consort as the Almighty. He is an astonishingly handsome young man, and he is also the same model who served for the portrayal in the upper left panel opposite Eve for the portrait of the equally shockingly nude Adam, about to walk out of his niche to assume his future role as mate of Eve's redemption in the persona of the \textit{Regina Coeli}.

The divine couple sit enthroned beside the Baptist, the original patron of the Church, to witness in the scene below them the marriage feast of the Mystic Lamb. The scene is the Apocalyptic Revelation of John of the stream flowing through the New Jerusalem, when he rescinds the prohibition of the Garden of Eden and invites all to eat freely now of the forbidden fruit of the knowledge of good and evil that will make man like onto God and his angels. The Lamb stands upon an altar in a flowering meadow, surrounded by the \textit{Arma Christi}, the instruments of the Crucifixion. The Lamb's Blood spurts from His body, as the source for an elaborate fountain that is the source of the river. The basin of the fountain contains gemstones and coral. Water passing over magical stones was thought to absorb their potency. The coral was supposedly derived from the blood that dripped from the decapitated Gorgon Medusa, from which sprouted spongy mushrooms that only turned petrified as coral when immersed in water. In scientific nomenclature coral belongs to the family of the \textit{Gorgonacea} and its name as 'coral' derives from ancient Greek, where it is the diminutive for the \textit{kore} or pubescent girl, probably linking the blood to the menses. The esteem for coral is of the greatest antiquity, traceable back to the Zoroastrian Magi and the Vedic Brahman priests, who endowed it with sacred properties, probably since it was metaphoric for the \textit{haoma} and Soma sacrament. As petrified, it was the original for the alchemical \textit{lapis philosophorum} or 'stone of the philosophers.' In medieval symbolism, it was known as the \textit{lapis Christi}, the petrified Blood of Christ.

To the left of the central panel of the Mystic Lamb, the Duke is portrayed amid a troupe of knights as the Soldiers of Christ, approaching the sacred meadow of the fountain river, about to lay claim to sovereignty over the New Jerusalem. Their path is strewn with gemstones and corals. The matching panel opposite on the left depicts Saint Anthony and the Hermit Paul, probably still discussing the miracle of the Raven's bread, as they, too, approach the Mystic Lamb. Anthony carries a rosary of coral beads, and several gemstones lie in his path at the base of the tawkross he carries as a walking stick, prodding the ground as a mushroom-seeker looking for truffles.
which folkloric tradition ever since antiquity considered the petrified urine of a stag. Anthony was also the patron of pigs, which were employed for scenting out the presence of the underground mushrooms. The sows are drawn to them by the noticeable scent of male urine, androstenol, which the truffles produce. Customarily they are hunted *avec la mouche*, 'with the fly,' as is the phrase, because like the *Amanita muscaria* they attract swarms of flies. Islamic tradition, allegedly going back to Muhammad, claimed that the truffle had an effect on the eyes, which implies alteration of vision.

On the outer presentation, the Baptist is depicted in grisaille as a statue holding the cup of poison to which he was immune, its toxicity indicated by the serpent lifting its head from the vessel. In the inner presentation, the spigot on the fountain is a grotesquerie that is the face of the serpent in the cup of poison. An inscription on the rim of the fountain identifies its water as *Aqua Vitae*, the 'water of life,' which by this date had been already for about a hundred years been labeled as the alchemical distillate.

The Altarpiece identifies the blood of the Lamb pouring over the corals and gemstones as the blood that flowed from the side of Christ, when pierced with the lance of the Roman centurion Longinus, which is depicted among the instruments of the Crucifixion. The Duke actually had a phial of the petrified Holy Blood, enclosed and sealed within a crystal tube, that was given to his ancestor Sybilla of Anjou on Christmas of 1148 in Jerusalem, a holy relic allegedly discovered by the Knights Templar, and when she touched it she had a vision of the New Jerusalem, which was going to be the city of Bruges in Flanders. It is preserved in Bourg Square in the city of Bruges, and every Friday up until 1325, and then intermittently thereafter, many witnesses claimed that the dried blood liquefied, sometimes dripping as newly shed blood from the reliquary. By this tradition, the story of the Altarpiece reaches back to Philip's twelfth-century ancestor, Philip of Alsace, the Count of Flanders, and the tale of the Grail commissioned from the poet Chrétien de Troyes.

**The Garden of Eden**

Wasson continued to suspect that confirmation of his identification of Soma would be found in Christianity. When it came in the form of John Allegro’s *Sacred Mushroom and the Cross* (1970), he didn't recognize it, much to Allegro's disappointment. As an amateur scholar, Wasson customarily deferred to the opinion of professional authorities. Allegro, the linguist and scholar of the Dead Sea Scrolls, an academic with impeccable credentials in ancient Classical and Near and Middle Eastern languages, had already published several books; he had read Wasson’s writings and appropriately acknowledged them, knew of his Mexican discoveries, and accepted his identification of Soma as the fly-agaric. Wasson, like all Allegro's critics, would have found the linguistic documentation beyond his expertise. He asked a rabbi and a Catholic Monseigneur in his acquaintance their opinion and they assured him that there wasn’t a word of truth in it.

*The Wondrous Mushroom: Mycolatry in Mesoamerica* was the last book that Wasson saw through to publication (Wasson, 1980). By this time, he had become quite convinced that the experience that had occurred with María Sabina was religious in essence. His later work with the Anishinaabeg (Ojibwe) shaman Keewaydinoquay (Peschel) demonstrated how widespread or universal was the role of sacred visionary substances in the origin and practice of religion (Keewaydinoquay, 1984), requiring a new designation devoid of the cultural environment of the psychedelic era. For this, he endorsed entheogen: "'God within us,' those plant substances that, when ingested, give one a divine experience. The new word notably captures the rich cultural resonances evoked by the substances, many of them fungal, over vast areas of the world in proto- and prehistory."

In *Persephone's Quest*, Wasson's final book, published just after his death in 1986, he proclaimed by its subtitle that he had concluded that entheogens were the origin of religion (Wasson et al., 1986). The first chapter was Wasson’s final summation. "As I am nearing the end of my days," he began, "I will draw up an account of our mushroom quest." Here he came back to the question of a mushroom cult in Christianity. "I once said that there was no mushroom in the Bible," he wrote. "I was wrong…. I hold that the fruit of the Tree of Knowledge of Good and Evil was Soma, was the *kakuljá*, was *Amanita muscaria*, was the Nameless Mushroom of the English-speaking people."
References


Geniusz WM. Our knowledge is not primitive: decolonizing botanical Anishinaabe teachings (Iroquois and their neighbors, Syracuse University Press, Syracuse., 2009.


Keewaydinoquay (Peschal), with an introduction by Wasson, R.G. The miswedo in Anishinaabeg Life, Stampaeria Valdensea, Verona. From the hand-corrected master proof of the unpublished printing, of which only five copies exist, sequestered from access in the Wasson Archives, Harvard Library, 1984.


Kurtz D and Boardman J. Greek burial customs, Thames and Hudson, London., 1971.


Samorini G. Mushroom effigies in world archaeology: from rock art to mushroom-stones. The stone mushrooms of Thrace, EKATAIOS, Alexandroupoli, 2012; pp. 16-44.
Mind and Tachyons: Six-dimensional Special Relativity - Tachyons May Inform Us about Our Future

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ABSTRACT
This is another article in a series proposing that memory and thought in our brains consist of tachyons. During the 1970's and later, tachyon physicists found six-dimensional special relativity with three space and three time dimensions, more suitable for the description of tachyons than the conventional four-dimensional special relativity. In six-dimensional relativity, events observable by a subluminal observer and those by a superluminal observer are located on two different four-dimensional Minkowski subspaces in the higher dimensional space-time. If one assumes that information in the mind of a sentient observer consists of tachyons then the observer’s brain and mind play the roles respectively of a subluminal and a superluminal agent, whenever he/she observes an external material object or an internal thought, emotion, etc. Six-dimensional special relativity then implies that the space-time of the physical world and the space-time of phenomenal information of the individual are different four-dimensional Minkowski sheets embedded in the six-dimensional space-time. Interestingly, this conclusion is compatible with the Material Dualism or Extended Materialism proposed by modern scientists, John Smythies, Bernard Carr, and others who think that physical world and phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time that includes at least one more dimension of time than the conventional four-dimensional special relativity. In six-dimensional special relativity, it is possible for tachyons to pass information about likely future states of a subluminal observer to the observer without violating causality. This feature of tachyons together with our hypothesis that intention, will, or volition all consist of tachyons, would explain why the unconscious neural activity called readiness potential precedes awareness of will/intention in the context of volitional or goal-oriented actions.

Key Words: six-dimensional special relativity, quantum brain, tachyons, conscious and unconscious thought, material dualism, extended materialism


Introduction
In earlier papers, we proposed that memory and thought in human brains (possibly in other living beings) consist of tachyons. We consider the mind as accumulation of ‘phenomenal information’ (PI) that includes subjective experiences of sensory inputs and psychological contents such as desires, emotions, feelings, volition, and sense of self. We propose that the PI which is not accessible to external observers by any physical means consists of tachyons defined and discussed by Bilaniuk et al. (1962), Feinberg (1967), and Recami (1986). Earlier, we showed that a brain consisting of neural matter and its mind consisting of tachyons can produce subjective experience in the form of

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tachyons by interacting with each other (Hari, 2011; 2014). During the 1970’s and later, tachyon physicists discussed six-dimensional special relativity (6D-SR) with equal number of space and time dimensions, as they found it more suitable for the description of tachyons than the conventional four-dimensional special relativity (4D-SR). In 6D-SR, events observable by a subluminal observer and those by a superluminal observer (if such an observer exists) are located on two different 4D-Minkowski subspaces in the 6D-space-time. If one assumes that information in the mind of a sentient observer 0 consists of tachyons, then the observer’s brain and mind play the roles respectively of a subluminal and a superluminal agent, whenever 0 observes an external material object or an internal thought, emotion, etc. The 6D-SR then implies that the space-time of the physical world and the space-time of phenomenal information are located in different subspaces of the 6D-space-time.

We point out in Part I of this article, that the above conclusion is compatible with the Extended Materialism proposed by John R Smythies, a neuroscientist of today, who thinks that physical world and phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time that includes at least one more dimension of time than the conventional 4D-SR. Smythies explains that his theory of mind (TOM) is Substance Dualism but not Cartesian Dualism. Because the tachyon TOM is Extended Materialism also, it is also different from Cartesian dualism; there is no soul or homunculus in our theory.

In Part II of this article, we describe how it is possible in 6D-SR, for tachyons to pass information about likely future states of a subluminal observer to the observer without violating causality. We will see that this feature of tachyons together with our hypothesis that intention, will, or volition all consist of tachyons, allows us to explain why the unconscious neural activity called readiness potential precedes awareness of will/intention in the context of volitional or goal-oriented actions. We suggest that unconscious will initiates the neural activity.

Besides information about matter, which physics has dealt with so far, minds contain other information such as thoughts, desires, feelings, and sense of self. Physicist Bernard Carr (2010) puts information in our minds into the following categories:

1. Information generated by perception of physical space through physical sensors and stored for use in replay of images and events experienced in the past.
2. Information generated and controlled by imagination, related to creativity.
3. Information in dreams possibly generated by the interplay of memory and imagination.

So far, all laws of physics are concerned only with information of the first kind above. Since the mind contains other information such as mentioned in the second and third categories above, Carr suggests that more than the usual four dimensions are needed to describe life consisting of both body and mind. The notion of extra dimensions beyond the three revealed by our physical senses has already been proposed by other physicists such as Kaluza and Klein to explain certain aspects of the material world. In all such theories, effects of the extra dimensions become important on certain scales. These theories therefore imply that our ordinary senses reveal only a limited aspect of physical reality. Carr (2010) proposed a “Universal Structure” in a higher-dimensional matter and information space to incorporate physical space as well as non-physical parts accessed only by the mind.

Pursuing Carr’s ideas, Smythies (2009) rejects Psycho-neural Identity Theory and proposes a theory of substance dualism, which he calls Material Dualism or Extended Materialism, according to which the brain and its phenomenal consciousness module are two ontologically independent parts of a human organism located in different but related subspaces of a higher dimensional space-time. This dualism differs from Cartesian dualism because in the latter, physical matter is extended but mind is not whereas both realms contain material, and both are spatial in the new dualism. Smythies (2003) observes that the 4D-SR as currently understood does not distinguish PI from the brain’s matter and cannot recognize a ‘now’ of time. He thinks that in addition to the time t1 of 4D-SR, a second time t2 in which the ‘observer’s field of observation’ moves through space-time is required in SR to
describe consciousness phenomena. Smythies (2014) therefore proposes a 5D space-time where a second time dimension is added to the space-time of 4D relativity, and where the physical world (containing ordinary matter such as atoms, fields, brains and planets) and the phenomenal world (containing phenomenal matter such as sensations, images and thoughts) are in relative motion and located in two different cross-sections of the 5D space-time. The relative movement, he says, generates the ‘now’ and the passage of the time that we experience. The contents of phenomenal space are all related to (but not identical with) particular brain events. In this article we are not working with Carr’s Universal Structure or with Smythies’ 5D space-time. We merely point out that our approach linking brain’s neural matter with mind’s tachyonic matter in 6D-SR not only satisfies Smythies requirements for an extended SR but also provides a clear mathematical formulation of a theory of Extended Materialism.

1. Some definitions

We will define some words/phrases which will be used frequently in the following sections.

**Material events:** We say that material events in space and time are events whose space and time coordinates can be found by a sentient observer by receiving energy, momentum, etc. via senses directly from them, or indirectly by means of physical instruments. Some information including the ‘where and when’ of an event is created in the mind of the observer upon receiving such signals. We will call creation of information as an observation of the material event.

**Events in imagination (EI):** Events such as dreams occur apparently without requiring receipt of signals via senses and physical instruments. We call such events as events in imagination (EI). It is not possible to associate space and time with EI-type events. For example, our dreams some of which we may be able to report to others are of this kind because an event in a dream for example, may not have happened and may never happen in the physical world.

**Subluminal agent:** New information is acquired in an observation. An observer is a sentient being O and acquires information via senses (by looking, hearing, etc.), about the space and time coordinates or a property of a material object either directly from the object or from a device used to measure the property. In the latter case, the measuring device records a change in its state by exchanging matter, energy, momentum, etc. with the material target of observation. When its response is received by O via senses, new information is created in O’s mind; and O ‘observes’ the new state. We will say that any object, which is subluminal relative to the body of a sentient observer, is a subluminal agent. It undergoes a change of state by exchanging energy, momentum, matter, etc. with other objects which may be bradyons or tachyons in its rest frame; it is said to ‘access’ the event at the other end of the exchange if the exchange is subluminal in its rest frame. Its own state is said to be accessible to it if a sentient observer can report the state using senses (speech, writing, etc.).

Thus the brain of O is a subluminal agent when it creates neural maps of sensory signals, which it receives from a material event P_M in the outside world; the brain ‘accesses’ P_M, the brain ‘accesses’ its new state B_P_M because B_P_M can be reported by a neuroscientist, who monitors the brain. In the case of EI-type events Q also, the brain undergoes a corresponding event B_Q, by receiving endogenous inputs (like in the case of intentional actions) or even unknown inputs (like in some dreams), which we assume contain tachyonic signals of energy and momentum. According to our definitions, the brain ‘accesses’ B_Q (because the neuroscientist can report it). We may say that the brain accesses Q by a superluminal exchange.

**Superluminal agent:** In tachyon physics, the word “superluminal observer” appears quite often but what does it mean? Although existence of tachyons is not ruled out by relativity theory, all sentient beings we know, and their rulers and clocks are all made out of ordinary matter and cannot move faster than the speed of light; we have not even observed any tachyons yet. So, in a way similar to how we defined a subluminal agent, we will say that any object, which is superluminal relative to the body of a sentient observer, is a superluminal agent. It undergoes a change of state by exchanging energy, momentum, etc. with other objects which may be bradyons or tachyons in its...
rest frame; it is said to ‘access’ the event at the other end of the exchange if the exchange is subluminal in its rest frame. We say a superluminal agent ‘accesses’ its new state if a sentient observer can report the new state using senses (speech, writing, etc.).

If we hypothesize that PI consists of matter tachyonic relative to the external world perceived via senses, then according to our definitions of ‘access’, any content of the mind of a sentient being is a superluminal agent.

Observer and awareness: Note that in our definitions, subluminal and superluminal agents do not ‘observe’ anything. We define an observer as follows so that only a sentient observer with both a brain and a mind ‘observes’ or is ‘aware’ of the observed object: A sentient being ‘observes’ or is aware of an object (which may be a physical object, or a past event, or a sensory experience in the present, or a future goal) when a physical representation (neural correlate) of that object and the ‘meaning’ of the neural correlate reportable to the outside world, both exist in the being’s memory.

Thus, a sentient observer ‘observes’ or is ‘aware’ of an event P (whether P is a material event PM or EI-type event Q) if and only if there is a required corresponding brain event BP and he/she is also able to report/communicate the ‘meaning’ of BP using the senses. The observer sees the event P as happening ‘now’. If one assumes that the brain is a quantum system, then its wave function collapses whenever it creates a neural record observable by a monitoring scientist. Hence this definition of awareness implies that the wavefunction collapses whenever the observer is ‘aware’ of something, or ‘observes’ something.

It is to be noted that the event of the brain’s quantum collapse coincides with the occurrence of awareness of the new input but does not necessarily coincide with completion of building the neural correlate (sometimes called neuronal adequacy) of the input. This feature of quantum collapse is believed to be the basis for Libet’s Delay and Antedating Paradox (Wolf, 1998).

2. An observer’s brain creates information in the mind

According to Neuroscience, “reportable” and therefore “perceived” information (“conscious” subjective experience) about an external material event in the world or an internal intention is created in one’s mind if and only if a neural correlate or neural activity representing the information exists in one’s brain (Libet, 1999; Mormann and Koch, 2007). For the experience of observing a material event to occur, the required neural activity is initiated by sensory inputs (material signals). In the case of volitional acts, to know one’s own intention, the required neural activity may involve endogenous inputs also. As an example, Figure 1 illustrates how the PI about seeing a book lying on a table is created in the mind of O, who is at rest relative to the table. To every material event PM reported by a sentient observer O, O’s brain goes through a corresponding event BP M (which can be observed by a monitoring neuroscientist N), namely, completion of the neural correlate of PM but O’s mind reports it as PM. For example, projection of the sensation of vision out in space, called spatial referral means that we see objects “out there not in here” although images of the objects are actually on the backs of our retinas. The experience appears to us as quite normal!

Note that in Figure 1, O and N agree upon the ‘where and when’ of PM using rules of coordinate transformations. This is true of all material events observed by sentient observers who are at rest relative to one another although the PI created in their brains by the events is not accessible to them or any material device. In the perception of any conscious observer, material events seem to happen in succession, in a space with three dimensions. Therefore, relativity assumes that space-time (call it R4) consists of a three-dimensional space and a one-dimensional time.

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3 There is no ‘meaning’ or ‘real information’ also called ‘phenomenal information’ in any form of pure matter. A word in any language is not identical with its meaning because the same meaning may be conveyed by different words in different languages; we, human beings have assigned meaning to them which is in our heads. Sometimes language is not even used to communicate information. For example, a right signal flashing from a car is an indication to others that it is about to make a right turn. A language is a mapping of information into words (symbols) which become sound energy when pronounced, particles of matter when written on paper, and become electrical energy when transmitted over a telephone line, and so on. On the other hand, there is ‘meaning’ or PI in our brains which is different from the language or energy signals that are used for its storage and communication just like water is different from its container without which it can not be taken from place to place.
3. Applying description of bradyons and tachyons in six-dimensional relativity to matter and phenomenal information subspaces

During the 1970’s and later, interest in SR with equal numbers of space and time dimensions arose for various reasons; some considered 6D-SR as a natural extension of the well-known 4D-SR to make the roles of space and time symmetrical while some others considered that three time dimensions are even essential for consistency of the SR postulates. Since in both special and general relativity all events in space-time are determined once for all, there has been considerable effort to reconcile the probability aspect of quantum mechanics (QM) with the determinism of relativity. Unifying QM and gravity turned out to be even more difficult. Pavšič (1981a) briefly explains how in a higher than four dimensional space-time, one can avoid incompatibility not only between the deterministic relativity and probabilistic QM but also between relativity and the concept of ‘free will’ or ‘free decision’. Considering that 4D-SR does not rule out the existence of tachyons, introduction of three-dimensional time and thereby symmetry between space and time were found to be useful when studying possible extensions of the Lorentz transformations to frames and objects moving faster than light (see Recami 1986, chapter 14 for a review of various extensions). Although proponents of 6D-SR are not concerned with living matter or with PI, once we identify PI with tachyonic matter, we will find that 6D-SR describes phenomena of matter-and-PI as occupying two different cross-sections of a 6D space-time with three space and three time dimensions.

Clearly, any brain-event is in R4 but not all brain-events and not all material events create awareness of them in a given observer O’s mind. Further, EI- type events are not in R4 even if they are reportable by O because they are not observable by other conscious beings or material devices by receiving material/energy signals. Thus, matter and PI together seem to exist in a space-time higher dimensional than R4. Our assumption that PI consists of tachyons therefore implies that the larger space-time is six-dimensional. Since in our experience, we see and report all material events PM as happening in succession, we assume:

Postulate of material-event-phenomenal-correlate succession in phenomenal space (PMEPCS): in a sentient observer’s phenomenal

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Footnote: Space and time dimensions are recognized by their sign in the signature of the metric of the space-time.
space, events other than those of EI-type, which correspond to events in physical space have their time vectors parallel to a single time direction in the 6D space-time.

Postulate of material event succession in physical space (PMES): Time vectors of material events accessed by a subluminal agent (material objects including brains) are all parallel to a single time direction in the 6D space-time.

Since all brain events BP of a given observer O happen in succession as observed by a neuroscientist, from PMES follows that their time vectors are also parallel in the 6D space-time. We make no assumptions about whether EI-type events happen in succession or not.

The six-dimensional pseudo-Euclidean non-compact space-time continuum is defined as the direct sum: \( \mathbb{M}^6 = \mathbb{T}^3 \oplus \mathbb{E}^3 \), of three-dimensional Euclidean time \( \mathbb{T}^3 \) and three-dimensional Euclidean space \( \mathbb{E}^3 \) with metric of signature \((+ ++ + - - -)\). In \( \mathbb{M}^6 \), an event is given by 6 co-ordinates \((t_1, t_2, t_3, x_1, x_2, x_3) \sim (t, x)\). The square of the distance between two infinitesimally separated events with the coordinates \((t, x)\) and \((t + dt, x + dx)\) is given by the quadratic form:

\[
ds^2 = dt^2 - dx^2,
\]

where \( dt^2 = dt_1^2 + dt_2^2 + dt_3^2 \) and \( dx^2 = dx_1^2 + dx_2^2 + dx_3^2 \). Three types of the quadratic forms are distinguished: (i) \( ds^2 = 0 \) null distance, (ii) \( ds^2 > 0 \) time-like distance, (iii) \( ds^2 < 0 \) space-like distance.

Case (i) is satisfied by the events connected by the light signals with the speed of light being defined as

\[
c = \left(\frac{dx^2}{dt^2}\right)^{1/2} = dx / dt.
\]

Case (ii) is satisfied by the events along the world line of a bradyon. Case (iii) is assumed to be satisfied by the events along the world line of a tachyon. With respect to the sign of the quadratic form two classes of transformations are distinguished:

i) subluminal transformations, satisfying 
\[
dt^2 - dx^2 = dt^2 - dx^2;
\]

ii) superluminal transformations, satisfying 
\[
dt^2 - dx^2 = dx^2 - dt^2.
\]

An object which appears as a bradyon \( B = B(F) \) in a frame \( F \), appears as a bradyon \( B^* = B(F^*) \) in another frame \( F^* \) related to \( F \) by a subluminal transformation whereas \( B = B(F) \) appears as a tachyon \( T = T(F') \) in a frame \( F' \) related to \( F \) by a superluminal transformation.

The transcendent (infinite relative speed) superluminal transformation relating a material event \( P_M \) and its corresponding brain event \( B_P \): In earlier work, we showed that the quantum brain creates subjective experience in the form of zero-energy tachyons (ZETs) if the mind consisting of tachyons pays attention to the brain (Hari, 2014). This means that new ZETs are created when the wavefunction collapses; the new ZETs carry information contained in the experience. Hence the coordinates of the observed material event in the rest-frame of any new ZET (as reported by the person having the experience) are obtained from those of the brain’s neuronal adequacy event in the rest-frame of the laboratory by the transcendent superluminal Lorentz transformation. This means that in Figure 1, coordinates of a material event \( P_M \) are obtained from \( BP_M \) by a superluminal transformation and those of \( BP_M \) are obtained from \( P_M \) by the inverse superluminal transformation in the 6D-SR. The Delay and Antedating Paradox (Libet et al., 1979) was resolved using this result (Hari, 2014).

Space-time \( M_{6B} \) of physical events of a given subluminal agent: In tachyon physics, the words “subluminal observer” and “superluminal observer” appear often but they are used without distinguishing between the brain and the mind of an observer. We can apply that theory to P1-and-matter space by replacing the two phrases respectively with “sub/superluminal agent” with the understanding that “observation” in physics implies access by subluminal exchange of energy.

To take into account the fact that our instruments and our brain, when only bradyons are present, do not register the three dimensionality of time, but only of space, one needs to obtain the usual four-dimensional subluminal transformations of coordinates from the six-dimensional coordinate transformations. Pavšič (1981a; 1981b) achieves this by assuming PMES, i.e., a subluminal agent B can subliminally access only those space-time points whose time vectors are parallel to a certain time direction \( \mathbf{m} \) in \( \mathbb{M}^6 \). He shows that PMES implies that all 6-vectors (events) which are physically accessible to a given subluminal agent B are situated on a four-
dimensional Minkowski sheet $M_{4B}$ embedded in $M_6$ ($M_{4B} \subset M_6$), and recovers all equations of the usual four-dimensional relativity. The physics on $M_{4B}$ when only bradyons are considered, is just the usual relativity. All other 6-vectors, not lying on $M_{4B}$ are not accessible to an object on $M_{4B}$ by subluminal exchange of energy.

**Space-time $M_{4T}$ of accessible events of a given superluminal agent:** Because of the tachyon-bradyon symmetry in extended SR, Pavšič also assumes (without identifying mind with tachyons), that a tachyon $T$ can access by energy exchanges that are subluminal in the rest frame of $T$ (superluminal in the rest frame of $B$), only those space-time points whose time vectors are parallel to a certain time direction $m'$ in $M_6$. The assumption implies that all 6-vectors accessible to $T$ are situated on a four-dimensional Minkowski sheet $M_{4T} \subset M_6$. It turns out that the accessible events (space-time points) of a subluminal agent are not the same as the accessible events of a superluminal agent.

In the above analysis, if we identify the subluminal agent with a particular observer $O$'s brain $S$ and the superluminal agent with a particular tachyon $T$ in $O$'s mind, then the brain-event $BP$ corresponding to any material event $P_M$ observable by $O$ is in $M_{4S}$. According to PMES, one can choose in $M_6$, a suitably oriented and translated co-ordinate system $F$ such that a brain-event $BP_M$ (the neuronal adequacy event) has coordinates of the form:

$$BP_M(F): (t, o, o, x_1, x_2, x_3)$$

where $(t, 0, 0)$ is the vector in $T_3$ to which all brain-event time vectors are parallel. Now, the transcendent superluminal transformation $K$ transforms the frame $F$ to a frame $F'$ so that the coordinates of an event $(t, x)$ transform according to (Pavšič, 1981a)

$$K(t, x) \rightarrow (t', x') = (x, t)$$

In the superluminal frame $F'$, event $BP_M$ has coordinates:

$$K(BP_M) \rightarrow BP_M(F') : (t' = (x_1, x_2, x_3), x' = (t_1, 0, 0))$$

Here, $BP_M(F')$ is not in $M_{4S}$ because the brain cannot access the space-time point $BP_M(F')$ in $6D$-space-time by sending/receiving energy subluminally. For superluminal agents, the vector $t'$ has the role of the 3-dimensional time. Since it is also assumed (because of the postulate PMEPCS) that a tachyon $T$ accesses only those 6-vectors whose time directions are all parallel in $T_3$, $T$ can access $BP_M(F')$ only if $X = (x_1, x_2, x_3)$ is a time direction accessible to $T$. If so, $BP_M(F')$ is in $M_{4T}$. Since $BP_M(F')$ is not in $M_{4S}$ it follows that events accessible to $S$ and those accessible to $T$ are not the same in $M_6$. Moreover, there exist many brain processes which do not create any awareness, and therefore not reported by the sentient observer; such events are in $M_{4S}$ but not in $M_{4T}$. Thus, the physical space $M_4 = M_{4S}$ and the tachyon space $M_4' = \cup M_{4T}$ of all $T$ in $O$'s mind, are different subspaces in $M_6$.

This conclusion is compatible with Smythies’ hypothesis that physical world and phenomenal world (even without including El-type events) contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time.

However, $M_4 \cap M_4'$ is not empty. If $BP(F)$ is of the form $(r, 0, 0, r, 0, 0)$ then $K(BP) \rightarrow BP(F') : (r, o, o, r, o, o) = BP(F)$. Therefore, $BP(F)$ is in $M_{4S}$ and also in the space $M_{4T}$ of a tachyon $T$ whose accessible time vectors are also parallel to $(t, 0, 0)$. Vectors $(r, 0, 0, r, 0, 0)$ form the boundary between the matter and tachyon spaces where particles travelling with the speed of light live.
Figure 2. Events observed by the brain and its mind lie on different subspaces of 6D-space-time. B_{P,M} \leftrightarrow P_{M}: To every material event P_{M} reported by O, there exists a corresponding neuronal adequacy event B_{P,M} in O’s brain S. The neuroscientist N and other subliminal observers who are at rest relative to O (call them the N-team), can observe both B_{P} and P_{M} by receiving sensory or physical signals from them. P_{M} is in M4 because S accesses it. B_{P} is in M4 because N reports it. O’s mind S’ accesses B_{P,M} superluminal; interaction between S’ and S creates P_{I} corresponding to P_{M} in the form of tachyons. Q \leftrightarrow B: To every event Q imagined by S which O is aware of, there exists a corresponding material event B_{Q} in O’s brain S. S’ accesses B_{Q} superluminally resulting in occurrence of Q. N-team observes B_{Q} but not Q. Observer O is ‘now’ aware of either P or Q according as either B_{P,M} or B_{Q} creates P_{I} in S’.

The ‘now’ of an observation

Consider the neuronal adequacy event BP in the brain S of observer O corresponding to a ‘conscious’ event P, a material event or of EI-type. If we assume S to be a quantum system, the wavefunction of S undergoes an associated collapse. According to our tachyon theory of the mind, awareness of P occurs because the collapse produces ZETs describing P (Hari, 2011). In the frame F in which S is at rest, according to PMES, the coordinates can be written in the form:

$$BP(F) : (t_{1b}, O, O, x_{1b}, x_{2b}, x_{3b})$$

where the space-coordinates \((x_{1b}, x_{2b}, x_{3b})\) can be taken to be \((0, 0, 0)\) because when one monitors the formation of a neural map, the completed neural map occupies the same place as where there is no such map earlier. The time \(t_{1b}\) is the time taken to build the map as measured by the monitoring neuroscientist. In the superluminal frame \(F’\) in which the ZETs (in the mind S’ of O) are at rest, coordinates of BP are then given by the transcendent superluminal transformation K as follows:

$$K(BP) \rightarrow BP(F’) : (t’ \sim (0, 0, 0), x’ = (t_{1b}, 0, 0)).$$

Thus, O’s mind is aware of P at time t’ \(\sim (0, 0, 0)\), i.e., as happening ‘now’.

Therefore, the tachyon theory of mind agrees with Smythies (2003) who says that the experienced ‘now’ of time in a block Universe is where consciousness is, or the experiencing subject is but not where his or her physical body and brain are. Further, he says that the present is a moment of physical time fixed by relation to an observing mind and that the observer’s mind in a block universe with a shifting ‘now’ of time must be some entity in addition to the physical body.

PART II

Role of tachyons in voluntary action, conscious will, and brain activity prior to awareness of intention

Baars and Gage (2010) point out that human cognition is forward-looking, proactive rather than reactive and that transition from mostly reactive to mostly proactive behavior is among the central themes of the evolution of the nervous system. We have visions of the future and formulate goals, plans, hopes, and ambitions, all of which pertain to the future and not to the past. Then we act according to our goals but to do so, these mental images of the future must become the content of our memory; thus the ‘memories of the future’ are formed. The frontal lobes endow the organism with the ability to create neural models as a prerequisite for making things happen, models of something that, as of yet does not exist but which you want to bring into existence.

Some time ago, experiments performed by Libet et al. (1983; 1985) seemed to show that the brain but not our conscious will is what initiates voluntary acts. But our perception is otherwise;
we think that the conscious intention to achieve a desired future state causes us to take the required action, for example, I take a bus to New York (NY) if I want to go to NY. This feeling occurs probably because no required action would be taken if there is no conscious intention to achieve the goal, or if there is a conscious change of mind; moreover, the conscious decision to act does precede the action as verified by Libet’s experiments and later by others. When we do perform an action with a purpose or a goal in mind, the result of the action will be most likely, the desired state in the future (unless of course, some external influence prevents the future state from happening) but the action begins in the present. More importantly, the action necessarily depends upon at least some information pertaining to the desired future state, for example, if I want to go to NY I will take a bus to NY but not to Philadelphia. If building the goal record (a neural model of something that, as of yet does not exist) is a prerequisite for the required action to take place, where does the brain get the information about a state in the future? The answer to this question cannot be that all the information comes from the environment and the brain’s past memory although for example, when the goal is to reach a visual object, the brain uses inputs from the environment to create a neural correlate (NC) of the goal. The scientist infers from the organism’s behavior and location of the NC whether it is a goal or something the organism has only seen but has no desire to reach. So, whatever scientists observe is not what tells the brain to build a model of a future state. The point is that there is no time information in any sensory input received from the environment. Hence the questions: who assigns the label “future” as opposed to “past” or “present” to the neural model? “Who initiates the goal record creation?” are not yet answered. It would be reasonable to assume that the physical brain cannot initiate a new process all by itself (because it would be against the law of causal closure). Even if one argues that the physical brain is a quantum system, and that spontaneous quantum processes such as spontaneous emission happens, such processes happen because of the system being in an unstable state as far as is known. Moreover, the decay phenomenon is irreversible whereas in the case of voluntary actions, one can always have a change of mind until the action has started and even afterwards if the duration of action is long enough. In addition, it seems reasonable to assume that will/volition is not a result of instability. Even the notion called “downward causation” used to explain emergence and self-organization phenomena of some physical, chemical, and biological systems does not answer the above questions because downward causation is irreversible also.

In what follows, we will consider the question of whether tachyons can inform our subliminal brains about our future without violating causality. If tachyons are able to do so, then our hypothesis that all thoughts including intention and will consist of tachyons implies that unconscious will/volition can initiate a goal achieving process. Indeed, some time ago, physicists Recami (1980) and Pavšič (1981a) answered the question in the affirmative. We will adopt the Pavšič approach that uses extended SR in six dimensions to the brain-mind system, and find that unconscious intention in the form of tachyons can define goals to our brains and direct them to achieve the goals.

1. Tachyons can indeed inform us about an event \( P^* \) with time vector \( t^* = (t_1^*, t_2^*, t_3^*) \) whose length \( |t^*| \) is greater than the presently perceptible time \( t \) (Pavšič, 1981a)

In the 4D-space-time of the conventional general or special relativity, all world-lines are ‘frozen’ and strict determinism is valid, there is no room for observer’s free decision. This is not so in a higher dimensional space such as M6 in which our space-time R4 is a 4-surface. The succession of brain events BP of an observer O (as seen by a neuroscientist monitoring O’s brain) is a progression through M6 of a certain 3-dimensional flat hypersurface E3 of ‘simultaneous’ events. If one adheres to the classical (non-quantum) physics even in 6D-space-time, then E3 moves forward in a prescribed direction in the 3-time. (Similarly, a hypersurface \( E_3' \) of a superluminal agent S’ moves forward in a prescribed direction in its 3-time which is the 3-space for the brain). But in reality, while O can control some parts of E3 motion consciously (for example, by moving arms and legs), others parts of E3 are not prescribed because O has no control over for example, the weather, accidents, etc. Furthermore, on a sufficiently small scale, the motion of E3 can be subject to unpredictable quantum fluctuations. Assuming that inputs from the environment are not predetermined because of its large number of degrees of freedom, the
progression of E3 is not prescribed for the brain. Each time O decides his/her next move, or O’s brain registers a perception about its environment, the brain’s wave function collapses giving rise to conscious experience.

E3 motions span a 4-dimensional surface\(^5\) in the higher dimensional space M6. Since the progression of E3 in M6 is not predictable, the events on V4 are not predictable. At each collapse point, there exist in M6 various possible events and various possible universes V4(1), V4(2), etc. out of which the actual universe V4 containing the actual event BP is just one. Tachyons (the dotted line in Figure 3) can inform O about a future event P1+ on V4(1) by following a time path different from the one in V4(1). O can then decide at BP either to follow the route V4(1) leading to P1+, or to follow some other route, for instance V4(2).\(^4\)

Some of the other possible universes V4(i) of O’s subluminal brain may be accessible to O’s mind. Denoting the set of all events in M6 which are accessible by the *superluminal* mind as \(V', O's\ mind can access simultaneously in 3-time, the cross-sections \(V' \cap V4(i)\). In other words, O can imagine some of the possible universes. Tachyons provide a possible way (Figure 3) for a *subluminal* brain to receive information from these other universes which consist of events that are situated outside the particular 4-dimensional space V4. When O receives information about a future event P+ lying on one such V4(i), O can choose to act or not to reach P+; accordingly, O will or will not experience P+ in his/her future, or somebody else may act and cause P+ not to happen before O reaches P+.

Among the inputs to the brain which it uses to create an NC of either a present experience or a future goal, or an EI-type event such as a dream, a neuroscientist can observe mostly those coming from the environment and sometimes from its past memory. In the case of EI-type events and intentional actions, there are inputs to the associated neural activity, which neuroscience does not yet know where they come from. For example, it is not yet known how the readiness potential building process is initiated.

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\(^5\) If E3 motion fluctuates, then the corresponding 4-dimensional continuum described by the progression of E3 is a curved space but not a flat one.

\(^4\) Thus causality paradoxes of tachyons are resolved because they are all essentially due to the possibility of receiving information from the future by means of modulated tachyon beams along V4(1).
Hari SD., Mind and tachyons in six-dimensional special relativity

hippocampus in future event construction is possibly a response to the novelty of these events. Here, the novelty which the brain recognizes cannot simply be that the information it has just received is not already there in its memory; the brain probably recognizes that the input from imagination is not all sensory as usual.

As shown in Figure 4, the second item in the list above follows the first. The third event in the list, namely, a trigger to implement the plan of action can enter the brain any time after the NC of the goal is completed but action can begin only after the plan of action is completed. This trigger is required because, action need not begin as soon as the plan is completed and may not even happen due to a change of mind or due to external circumstances. Change of mind can happen any time after one is aware of one’s own intention, will, desire, purpose, etc. before action starts. There is evidence in neuroscience for this functional sequence. The readiness potential (RP) observed in experiments related to voluntary acts seems to consist of the NC of the goal and that of the appropriate action plan. Haggard (2001) suggests that Lateralized Readiness Potential which consists of later parts of RP may indicate that the intention has progressed from abstract stage – “Do something or other!” to drive a specific movement – “Do precisely this!”

Thus the questions: “how does the brain acquire in its present memory, information regarding a possible future physical state of itself, “who initiates the goal record creation, and “who initiates action?” are answered as follows: Tachyons coming from a possible future state (for example the event $P_2^+$ in the 6D-space-time of Figure 3) can convey to the brain what its future should be and also trigger both the goal building and action-plan building processes. The intention which initiates the brain to build the NC of the goal remains unconscious until the brain completes the NC because both the intention and its NC are required for awareness. Similarly, change of mind is a tachyon coming from the predetermined future state $P_1^+$ in Figure 3. This simply tells the brain to reject the earlier NC and the partial or completed plan of action it has already built. Awareness of the change-of-mind arises immediately because this trigger does not require building new NCs but only stop further work.

![Figure 4](image-url) Functional flow in a goal achieving or volitional activity (future state realization).

**Conclusion and outlook**

The tachyon theory of mind in the space-time of the extended SR with three space and three time dimensions shows that tachyons can pass possible-future-state information to an observer’s brain without violating causality and thus explains why an unconscious readiness potential precedes the conscious intention to perform a volitional or goal-oriented act. Thereby the theory suggests the presence of unconscious thought. Our theory of mind satisfies the need for Special Relativity with extra time dimensions expressed by the modern...
neuroscientist John R Smythies in his theory of Material Dualism. His proposal that the physical world and the phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a space-time with higher-than-four dimensions turns out to be a conclusion of our theory.

In our analysis we stated that an observed material event $P_M$ and its corresponding brain event $BP_M$ are related by a transcendent (infinite relative speed) superluminal transformation. It should be possible to test this rule experimentally because the observer can report the coordinates of $P_M$ and the neuroscientist monitoring the observer’s brain can measure the coordinates of both $P_M$ and $BP_M$. Such a test would not only verify the validity of our hypothesis that the mind consists of tachyons but also indirectly verify the existence of tachyons!

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**References**


Libet B. Unconscious cerebral initiative and the role of conscious will in voluntary action. The Behavioral and Brain Sciences 1985; 8: 529-566.


We propose a hypothesis of a mathematical algorithm for coherent quantum frequencies, that may create stability of biological order. The concept is based on an extensive literature survey, comprising 175 articles from 1950 to 2015, dealing with effects of electromagnetic radiation on in vitro and in vivo life systems, indicating that typical discrete coherent frequencies of electromagnetic waves are able to stabilize cells, whereas others cause a clear destabilization. We find support for the hypothesis of H. Fröhlich, that a driven set of oscillators condenses in a broad energy range, may activate a vibrational mode in life organisms at room temperature. Taking into account the life sustaining frequencies, as extracted from literature, an algorithm of coherent frequencies of standing waves for the stability of biological order was inferred. Interestingly, we found that the origin of the particular biological algorithm can be mathematically approached by a selected “tempered Pythagorean” reference acoustic scale. The algorithm expresses one-dimensional wave equations known for vibrating strings. The origin of the biological algorithm was condensed in a mathematical expression, in which all frequencies have ratios of 1:2 and closely approach ratios of 2:3. This inferred algorithm was subsequently verified with regard to various frequencies of electromagnetic waves, as applied in the above-mentioned independent biological studies. It was also matched with a range of 23 different measured quantum resonances emitted by a selected inorganic silicate mineral, that is able to catalyze the oligomerization of RNA. The selected silicate was experimentally shown to act as a quantum replicator, specifically emitting EM radiation at frequencies that are fully in line with this algorithm. Such silicate quantum replicators, therefore may have been instrumental in the initiation of first replicating, life, cells at the edge of pre-biotic evolution. Our model may imply that, at the quantum scale, an underlying electromagnetically defined order may have been present, that was a prerequisite for the coding of synthesis and functional arrangement of cellular elements in biological evolution. Far infrared dynamics, reminiscent of coherent non-relativistic super fluids in 3+1-dimensions, may have played a role. Finally, we address the question whether the identified electromagnetic fields may also influence neural systems in general and human (self) consciousness in particular. We are finding support for recent electromagnetic and stochastic zero-point energy field theories in quantum consciousness studies. The striking similarity of electromagnetic wave frequencies, detected by us in the biological studies, and in selected clay minerals, as well as in color spectra, tone scales and sound induced geometric Chladni patterns, may indicate that we identified the involvement of a universal electromagnetic principle, that underlies the observed life sustaining effects and also may have been instrumental in the creation of biological order in first life and quantum consciousness.

**Key Words:** life algorithm, eigenfrequencies, coherence, biological systems, Bose-Einstein condensates, Fröhlich, silicate minerals, quantum replicators, EM frequencies, quantum biology, quantum field, consciousness

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1. Introduction

It has become clear in the last decades that living organisms on earth are exposed to various long distance fields such as gravity/inertia as well as to zero-point energy/dark energy fields, and in addition are exposed to a whole spectrum of electromagnetic radiation modalities, related to the physical constitution of earth and our planetary position in the solar and galaxy systems. Many studies indicate that quantum mechanical information may have had an essential role in the evolutionary creation of first life and the build up of consciousness in nature, in particular as to the multitude of life forms that inhabit earth (Davies, 2004, Kaufmann, 2015).

In humans, the extremely complex neural system for disposition of sensory and extra-sensory information is based on electro-chemical and neurohormonal signaling processes and concepts for quantum mechanical and electromagnetic operation of brain processes have earlier been proposed (McFadden, 2007, Pockett, 2012). The integral subject of quantum consciousness has been reviewed by Atmanspacher, 2008; Vannini and DiCorpo, 2008; Meijer and Raggett, 2014; Tarlaci, 2015, among others.

Einstein, 90 years ago, pointed out that bosons could condense in unlimited numbers into a single ground state since they are governed by Bose-Einstein statistics and are not constrained by the Pauli exclusion principle (Einstein, 1925). Fröhlich claimed oscillating charges in a thermal bath, in which a large numbers of quanta may condense into a single state known as a Bose condensate, which could constitute a physical and non-thermal interaction between cells (Fröhlich, 1968).

Open boson systems have been proposed by Luzzi and Vasconcellos, if sufficiently away from equilibrium, may have relevance in the functioning of information-processing biological and condensed matter systems. The so-called Fröhlich–Bose–Einstein condensation is a self-organizing-synergetic dissipative structure, a phenomenon working in biological processes and present in several cases of systems of boson-like quasi-particles in condensed inorganic matter (Vasconcellos and Luzzi, 2012).

Wave-particle duality in quantum physics was proposed from around 1920 and still seems a crucial concept. Yet, Einstein was not happy with a quantum jargon mixing wave and particle elements and was sure that wave-particle duality should be finally resolved in favor of a wave model perse. Indeed nowadays quantum biological effects at room temperature have been discovered (reviewed by Arndt et al., 2009; Ball, 2011; Lambert et al., 2013; Lloyd, 2014; Huelga and Plenio, 2013).

Schrödinger’s wave equation describes the statistical nature of eigenstates that exhibit wave-particle duality. The wave function gives the potential energy of waves and is associated with respective wave numbers related to wavelengths or energy levels known as a quanta. In his book ‘What is Life’ Schrödinger promotes the idea of the presence of a molecular code-script, which supplies external information to realize biological order in life cells. In this code script, coherent states of a classical harmonic oscillator might be involved in order to obtain a quantum description (Schrödinger, 1944).

Referring to quantum theory, Bohm evolved a theory of the universe, called the "Implicate Order" (Bohm, 1980). This theory resembles the concept of Richard Feynman, assuming that in quantum electrodynamics charged particles somehow generate spherical electromagnetic ‘in and out waves’ within a quantum field. A relation between ‘living’ and non-living matter has also been made by Wolfgang Pauli. He stated that the mental and the material domain are governed by common ordering principles, and can be understood as “complementary aspects of the same reality” (Pauli, 1994).

While the ecosystem is a system governed by neg-entropy, a driven set of oscillators might condense with nearly all of the supplied energy, specially activating the vibrational mode of the lowest frequencies at room temperature (Del Giudice, 1989). In this manner biopolymers make use of a quantum system of many bosons, according to Bose-Einstein statistics, being embedded in a surrounding field (Fröhlich, 1968; 1988). A possible way to describe quantum resonance is by wave interaction: there is not an irreducible randomness, and a driven set of preferred oscillators at certain frequencies plays a role to increase the degree of its coherence. Coherency of resonances has been studied, among others, for microtubules (Sahu et al., 2013 and b). A wave equation describing a Fröhlich system for cellular physiology has been proposed, which describes the coherence between individual
oscillations using a number of energy quanta concentrated in one vibrational mode above the thermal equilibrium level and using an ensemble of interactions counting two or three coupled oscillators (Pokorny, 1998; Šrobár, 2012). A model to predict electromagnetic resonances in proteins, RNA and DNA has been proposed, based on findings that energetic periodicities of delocalised electrons along a molecule are critical for the function of proteins, DNA and RNA (Cosic, 2015).

Coherence and interaction of waves is coupled to entanglement and it was Schrödinger who recognized entanglement as 'the characteristic aspect of quantum mechanics and suggested that eigenstates or preferred states are able to survive interaction with the environment (see also Ogryzko, 2008). Using the Laplace operator, the Maxwell wave equation can be taken in two parts: in a vectorial part, which results from this equation and in a scalar part, according to which the divergence of a field pointer is a scalar. If the field vector is derived from a scalar potential, then this approach leads to a wave equation, which is defined as a plasma wave. Solutions are known for electron plasma waves, which are longitudinal oscillations of electron density (Meyl, 2002).

Interestingly, Pythagoras, a Greek philosopher and mathematician, has studied the mathematics of coherency of waves in the late 6th century BC, which is known as 'Pythagorean-tuning'. This aspect can be found for example in a musical tone scale, based on audible frequencies of a string, in which frequency ratios of intervals have been based on ratios of 1:2 and 2:3 and approximations thereof. The order and coherency of musical scales has been discussed by many physicists (Barbour, 1951). E. Chladni has already shown in 1787, that coherent patterns of geometric shapes are formed in suspended materials on vibrating thin square plates, exposed to typical pitch frequencies, also called eigenfrequencies.

We raised the question whether it would be possible to find direct evidence for this information-processing system in the room temperature range by: 1) analyzing preferred wave frequencies able to stabilize and modify living cells, 2) analyzing preferred wave frequencies in condensed inorganic matter and 3) to find a direct relation between coherent quantum resonances and preferred electromagnetic wave frequencies.

Three considerations were our starting point for the search to preferred frequencies of coherent waves for living organisms and condensed matter: 1) a supposed quantum wave model, 2) the, abovementioned, idea of Einstein that quantum randomness is not the only determinant of the fabric of reality 3) the conclusion of Schrödinger that living cells need external quantum information for their development and ecological survival. To understand why electromagnetic waves and quantum states with typical frequencies have a positive or negative influence on cellular function, the current knowledge of physics/biology interactions on life organisms is highlighted in the present paper. A wide variety of studies is available about the use of electromagnetic waves to improve the viability and proper repair of cells, or to prevent the metastasis of cancerous cells. (see appendix 1). Yet, electromagnetic radiation also can have detrimental effects both in vitro and in vivo,

We found also that much relevant knowledge is available at present, about electrochemical features and nano-chemical properties of nano-materials, including their influence on biological systems and living cells. A unique form of wave coherence is supposed to be present at multiple scales in biology and a better characterization of this may have broad consequences for the understanding of living organisms as complex systems (Robert, 2012).

The following material is presented in four subsequent sections:

- The hypothesis of a mathematical algorithm for coherent quantum frequencies to create stability of biological order.
- Our meta-analysis of literature concerning the effects of non-thermal radiation on life systems, with the aim to identify preferred coherent frequencies of waves that apparently affect life and, on the basis of these results, attempt to define an underlying biological algorithm.
- To position these results in a wider perspective, namely in relation to the quantum vibration world we live in, with special reference to the electromagnetic absorbing and radiation modalities of complex clay minerals that may
constitute potential life-protective quantum wave replicators

○ To discuss these crucial electromagnetic transmutation and signaling properties of silicates in relation to the quantum conditions that may have been instrumental in the creation of first life, as well as the potential influences on quantum neural resonance and coherence.

2. Hypothesis of a mathematical algorithm for coherent quantum frequencies to create stability of biological order and its verification

In theoretical physics, quantum field theory (QFT) is a theoretical framework for constructing quantum mechanical models of subatomic particles in particle physics as well as for quasi-particles in condensed matter physics. Quantum field theory explicitly recognizes an extended vacuum field interacting with matter, as well as intrinsic quantum fluctuations. The entire universe can be seen as consisting of fields, reflecting a spectrum of particles such as electrons, photons, quarks, gluons, muons and Higgs bosons, of which the vibrations thereof are constantly interacting with each other. It is proposed that these fields consist of harmonious and coherent waves that can be described as quantized string oscillators. Inherent characteristics of a quantum field involve: 1) the presence of standing waves, 2) charged subatomic ‘particles’ in a plasma, 3) elementary particles represent field phenomena, 4) charged ‘particles’ generate spherical ‘in and out waves’ and 5) not only 3-D but even 4-D structures of waves are at stake. We decided to use an analogue from the science of musical scales, to describe such harmonious and coherent standing waves. This provides necessary preconditions to arrive at regular 3-D geometries, and also enable an entrance to 4-D geometries. The demands of tuning standing waves in order to attain a perfect coherent scale and associated temperament have already challenged many scientists from the earliest civilizations onward. Barbour surveyed these longstanding problems, and offered an account of the history of tuning and temperament (Barbour, 1951).

As mentioned above, the Pythagoreans worshipped whole numbers and held a belief that whole numbers can be used to explain ‘everything’ in the natural world. The most harmonious interval is commonly thought to be an octave (1:2) combined with a fifth (2:3), which is generally agreed to represent the second most harmonious interval, that is, within a tone scale of twelve basic frequencies. Standing wave patterns can be produced in a medium, if two waves of identical frequencies interfere in such a manner that they produce stable points along the medium. These points that have the appearance of standing still, are referred to as nodes and the variety of actual wave modalities can be produced by distinct patterns characterized by a collection of different nodes. Such standing wave patterns can only be produced at certain frequencies and each separate frequency is associated with a different standing wave pattern. The frequencies and their associated wave patterns are referred to as harmonics (see Figure 1).

For a fixed string there is also a direct relation between the harmonics and the overtones. The harmonic of a wave is the component frequency of the signal. This is an integer multiple of the fundamental frequency, i.e. if the fundamental frequency is $f$, the harmonics have frequencies $2f$, $3f$, $4f$, $5f$, . . . etc. (Figure 1). The harmonics have the property that they are all periodic at the fundamental frequency, and therefore the sum of harmonics is also periodic at that frequency.

An algorithm of multiple scales is proposed based upon a tempered Pythagorean scale and composed only by connecting approximated stacks of fifth’s (frequency ratio of 2:3), and octaves (ratio of 1:2), while 12 discrete frequencies fit within each octave. By making use of scales of fifths and octaves there is an algorithmic relation between the basic frequencies, the overtones and harmonic frequencies. Reasoned from one scale: 2 frequencies are ordered 1:2, 6 frequencies are powers of 2 and 3, 5 intervals are 2:3, 6 intervals approach 2:3 with a difference of less than 0.1%, and one interval approaches 2:3 with a difference of less than 1.34% causing circular polarized traveling waves. If a frequency of one cycle per second is used, which is 1 Hertz, than all frequencies in all scales can be calculated. Under these conditions preferred coherent frequencies also called scalars of a so called ‘reference scale’ can be calculated: 256.0, 269.9, 288.0, 303.1, 324.0, 341.15, 364.7, 384.0, 404.5, 432.0, 455.1, 486.0 Hz.

This particular scale is called a ‘tempered Pythagorean scale and it’s patterns of harmonic and coherent waves can be extended to all frequency scales: all lower and higher preferred
frequencies are entangled by this scale and can be simply calculated by multiplying or dividing each preferred frequency of this reference scale by powers of 2. In this manner about 127 scales having coherent algorithm frequencies can be derived from 0.001-Hertz till the highest possible frequency of ≈6.2×10³⁴ Hz. The latter is related to the smallest theorized unit of distance of the Planck length, as represented in a mathematical algorithm of coherent frequencies. Examples of preferred frequencies according to the 'mathematical' algorithm have been given in appendix 2. Mathematically, coherency can be described by multiple one-dimensional wave equations for vibrating strings with algorithmic intervals (Figure 1 and D’Alembert, 1747).

Figure 1. Molecular structure of a clay mineral (A and B) and wave function describing the ordering principle in life processes as an algorithmic standing wave system (D) that can be derived from the wave equation depicted in the inset (C).

It is proposed by us that, in principle, the nature of these preferred frequencies of electromagnetic waves can also be found in the frequencies of quantum states of atoms and molecules. Therefore, these frequencies, might be able to stabilize Bose-Einstein condensates at room temperature. It is further hypothesized that nature makes use of these frequencies to create stabilization of biological order within a natural quantum field, as once discussed by Schrödinger. Next to this it is proposed that nature makes use of quantum replicators such as clay minerals able to emit these preferred quantum frequency waves, and thereby also may have played a role in the creation of first life.

The mutual coherence of resonances and interference of quantum states of ions, molecular groups may explain many of the current paradoxes surrounding the non-thermal action of electromagnetic fields on living cells. Abundant sources of literature were available, in which effects of ‘non thermal non ionizing radiation’ on the viability of cells have been described. Typical biological effects of ‘non-thermal’ natural as well of man made electromagnetic waves on living organisms are well known:

1) Influences of natural Schumann electromagnetic waves on the well-being of human individuals and other living organisms has been found (König, 1960).

2) 'Non-thermal' millimeter waves affect cells in coherent multi-quantum oscillations only at specific frequencies, being separated by wide ranges of non-effective frequencies (Devyatkov, 1974, Fröhlich, 1988, Betskii, 2000).

3) Harmonics and subharmonics of biologically important ions are involved in frequency-dependent effects in different cells at extreme low frequencies (Blackman, 1979).

4) Natural microwave resonances present in the upper atmosphere have a positive or negative influence on well-being of living organisms on earth (Avakyan, 2006).

5) Biological effects of non-thermal man-made electromagnetic waves on cells take place (Cifra, 2011).

6) Symptoms such as fatigue, stress, irritation, frequent headaches and sleep disturbances due to the presence of electronic devices and electric cables have been found (Zwamborn, 2003; Adang, 2006; Nittby, 2007; Johansson, 2010; Havas, 2013).

7) 'Non-thermal' electromagnetic fields can have effects on stem cell gene expression (Muehsam, 2014).

8) There is a functional role of rhythmic neuronal synchronization, which is called a ‘communication through coherence’ (Bastos, 2014).

9) Tubulin and microtubules have specific resonance frequencies in the range from kHz to THz (Sahu and Bandyopadhyay, 2014).

10) Biological functions of “serial” signaling pathways of proteins can be described by spectral patterns of peak frequencies from a field perspective (Persinger, 2015).

To verify the proposed underlying algorithm, we studied the reports of biological
studies from 1950 to 2015, dealing with effects of electromagnetic radiation on in-vitro and in-vivo life systems, in which typical discrete frequencies of electromagnetic waves, were chosen by the particular authors. Collectively, 175 independent biological studies were identified, describing the influence of single preferred wave frequencies on cells. In total 97 different frequencies of electromagnetic waves were applied in these studies, that were found to support the quality of cells, whereas 5 typical frequencies were reported that negatively influenced cells (see appendices 1 and 3). All of the applied frequencies are in the frequency band from extremely low frequencies: one tenth of a Hertz to high frequencies: PHz, and replication studies of the applied frequencies have generally been made.

The experiments in these studies were in the areas of: neuro-stimulation, brain stimulation, spinal cord stimulation, self-assembly via tunneling current of microtubulins, transcranial magnetic stimulation, reduction of Parkinson, anti-proliferative effects on tumor cells, inhibition of tumor growth, improvement of memory, rhythmic neuronal synchronization, improvement of attention, wound healing, decrease of inflammatory cells, increase of bone growth, reduction of diabetic peripheral neuropathy, increase of fibroblast proliferation, stimulation of angiogenesis, granulation of tissue formation and synthesis of collagen, promotion of proliferation of human mesenchymal stem cells, entorhinal-hippocampal interactions, among others.

The different, beneficial, frequencies identified by us in this total data base as derived from these studies, were established to be manifest in a broad range of ELF, kHz, MHz, GHz, THz and color-frequencies. Listing the various EM (electromagnetic) frequencies used, pattern recognition shows that all of the registered biological frequencies can be positioned at or close to all scalar frequencies described by the mathematical algorithm with a strikingly narrow band width.

This implied that the particular 97 different radiation data from the 175 studies, represent about 190 different frequencies, representing also a biological algorithm and provide a first clue for an underlying mathematical algorithm. Based upon these findings and the proposed algorithm, all of the applied biological frequencies, representing 97 local maxima, can also be normalized to a mathematical ‘reference-scale’ with 12 local maxima, by dividing or multiplying the reported applied frequencies by powers of 2. It could be concluded that the normalized biological frequencies show a distinct pattern at and around these 12 scalar reference frequencies of local intensity maxima (Figure 2). A measure of exactness, compatible with the conditions of the algorithm frequencies, is the mean absolute difference in between the applied and calculated frequencies, and represents a band width around the 12 preferred frequencies. This band width, calculated for the investigated biological experiments, is very small and amounted to: 0.78%. The highest possible theoretical coherency can be met when the mean bandwidth is 0%, a high coherency is assumed at around 0.78% and no coherency exists when the mean bandwidth is >1.50%.

![Figure 2. 12 algorithmically based, scalar, frequencies, at which biological experiments with 97 different frequencies could be positioned. The EM frequencies were experimentally applied to various in vitro and in vivo life systems, resulting in beneficial effects. All data at frequencies of Hz, kHz, MHz, GHz, THz could be normalized in an logarithmic acoustic reference scale (Hz). Each point indicated in the graph represents an individual experiment. For clarity, points are evenly distributed along the Y-axis, according to the number of experiments within each apparent frequency band.](image-url)

We conclude that all selected biological frequencies from the independent studies, over a wide spectrum of frequencies of EM waves, fit with the calculated pattern of the proposed mathematical algorithm of frequencies, and show a high coherency in a frequency window of one tenth of a Hertz till PHz.

**Detrimental effects**

Interestingly, a total of 11 articles were identified that showed negative biological effects of EM
waves, in particular when living cells were exposed to frequencies just in between the above mentioned coherent frequencies of the algorithm. These biological studies were performed in the very different areas of mutagenic response, phototoxic effects on the human eye, alterations in immune reactivity, decrease in sperm viability parameters, increased anxiety-related behavior, reduced mobility, and neurological depression. The particular non-favorable values were invariably located at frequencies, exactly in between those that were favorable for life processes, within a small bandwidth. Studies on radiation exposures of eyes, for example, showed that frequencies of blue light around 435 nm are clearly phototoxic for the human eye health, especially with regard to detrimental effects on the retina (Smick, 2013; Tomany, 2008). The wave frequency of 435 nm is just in between two calculated coherent colors of the algorithm at 420.8 and 449.4 nm (appendix 2), and showed a distance of 0.02% from the calculated (not preferred) frequency. This value was further designated by us as a non-coherent color blue.

Photosynthesis

The evidence for essential quantum effects during photosynthesis has already been shown (Engel, 2007; Whaley, 2011, Butkus, 2015). The reason that efficiency of this process is so high in living plants, is that the entire process of transmitting solar energy inside the leaves takes place under the conditions in which the energy remains in a quantum state. Quantum coherence in electron transfer in photosynthesis lasts for a long time (600 fs) in the pigment–protein complex (Engel, 2007; Ishizaki, 2010). But it is not yet fully known how this coherence is brought about in living tissue, although it has been shown that environmental noise increases energy delivery efficiency (Panitchayangkoon, 2010; Collini, 2010). The inferred algorithm of the present study shows that this coherence may be embedded in both higher and lower frequency bands. Plants are using mostly chlorophyll a and chlorophyll b in the process of photosynthesis. Of note, the color frequencies of chlorophyll show distinct maximum absorption peaks in blue and in red regions of the visible spectrum near chlorophyll: 450 nm and chlorophyll: 675-680 nm. Both color wave lengths are close to the proposed preferred frequencies described by the algorithm at a mean bandwidth of 0.59%, which means that both color frequencies are highly coherent. Pigment spectra of algae are also close to the proposed preferred frequencies: 340 nm, 740-750 nm, phycoerythrin: 560 nm, phycocyanin: 605-610, phycocyanin: 630 nm: chlorophyll: 420-450-675 nm, (Myers, 1999; Griffiths, 2011, Astoreca, 2005), and show a mean average bandwidth of 0.44%.

Color spectra

How our brain separates the properties of light, energy and wavelength, and then recombines them into color perception is still unknown (Wright, 1946), but color should be explained at the level of single cells in our brain (Gouras, 2007). Color scales have been studied by Newton in 1704 and by H. von Helmholtz in 1867. Helmholtz proposed an analogy between colors and sound, and has published this concept (Helmholtz, 1863; 1867). He did not attempt to provide a quantitative determination of the wavelengths of the proposed analogy. The color scale proposed by Helmholtz approaches the color scale based upon the algorithm, that is if 432 Hz is used in the concept of Helmholtz instead of a pitch of 440 Hz.

Musical tone scale

A musical tone scale can now be calculated making use of the algorithmic frequencies. The tones in this scale has a frequency ratio of 1:2 and approaches the ratio 2:3, and 6 frequencies of the tone scale obey to powers of 2 and 3, which means that the tone A is tuned at 432 Hz and C at 256 Hz, which is the same tone as proposed by mathematician John Herschel in the mid-19th century. A similar scale has been proposed by the Schiller Institute in 1939, but a pitch of A at 440 was accepted internationally and standardized by the International Organization for Standardization in 1955, in order to serve as the audio frequency reference. James Furia and many others have later asked to use A at 432 or C at 256 be the standard, which was often used by classical composers and resulted in a tuning of approaching whole number frequencies (Furia, 2012).

Sound induced geometric shapes

Researchers have further validated the connections of sound and mechanical vibrations on the basis of geometric shapes: at typical pitch frequencies geometric patterns will be formed.
The German scientist Ernst Chladni was the first in 1787, who made a clear connection between sound waves and the generation of visible coherent standing waves in a membrane. Later, Nathaniel Bowditch, 1815 concluded that these structures arise because the frequencies are approaching whole number ratios to each other: 1:2, 2:3, 3:4. Eigen-frequencies of Chladni patterns have been analyzed by us for thin square and round plates at 96, 142.2, 190, 340, 490, 800, 1033, 1225, 2041, 3240, 4129, 4671, 5201, 5907, 7800 Hz. It turns out that this sequence is very close to the proposed algorithmic frequencies in the present paper, and shows the same coherency of scalars.

3. The role of nano- and submicron minerals as quantum replicators

Aristotle observed unity in living and in lifeless objects and developed the idea of matter and form. Life was supposed to be supported by a principle of life: the form (Greek morphe, Latin forma), that “informs” a specific type of matter (Greek hyle, Latin materia), such that it becomes a living organism. More recently, Davies, considered the existence of quantum replicators, related to a potential quantum algorithm. He argued that quantum mechanics may play a nontrivial role in various life processes, particularly in the physics determining the speed of polymerases (Davies, 2004). The need to involve quantum mechanics to understand the origin of living cells is firstly due to the fact that quantum processes allow a large amount of a priori information to be stored, and second, that quantum processes may better explain the accuracy by which the 3-dimensional molecular machines are constituted and work (Melkikh, 2004). A system with a large number of entangled qubits in a pure state might (in principle) maintain itself (Matsuno, 2012).

Nano- and micron mineral particles, present in nature, can exhibit preferred coherent condensate frequencies and thereby may act as energetic oscillators, able to supply externally quantum information to living cells. Silicate minerals, for example, can have a high coherency of frequencies and may act as a template for preferred discrete oscillations. These minerals have been regarded as candidates for trans-material catalysts, since they are resonance carriers that are able to resonate within a quantum field (Bechmann, 2013). Therefore, a causal association between preferred coherent frequencies of minerals and biological frequencies might exist.

It has been found that ‘Eigenstates’ of metamaterials, based upon nano and submicron silicate minerals, can have coherent frequency patterns located in bands of UV, colors, IR, FIR, MHz, ELF and approach mutual frequencies ratios of 1:2 and 2:3 (Geesink, 2014). The same minerals are candidates to catalyze the formation of RNA-like molecules (Pitkänen, 2015) and have typical eigenstates. ‘Eigenstates’, in quantum mechanics, are states with a characteristic wave function, independent of time, corresponding to typical quantum states and eigenfrequencies. The investigated silicates show boson-like quasiparticles resonances, which have been measured by Geesink, 2014, by low frequency Raman, FIR spectroscopy, Fourier transform infrared spectroscopy, photoluminescence as well as UV Spectroscopy, X-ray spectroscopy (the latter to detect inherent radioactivity) and were shown to be located within scales of X-ray, UV, light, IR, FIR. Of note, extreme low frequencies (ELF) may also play a role, but one did not yet succeed to measure these frequencies. A potential relation between these ELF frequencies and ion-cyclotron resonances might exist.

Meta-materials, such as clay minerals, are condensed materials, engineered in assemblies of multiple individual elements that are arranged in periodic patterns and gain their specific properties from their composition and designated structures, such as their precise 3-D shape, micro-geometry, overall size, molecular orientation and arrangement, features that also determine their generated electromagnetic waves and quantum transitions. Meta-materials show a relation with “geometry-fractality-quantum dynamics” and therefore unison and harmonic oscillations may occur. Typical meta-materials are clay minerals, that have also been studied by scientists, who try to unravel the origin of life. Coyne (1985) has discussed a possible energetic role of quantum states of silicate surfaces in the evolution of life (Figure 3).

The electronic structures of the minerals have been considered in terms of band theory and localized defect centers and provides a predictive theoretical framework from which to rationalize the capacity of these materials to store and transduce energy.
Figure 3. Phyllosilicate mineral with stabilized ion/water clathrates. The metal ion-doped silicate structure exhibits platonic geometries (After G. Sposito).

The bulk crystal is seen as a collecting antenna for optical, infrared and electronic energy, of which the defect centers serve as storage sites. The mobility of charge and electronic excitation between the defect centers may constitute a primordial inorganic electron transport chain (Coyne, 1985). J. Ferris studied the same types of minerals, formed by the weathering of volcanic ash, and found that these minerals may have played a central role in the origin of life. The structure of this clay mineral allows the adsorption of organic compounds and, among others, this contributes to the ability to catalyze the formation of RNA molecules (Ferris, 2005). Szostak found that the same clay minerals aid in the creation of vesicles that are needed to create a primitive cell (Szostak, 2005). Phyllosilicates (see Figure 3) have also been proposed as binary automata and as non-rectangular lattice analogs of “Conway’s Game of Life” cellular automata: in the clay each node updates its state in a discrete time, depending on a sum of states of its three (silicon) and six (oxygen) neighbors (Adamatzky, 2013). In this framework, the origin of chirality of bio-molecules has been related to so called Rydberg matter, which are highly excited clusters of atoms with one valence electron of a principal quantum number n >>1, that generate circularly polarized light and are present in the higher atmosphere (Holmlid, 2012).

Silicate minerals, within the class of a potential catalyst for RNA, are able to emit assemblies of electromagnetic waves at typical frequencies, caused by the different quantum states, when activated by energy (see section 4). The discrete frequencies of these quantum states are in the spectra of ELF, FIR, IR, light, UV and X-ray (radioactive elements), and are located at the scalars described by our algorithm.

The measure of coherency of these silicate frequencies can be calculated by taking the mean absolute difference between the measured frequencies and the calculated preferred frequencies according to this mathematical algorithm.

The calculated absolute bandwidth amounts to 0.75% for 23 different measured frequencies, which means that the coherency of the resonant frequencies of the silicate is high and occurs at the same level as the coherency for the selected 97 different beneficial biological frequencies identified by us in the total established data base of derived biological studies. This was shown to be manifest in a broad range of ELF, kHz, MHz, GHz, THz and PHz. An example of the preferred frequencies of this silicate mineral in the THz-range is given in Figures 4 and 5.

4. Electromagnetic signaling properties of clay under quantum conditions that may have been instrumental in the creation of first life

Clays as assemblies of silicate minerals are proper candidates for key elements in prebiotic evolution, since they can replicate and can form a dynamic basis for the assembly of poly-alpha-aminoacids and poly-nucleotides in the process of the polymerization to oligomers (Ferris, 1996; Guggenheim, 1995; Hashizume, 2012). Yet polymerization alone is not sufficient: also a distinct functional sequence of the particular
building blocks is required. In this respect it is essential that clay-minerals, as mentioned above, also display electromagnetic properties (Adamatzky, 2012), both by resonating with non-local force fields such as zero-point energy wave activity, and in general can act as quantum wave replicators. We propose that the resulting wave patterns may induce an ordering influence on EM radiation sensitive life systems, with major implications for sequence coding in the formation of bio-molecules and/or protective (repair) effects aimed at preservation of coherence of metabolic networks.

Silicates have the presence of OH- groups, multivalent ions and water clathrates within the compacted nano and submicron galleries of silicium-oxide layers, which inherently have obtained a coherent vibrational character. It follows that this antenna structure is open for absorption and emission of quantum wave information. They can receive, as well as produce, coherent EM radiation patterns and, in this manner, in fact function as quantum wave replicators, (see Figure 5: depicting measured FIR-resonances versus calculated resonances according to the algorithm, and differences between measured and calculated values). The ZPE (zero-point energy) coded information might be collected and transferred to prebiotic (proto-cell) structures, offering coherent, entangled and neg-entropic information that can act as an ordering principle in the formation and assembly of cell components and life processes (see pictures in Figures 6 and 7).

A potential vehicle for quantum wave transition in nature, might be envisioned as a torus, enabling compression of information within the geometry of a toroidal field (see also section 5). According to Del Giudice and Vitiello, polarization waves predicted by Fröhlich in living cells are identified as the Goldstone massless modes which appear as a consequence of the spontaneous breakdown of a dipole-rotational symmetry and this breaking is provided by the water polarization induced by Davydov solitons travelling on molecular chains (Del Giudice, 1983). Infrared effects play a crucial role in the dynamical rearrangement of symmetry, which leads to the group contraction (Concini, 1976).

Berges proposed a universality class for longitudinally expanding systems, encompassing strongly correlated non-Abelian plasma’s and N-component self-interacting scalars. This occurs in the far infrared (FIR) regime of very high occupancies and leads to the formation of a Bose-Einstein Condensates. This theory can be cast as a vertex-resumed kinetic theory and it has been indicated that the IR dynamics are a non-relativistic system, where a self-interacting scalar field exhibits IR dynamics, reminiscent of turbulent nonrelativistic superfluids in 3+1-dimensions (Berges, 2015). Some of the life frequencies found by us are also reported by Rouleau and Dotta (2014) and are numerically fully in line with our present data.

Both electrons and photons (Williamson, 1997; Yépez, 2004) have been pictured as toroidal geometries (Figure 7). A torus consists of a central axis with a vortex at both ends and a surrounding coherent field. Energy flows in one vortex, through the central axis, out the other vortex, and then wraps around itself to return to the first incoming vortex. The torus is the fundamental form of balanced energy flow found in sustainable systems at all scales. The torus as a flow process exhibits a set of characteristics that evolution biologist, Sahtouris (2015) has identified as features and principles of living systems. Through her study, she has observed that when these features are present, the system is balanced and whole. However, when these features become compromised or absent, the system goes out of balance and becomes dysfunctional and corrupted to the point that it will either collapse completely, transform into a new balanced state, or restore its balance again by restoring the appropriate presence and functioning of these features. The features of healthy living systems that Sahtouris identified are: self-creation (auto-poiesis, complexity as...
diversity of parts, embeddedness in larger holons and dependence on them (holarchy), self-reflexivity (autognosis/self-knowledge), self-regulation/maintenance (autonomics), responsibility to internal and external stress or other change, input/output exchange of matter/energy/information with other holons, transformation of matter/energy/information, empowerment/employment of all component parts, including communications among all parts, as well as coordination of parts and functions.

This type of information integration, interestingly, is also applied in tonal theory (Purwins et al., 2007) and recently in music studies of Van De Bogart and Forshaw, 2015. The latter authors showed that quantum algorithms can be coded through toroidal information compression, using frequency resonance by which information can be encoded in electronic sound that in turn can be decoded to the original information. The particular information processing modality resembles a self-generating imagination that exhibits probabilistic fractal features for storing and retrieving information, thereby attaining a sort of neuralplastic quality. Toroidal flow may, in this respect, be conceived as a modality of rotational information flux, that returns to itself, a characteristic that may be the very basic mechanism for creation of awareness and (self)-consciousness.

If a silicate quantum replicator might have been instrumental in the very starting of life, then a major question is whether there is a relation between the quantum resonances of this replicator, geometries of local fields in and near this replicator and oscillations present in living cells. The science of “geometry” claims that everything in our universe has an underlying geometric structure following a fundamental principle (Wheeler, 1962). The knowledge of “geometry” can be used to explain how physical reality is constructed from the omnipresent and all-pervasive infinite background energy of the physical vacuum (Meijer, 2015). The five Platonic solids, named after Greek philosopher Plato, who first described these 350 years BC in his book Timaeus, were supposed to play a central role.

Charged particles: plasmas, electrons and electromagnetic waves might act as energy carriers, and have influence on geometries of clathrate hydrates. Assembled geometries of ordered phyllosilicates are able to emit coherent quantum resonances and stabilize different kinds of water dathrates (Sposito, 1999). They may also restore the connection and the access to natural fractal waves and natural quantum dynamics, by locally generating a natural pattern of quantum resonances. These patterns can be disturbed by noise of the surroundings as “non thermal non-ionizing radiation”. The different incorporated doped ions, and paramagnetic ions as well as the geometry of crystals of these silicates, are responsible for these coherent oscillations and obey to geometries/oscillations.

By emitting simultaneously quantum waves according to the resonant frequencies of the algorithm, inferred by us, a toroidal field of resonances in a natural plasma might be generated and stabilized, of which the assembly of resonances closely approaches a Fibonacci sequence: 1, 2, 3, 5, 8, 13... Therefore, we may be living in a diluted plasma with natural coherent quantum resonances making use of the principles of eigenfrequencies and orthogonal eigenvectors of symmetric matrices, which can be described by equations of standing and longitudinal waves, using ratios of a ‘tempered Pythagorean tuning’, based upon ratios of 1:2, and approximated ratios of 2:3, 3:4 showing constructive interference and circular rotation, due to relative phase shifts.

The evolution of proto-biotic or primitive non-living units, to even a minimal constitution of a real first life cell (Figure 7), was obviously not a single step as pictured, but rather an extremely long feedback sequence of subtle perturbations, induced by interaction with the environment, that finally gave rise to self-sustaining and replicating cells. In this process a number of features were gradually integrated: inclusion and further development of dynamic metabolic processes, including their timing and network organization, encapsulation of various essential organelles, including their functional localization in the cell, as well as the internalization and/or synthesis of required sensor and ion-channel molecules for internal and external communication. Additional instrumentation includes also a microtubule/microfilament apparatus for the capability of self-movement, in addition to information storage and retrieval modalities, forming a kind of primitive cellular memory. The biological organization of cellular life, in our opinion, is directly related to primordial information from the quantum vacuum (see also Grandpierre, 2014), that among others, is transduced by the clay mineral quantum replicator and exposed to the proto-biotic elements.
The miracle of the first cell: the potential role of quantum processes

- Superposition and entanglement of wave information
- Central information search in an environmental pool
- Parallel processing and selection of non-living states
- Goal directed backward causation due to time symmetry
- EM radiation in clay minerals as ordering quantum replication

Ca-ions as informational units: shielded Ca2+ in a vibratory state

Parallel processing

Wave/Particle duality

Figure 6. Non-trivial quantum processes in the creation of first replicating cells (left above), including parallel processing (inset right below) and complexity ordering as mediated by coherent EM radiation patterns. Inset, right above, depicts Ca2+ channel protein that is present at various locations in neuronal structures, as an example of a de-coherence shielded compartment, that allows coherent vibrations and thereby enables quantum wave transitions. Quantum phenomena such as superposition, tunneling, entanglement and time-symmetric backward causation may be instrumental in environmental information search and parallel processing/selection.

All this required the assembly of correlations that may have been enabled by the specific properties of fundamental quantum processes in all of these components, such as coherency, circular rotation, entanglement, quantum-tunneling, and non-locality (see Figure 6), including potential goal-directed backward causation, (Meijer, 2012). We consider the induction of quantum coherent domains in the cytoplasm and/or vibrational macro-molecules in organelles, as instrumental in these processes. In this respect, we propose that the resonance with EM frequency wave patterns of coherent environmental matrices such as typical clay-minerals, including intermolecular resonances of water molecules (Figure 7 A), might have had a non-trivial role as a prime organizational and ordering principle (see also Bischof and Del Giudice, 2013).

These frequencies are coupled to geometrical structures and conformational states of water molecules, act at characteristic monochromatic terahertz resonances and might influence the folding of biopolymers. According to the theory of Del Giudice et al., (1990), there is energy exchange between quantum resonances, electromagnetic waves and the so called vacuum or ‘zero-point field’. Quantum fluctuations and coupling between matter and electromagnetic fields in quantum-electro-dynamics predicts quantum coherence for liquid water even under ordinary temperatures and pressures. Their theory suggests that interaction between the vacuum electromagnetic field and liquid water induces the formation of large, stable coherent
domains of about 100 nm in diameter at ambient conditions, and these domains may be responsible for the special properties of water including life itself.

This implies that through the implicit feedback reaction from living organisms to the field, a sort of dynamic space-memory, outside the becoming life systems, might be permanently renewed and actualized. This enables parallel search procedures in nature as well as backward causation (also seen as nature's "precognition" capability). In the latter phenomenon weak quantum measurement may play a role, in which future events may influence the past (Meijer, 2012). The functional structure of a living cell can therefore be viewed upon as a bundling of useful information in which the entropic forces are counteracted by neg-entropic (syntropic) modalities. The latter originate from interactions with the direct environment as well as with long distant EM forces, including the zero-point quantum energy field, containing the final space memory for the recipe of life.

We propose that the underlying order, mentioned by Bohm, Fröhlich and Del Giudice, is also coupled to typical resonances of charged particles/electrons characteristic for the Rydberg states of nearly all elements present in the ionosphere, higher atmosphere, including top-layers of the earth, of which assemblies of resonances states are able to generate patterns of vortices and toroid’s in a natural quantum field. Noise like ‘non thermal/non ionizing radiation’ and chemical pollution are able to disturb these patterns, while typical silicate minerals acting as quantum replicators emit coherent resonances with power densities of around 0.0001 µW/m2 and are able to stabilize these patterns.

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**Figure 7.** The potential influence of coherent EM radiation frequencies, as an ordering principle in the creation of first viable replicating cells through ordering of water clusters (A). A minimal cell model is shown in (B). Ordering of essential cell components and metabolic processes from protobiotic structures to an ordered life cell, is shown (C) and (D). Clay minerals mediate EM absorption and EM quantum transmission as natural quantum replicators. Toroidal data compression and transmission in the life system, is required for further processing of the coherent signals (E).
5. Coherent quantum waves in relation to brain function and consciousness

Many scientists have proposed that there is a relation between consciousness and quantum physics (reviewed by Atmanspacher, 2011; Vanini and DiCorpo, 2008; Meijer and Raggett, 2014). Parallels between quantum mechanics and mind/body dualism were first drawn by the founders of quantum mechanics including Erwin Schrödinger, Werner Heisenberg, Wolfgang Pauli, Niels Bohr, and Eugene Wigner. Bohm stated that consciousness is not only present in animate life forms but also in inanimate matter since, energy, space, time and consciousness are not separate things. Umezawa proposed that quantum field theory (QFT) has a role in the working of the brain (Ricciardi and Umezawa, 1947; Stuart, 1978).

Synchronous and coherent firing at certain frequencies is related to the state of consciousness and attention. Gamma wave oscillation at 40–80 Hz is supposed to be related to attention and perception, while there is a relation with an internally generated magnetic field (Singer, 1998; McFadden, 2007; Cherry, 2003; Tarlaci, 2015).

Brain function requires complementary information processing mechanisms both at iso-energetic and quantum levels, enabling bottom up and top down information processing, which requires a nested organization of fine-tuned neural micro-sites that enable coherence/de-coherence transitions as a basis for information transfer (Meijer, 2014). It has also become clear that the brain should not be seen solely as a collections of neurons, but rather as a fractal network of a tripartite structure of neurons, glial cells and astrocytes, that intensively communicate, among others by Ca2+ fluxes (Pereira, 2010; Bieberich, 2012), even explaining the mechanism of general anesthesia (Thrane (Pereira, 2010; Bieberich, 2012), even explaining the mechanism of general anesthesia (Thrane et al., 2012). For a rapid and causally effective flux of information, as well as a continuous updating of a personal information domain, a “bi-cyclic” mental workspace was conceived, housing interacting and entangled wave and protein-based transitions that build-up and retrieve information from a universal knowledge domain (Meijer, 2014).

Such a cyclic mental workspace could operate at the atomic/molecular and field levels. One example of such a potential bidirectional information flow, is based on a central role of Ca2+ ions under the control of various neuronal proteins (Pereira and Furlan, 2011). In this concept Ca2+ is viewed upon as an informational vehicle influencing the activity state of the neuron, (Figure 8). Similar schemes could be imagined for other molecular mechanisms, mediating the tuning of cellular activity into large scale patterns, in the context of the creation of higher mental functions. As potential candidates, the hydrogen atom in relation to H2O and unpaired electron spins as present in in DNA, other metal ions and even O2 and NO molecules (if associated with membrane proteins), have been proposed (Hu and Wu, 2004).

The informational aspect of Ca2+ is encoded in positive and negative charges within micro-sites on the surface of a spectrum of flexible macromolecules, that allow binary choices at various spatio-temporal levels (see also Bieberich, 2012). The latter may also depend on ultra-rapid conformational changes in proteins in pico-seconds, as influenced by locally induced electromagnetic fields, that thereby obtain a probabilistic electro-magnetic vibratory character, an aspect that could also play a role in the earlier presented brain model (Meijer, 2015). In turn, local magnetic fields influence neural firing patterns and induce regional convergent zones of brain activity that are produced through sub-threshold excitatory postsynaptic potentials (EPSP’s) and inhibitory inter-neuronal synaptic activity, being amplified by reentry and recurrent circuitry (Pereira and Furlan, 2007). The importance of Ca2+ waves in fast strategic search algorithms, in a sort of bio-reaction quantum computing was earlier stressed by Clark (2012).
Total brain activity is therefore determined by genetic and epigenetic information, neuroplasticity, as well as functional cycles of efferent and afferent signals (internal copies and external mirror information), that reflect the interaction with the whole body and its environment and dynamically produce our inner worldview, earlier referred to as a “personal universe”.

Of note, much of the sequential steps depicted are situated in single neurons. Yet, our model, in higher-order levels, requires an integrating modality in which the firing patterns of millions of neuronal networks are translated in a meaningful overall coherent brain response. Sensory processing involves the formation of wave packets affecting large populations of neurons, instrumental in the reciprocal broadcasting of excitatory patterns located at several brain regions (Freeman and Vitiello, 2006), and inducing neuronal assembly. Interestingly, in this process calcium waves along the astroglial syncitium may play a role, contributing to collective oscillations and synchrony and thereby to efficient binding of distributed neuronal activity.

Proper information integration, transmission and exchange with outer information domains requires a guided interactive quantum process, in which the classical separation of sender and receiver is overcome through an act of measurement and/or proper resonance with the information source. This implicitly should be based on the phenomenon of entanglement and consequently on unitary and conscious field properties of the neural and exosystems (McFadden, 2007; John, 2001; Bohm and Hiley, 1987). This allows the continuous exchange of meaningful information with global magnetic fields as proposed by McFadden, 2007 and Burke and Persinger, 2013 and also a universal quantum knowledge field, as earlier proposed by Bohm and Hiley, 1987. The latter “implicate order” concept was suggested to contain also “personal” information: conceptualized as our mental double in the universal consciousness domain (Vitiello, 2001).

McFadden, 2007, proposed that the digital information from neurons is integrated to form a conscious electromagnetic information (CEMI) field in the brain. Consciousness is suggested to be the component of this field that is transmitted back to neurons, and communicates its states internally. The EM field is supposed to recruit neurons into local networks, thereby increasing the synchrony of neuronal firing, a phenomenon that is generally seen as correlating with consciousness. Thoughts are viewed as electromagnetic representations of neuronal information, and the experience of free will in our choice of actions is argued to be our subjective experience of the CEMI field, acting on our neurons. Pockett, 2012, however, implied that the EM field in our brain stands on its own, in the sense that it is generated by electricity of the brain, but does not influence the neural system in a broad feed-back reaction. Rather our EM field communicates bi-directionally with a global EM field, via wave resonance (see also Keppler, 2012, 2013, in the following). Pockett (2012) suggested that the EM field comprises a universal consciousness, that experiences the sensations, perceptions, thoughts and emotions of every conscious being in the universe.

The neuronal network clearly affords a dynamic vibrational structure, as present in membrane channel proteins (Bernroider, 2003), micro-tubular proteins (Hameroff and Penrose, 2013), as well as in DNA (Grandy, 2013). It is hypothesized by us, that this information-receptive neuro-system mirrors the antenna-like structures, described by our algorithm, as it is also present in organized quantum trans-conducting clay materials, were first life was supposedly initiated. In this respect Vattay and Kaufmann (2015) stated that “One of the fascinating aspects of life is the highly organized molecular machinery taking care of myriads of complex processes such as DNA replication, protein synthesis, cell division and metabolism, to mention only a few. Electric forces animating the parts require a perpetual and precise motion of charges throughout the system for perfect execution of biochemical tasks. Practically biomolecules, from small signaling molecules, to proteins and DNA surrounded by ions and water clathrates can take part in biochemical electronic processes, and belong to a class of molecules having semiconductor-like properties at physiological temperatures. Quantum order of semi-conductors exists when the different energy bands that corresponds to the different dopant types have been tuned”.

Keppler (2012; 2013) postulated that “the brain produces a stream of consciousness by periodically modifying the Zero-point energy field (ZPF, see for the latter Rueda and Haisch, 1998; 2005) and generating ZPF information states, within this all pervasive radiation field (De la Pena
and Getto, 1994; 2001). This process takes place by transient gamma-band oscillations and synchronization of cortical regions of our brain. These long-range activity patterns may represent the neural correlate of consciousness. The regular perceptual process, the alternation of synchronization and de-synchronization is supposed to be linked to theta oscillations. Whenever the brain activity falls into a stable attractor, there is a corresponding ZPF information state, which carries the integrated information of the attractor and might be characterized by specific correlations between frequency components of a ZPF spectrum. Every ZPF information state, in this concept, is associated with a conscious state, i.e., every ordered pattern in ZPF information space corresponds to a phenomenal state in qualia space. The brain together with the different neurological systems evidently provide an environment that is sufficiently stabilized against thermal noise, making the ZPF an agent and communication medium that orchestrates finally the brain activity. This indicates that the recurrent formation and dissolution of quantum states may constitute a fundamental mechanism in the brain. ZPF, therefore, seems to be a promising candidate for the carrier of consciousness”.

Consciousness, therefore, might be a fundamental property of universe itself, and our individual consciousness may constitute the result of a dynamic interaction process that causes the realization of ZPF information states (Keppler, 2012). This also implies that matter and consciousness have a common basis in the ZPF, and enable the orchestration of matter. The brain is viewed upon to be a complex instrument that selects and filters the varied shades of sensations and emotions out of the all-pervasive field of consciousness, the ZPF. Every attractor might act as a typical resonator and filter on the ZPF, and generates a characteristic frequency pattern, thus specifying a particular ZPF information state that is associated with a conscious state. In this way the brain may produce an individual stream of consciousness by periodically attracting information from the ZPF and, in turn, generating ZPF information states. Based on the hypothesis that the ZPF is the carrier of consciousness, only systems, that interact dynamically and coherently with the ZPF, while generating ZPF information states, are seen as sustainable, according to this interesting theory. Keppler states that, especially, complex systems, that have rich and highly adaptive attractor landscapes, can give rise to a broad spectrum of conscious experiences. The latter idea bears resemblance with the integration of information model for consciousness of Tononi, 2008.

6. Conclusions and final discussion

Electromagnetically seen, we may be living in a “diluted plasma” with natural coherent quantum resonances, that can be approached by equations for standing waves as present in strings, at 1:2 ratios and approximated 2:3 frequency ratios according to an algorithm of scalars. We propose that a natural quantum field makes use of, invariable, 12 typical basic quantum resonances, positioned in an algorithm, of which FIR frequencies are central basic frequencies, next to lower and higher coherent frequencies. The energy of these quantum resonances is around KT, and sufficient stable due to the entanglement of the algorithmic frequencies, and present in natural resonances positioned in frequency bands of: ELF, LF, HF, IR, Light, and UV. Natural resonances are supplied by metamaterials and Rydberg states of excited atoms and molecules. Metamaterials such as typical clay minerals act in concert with water molecules, and are able to transfer their FIR resonances to a diluted plasma, as the substrate of a quantum field. Also Rydberg excited atoms and molecules in the higher atmosphere at microwave and FIR frequencies transfer their resonances to stabilized water clusters, of which is known that there is a direct influence on biological effects (Avakyan, 2004).

All applied frequencies mentioned in the independent biological studies approach the proposed algorithm, within a small bandwidth. The overall mean distance (bandwidth) between the applied biological frequencies (97 different frequencies) and the preferred frequencies of the mathematical algorithm is 0.78%, which means that these waves are coherent. There is also a good statistical frequency match for a typical silicate mineral in the category that is able to catalyze RNA, as a proof of principle. Interestingly, there is also a striking match with color frequencies used in the photosynthesis of plants and algae, and a non-coherent blue-frequency showing phototoxic effects on the human eye health.

There is a good agreement with the ‘tone and color analogy’ proposed by Von Helmholtz,
when the frequency 432 Hz instead of 440 Hz is used. The proposed tone scale by Furia, approaches the algorithmic frequencies, while the eigenfrequencies of so called Chladni patterns in square plates show a quantitative resemblance. The proposed equation of the algorithm resembles the proposed equation of Šrobár to use a one-dimensional equation with two whole numbers as a Fröhlich ensemble of interactions counting two or three coupled oscillators (Šrobár, 2012). The model fits with the proposal of Ogryzko that 'preferred states' in biological systems can be protected from environmentally induced decoherence exactly, because they are 'preferred states' surviving interaction with the environment (Ogryzko, 2008). The relation found between the order of the quantum states in the selected silicate minerals and typical coherent frequencies applied in 175 independent biological studies, analyzed by us, shows that, at a quantum scale, there exists a similar underlying order, comparable to electromagnetic waves. It can now be considered that this order in nature is present in distinct quantum states as well as in electromagnetic wave patterns. We propose that in the present study, a potential template of oscillations is identified, as predicted in the book "What is Life" (Schrödinger, 1944).

If our proposed mathematical algorithm is operable in nature, then we may question the very reason for its existence. If a pre-quantum state or a "backfield" is considered, in which electromagnetic fields are quantized in the process of interaction with matter, according to this algorithm, then the matter involved has to be defined (Tegmark, 2007). We consider the possibility that a spectrum of silicates presents in the form of naturally occurring nano- and micron-particles and Rydberg states of atoms, as well as in molecules in gas clouds, support the implied oscillations. Such modalities are present in the cosmos, in layers of the earth, as well as in the higher atmosphere. Quantum resonances are supplied by these minerals, creating and/or stabilizing a quantum field, that can be characterized by frequencies described by the algorithm, in which stability of biological order can be maintained. In this concept, water molecules play an important role. Water is not only the medium for the reaction of biomolecules, but also the medium to spatially arrange molecules, and to keep their coherence (Del Giudice, 2009). Water is known to be nano-structured, affecting bio-molecular processes, including protein stability, substrate binding to enzymes, as well as electron and proton transfer. THz vibrational modes communicate by phonons via coupling of THz-frequencies to large water clusters due to electric dipole moments. By making use of wave information, on the basis of the proposed algorithm, this can lead to quantum coherence and Bose-Einstein-like condensation of such interacting water clusters.

Assumed that the here proposed algorithm is instrumental in a type of ordering, along with aspects of entanglement and fractality, there might be a link with multi-dimensional field dynamics. Multi-dimensional fields have been considered by many physicists: B. Riemann, for example, developed a general characteristics of non-Euclidean geometries in 1854, including curved spaces and higher dimensional geometry of manifolds. Chew proposed a three-dimensional tone model, in which tones are lined up on a helix along the circle of fifths (2:3), while Purwins showed double circular relations of the major and minor keys, based on all twelve pitch classes, which, interestingly, can be depicted in toroidal models (Chew, 2000; Purwins, 2007). It is considered by us that the described coherent quantum waves and their geometries are able to constitute vortices and toroidal like flow structures (Figure-7), which might be conceptualized as quanta flux of dark matter. It is expected that a 3D ordering of frequencies at 1:2 and closely approaching intervals of 2:3, can be mathematically described to enable the calculation of a coherent 3-D geometry of standing waves with well-defined eigen-frequencies. The particular 3D geometry might also enable an entrance to a 4-D geometry (to be published).

The primary waves in a plasma of a quantum wave field that are able to realize biological order, can therefore be coupled to standing waves and circular rotation among at terahertz frequencies. Waves in the so-called terahertz-gap are able to transfer energy between photons as well as electrons.

The underlying physical principles of the influence of ‘non thermal/ non ionizing radiation’ on living organisms are still not fully known, but a better insight in the underlying algorithm may give us further clues. We showed that ‘non thermal’ coherent frequencies, obeying the inferred algorithm, are able to stabilize cells, while frequencies just in between the proposed coherent frequencies, clearly destabilize these
cells. Of note, the geometrical study of the handling of quantum information is more fruitful when the global evolution of a system is taken into account, without disturbing its non-local nature, (Tarlaci, 2015).

To summarize, we propose that the frequencies, described by the algorithm identified in the present paper, are characteristic for the oscillations of a quantum field, in which we are living. Phyillo-silicates may therefore have been instrumental in biological evolution, since they can represent an ongoing dynamic constituent in the circular organized fabric of reality and evolution of consciousness. (Meijer, 2015).

As far as we can see now, we may have identified a quantum electrodynamic basis for life, that we tentatively hypothesize as a non-trivial building block for an electromagnetic principle in molecular biology. We are presently collecting further supporting physical and mathematical evidence for our hypothesis, surveying a spectrum of biophysical phenomena, exhibiting similar coherent wave patterns, as instrumented by toroidal information geometry.

References


Einstein A. Quantentheorie des ein atomigen idealen Gases. Sitzungsberichte der Preussischen Akademie der Wissenschaften 1: 3, 1925.


Fröhlich H. Bose condensation of strongly excited longitudinal electric modes. Physical Letters 1968; a 26, 402e403.


Holmlid L. Experimental studies and observations of clusters of Rydberg matter and its extreme forms. Journal of Cluster Science 2012;23: 5-34.


Appendix 1

Literature on the biological studies used for deriving the “life algorithm”

Authors of biological studies of frequencies applied to cells: beneficial effects


The complete reference list of the 175 surveyed biological studies, is available from the authors via mail request.
Appendix 2

Condensate frequencies according to the “mathematical” algorithm

4-8 Hz:
4.0, 4.22, 4.5, 4.74, 5.06, 5.33, 5.70, 6.0, 6.32, 6.75, 7.11, 7.59 Hz

32-61 Hz:
32.0, 33.7, 36.0, 37.9, 40.5, 42.7, 45.6, 48.0, 50.6, 54.0, 56.9, 60.75 Hz

64-122 Hz:
64, 67.5, 72, 75.78, 81, 85.3, 91.18, 96, 101.1, 108.0, 113.8, 121.5 Hz

255-487 Hz:
256, 269.8, 288, 303.1, 324, 341.2, 364.7, 384, 404.5, 432, 455.1, 486 Hz

16.3-31.2 kHz:
16.38, 17.25, 18.43, 19.40, 20.74, 21.84, 23.34, 24.58, 25.91, 27.65, 29.13, 31.10 KHz

16.7-32 MHz:

4.2-8.2 GHz:
4.293, 4.520, 4.831, 5.085, 5.437, 5.724, 6.119, 6.443, 6.792, 7.247, 7.636, 8.154 GHz

1.1-1070 THz:
1.10, 1.158, 1.237, 1.302, 1.391, 1.466, 1.566, 1.649, 1.738, 1.855, 1.955, 2.088 THz
2.20, 2.316, 2.474, 2.604, 2.783, 2.931, 3.133, 3.298, 3.475, 3.710, 3.909, 4.175 THz
8.80, 9.266, 9.897, 10.42, 11.13, 11.73, 12.53, 13.19, 13.90, 14.84, 15.64, 16.70 THz
35.19, 37.06, 39.59, 41.66, 44.53, 46.90, 50.13, 52.78, 55.60, 59.36, 62.55, 66.80 THz
70.38, 74.13, 79.18, 83.33, 89.05, 93.80, 100.3, 105.6, 111.2, 118.7, 125.1, 133.6 THz
140.8, 148.3, 158.4, 166.7, 178.1, 187.6, 200.5, 211.1, 222.4, 237.5, 250.2, 267.2 THz
281.5, 296.5, 316.7, 333.3, 356.2, 375.2, 401.0, 422.2, 444.8, 474.9, 500.4, 534.4 THz.
562.9, 592.9, 632.7, 666.5, 712.4, 750.4, 802.0, 844.4, 889.6, 949.8, 1000.8, 1068.8 THz
# Appendix 3

**EM frequencies extracted from the biological studies, versus the calculated (via mathematical algorithm) derived frequencies**

Depicted are: Applied biological frequency \(x\), Calculated mathematical algorithm frequency \(y\) and Difference in \% \(z\): \((x; y; z)\).

### Positive effects \((x; y; z)\):

<table>
<thead>
<tr>
<th>Hz</th>
<th>(100.0); 101.1; -1.09%</th>
<th>(390); 399.5; -2.38%</th>
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<tbody>
<tr>
<td>0.445; 0.444; -0.23%</td>
<td>110.0; 108.0; +1.85%</td>
<td>393; 399.5; -1.63%</td>
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<td>0.473; 0.474; -0.21%</td>
<td>120.0; 121.5; -1.24%</td>
<td>395; 399.5; -1.13%</td>
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<td>0.482; 0.474; +1.69%</td>
<td>150.0; 151.6; -1.06%</td>
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<td>160.0; 162.0; -1.24%</td>
<td>415; 420.8; -1.38%</td>
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<tr>
<td>0.750; 0.750; 0.00%</td>
<td>200.0; 202.2; -1.09%</td>
<td>420; 420.8; -0.19%</td>
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<tr>
<td>1.000; 1.000; 0.00%</td>
<td>300.0; 303.1; -1.02%</td>
<td>445; 449.8; +1.07%</td>
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<td>2.000; 2.000; 0.00%</td>
<td>3.200; 3.160; +1.27%</td>
<td>450; 449.8; +0.04%</td>
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<td>505.86; 505.6; +0.05%</td>
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A Short Introduction to System Theory: Indispensable Postulate Systems and Basic Structures of the Systems in Quantum Physics, Biology and Neuroscience

H. Umit Sayin

ABSTRACT
Constructing a System Theory (ST) is a method to establish a logical, mathematical, self-consistent, self-existing, coherent model to explain the interactions of the elements, functions and development of a closed or open system. System Theory (ST) is very important to define, organize, evaluate, control, regulate the systems and form mathematical models in a set of elements of that particular system. General Systems Theory (GST) is a name which has been adopted to describe a level of theoretical model-building which lies somewhere between the highly generalized constructions of pure mathematics & logic and the specific theories of the specialized disciplines. An ST can be universal, perfect, imperfect or defective; while the defective STs cannot survive. GST is a series of related definitions, assumptions, and postulates about all levels of systems from atomic particles through atoms, molecules, crystals, viruses, cells, organs, individuals, small groups, companies, societies, planets, solar systems, and galaxies. General Behavior ST is a subcategory of such a theory, dealing with living systems, extending roughly from viruses through societies. A significant fact about living things is that they are open systems, with important inputs and outputs. Laws which apply to them differ from those applying to relatively closed systems. Ludwig von Bertalanffy, the founder of ST, described two types of systems: open systems and closed systems. The open systems are systems that allow interactions between its internal elements and the environment. An open system, like space, is defined as a "system in exchange of matter and energy with its environment, presenting import and export, building-up and breaking-down of its material components." Closed systems, on the other hand, are held to be isolated from their environment. Equilibrium thermodynamics, for example, is a field of study that applies to closed systems; so are the biological cellular structures and neuroscience systems. Brain and central nervous system (CNS) are also closed systems. Establishing, for instance, an ST on CNS, will help us to use that ST not only in neuroscience, to explain the interactions of neurons, but also it will be a good aid to make new models in many other fields such as, biology, computer science, electronics, and social sciences etc., as well.

Key Words: system theory, general system theory, neuroscience, brain, open system, closed system, scientific model, social system model


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Introduction

Most of the science theories and scientific systems depend on certain axioms and postulates, which constitute the basics of scientific and logical reasoning. Without establishing some rigid and robust axioms and postulates, which are stable, logical, consistent and not interchangeable, it is nearly impossible to build up a scientific theory or a consistent system. For instance, without the main postulates and definitions of point, line, plane, cube and 3-D, parallel lines, angles, it is would not be possible to establish Euclidean plane geometry-system theory; analytical geometry; mathematics; number theory; probability theory; topology; algebra; optics; static, dynamic and kinetic physics; fluid dynamics etc. (Euclid, B.C.) (See, Figure-1, 2). Axioms and postulates are a result of numerous trial-errors and they are "the established facts" in the real world. However, the reference systems are the most important. If you take the main reference system or universal set-space as a continuous plane or a cube, then the Euclidean geometry and Euclidean postulates are correct. On earth and on small dimensions, they are correct and work perfectly well, as well as the Newtonian physics does. However, if the reference system and the "universal set" have different shapes and structures, e.g. if the universal set or space is continuously curved, then the axioms of Euclidean geometry cease to work, then one needs to establish another system & system theory (ST) and other series of postulates which will work in the new "universal set"; then you have to define a non-Euclidean geometry, whereas the shortest distance between two points is a curve, not a line (Figure 2).

Non-Euclidean geometry consists of two geometries based on axioms closely related to those specifying Euclidean geometry. As Euclidean geometry lies at the intersection of metric geometry and affine geometry, non-Euclidean geometry arises when either the metric requirement is relaxed, or the parallel postulate is set aside. In the latter case one obtains hyperbolic geometry and elliptic geometry, the traditional non-Euclidean geometries. When the metric requirement is relaxed, then there are affine planes associated with the planar algebras which give rise to kinematic geometries that have also been called non-Euclidean geometry.

Another way to describe the differences between these geometries is to consider two straight lines indefinitely extended in a two-dimensional plane that are both perpendicular to a third line: In Euclidean geometry the lines remain at a constant distance from each other even if extended to infinity, and are known as parallels. In hyperbolic geometry they "curve away" from each other, increasing in distance as one moves further from the points of intersection with the common perpendicular; these lines are often called ultra-parallels. In elliptic geometry the lines "curve toward" each other and intersect (Figure-2).

Alcides first determined some postulates to establish the following
1. 1-To draw a straight line from any point to any point.
2. 2-To produce—extend—a finite straight line continuously in a straight line.
3. 3-To describe a circle with any center and distance—radius.
4. 4-That all right angles are equal to one another.
5. 5. The parallel postulate: That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles.

Figure 1. Basic Euclidean axioms and postulates of Plane Geometry.

After establishment of Non-Euclidean geometry and also “Topology” using the aptitude of calculus and linear algebra, it was understood that, Euclidean geometry, that was valid only practically at short distances on the globe, would not be valid at very large distances in a universal set, such as a curved universe or sphere like the globe (earth); thus, the postulates of a system are precisely dependent on the reference system and the universal set. Euclidean geometry was consistent and working perfectly in daily life at short distances and it was a consistent, self-sufficient and self-progressive system. However,
in the space and at the quantum level, whether Euclidean geometry will work is very ambiguous. Our real reference system is shown in Figures 3, 4; actually, this is only the known and discovered part of it, we do not know many pieces of the universal puzzle, but we are sure that at both sides we come across to “emptiness”. In such a massive system from $10^{25}$ meters to $10^{-16}$ meters, we are mentioning about two sphere-like sets of which diameters have an exponential relation of $10^{31}$ meters in size; namely, from quarks and hadrons to the outer limits of empty space, the size is multiplied by: $10^{000 \ 000 \ 000 \ 000 \ 000 \ 000 \ 000 \ 000 \ 000}$.

In such a huge universal set, it is nearly impossible to determine all the parameters that rule the system and to construct a very consistent “system theory” (ST) of how the universe works in macro and micro cosmos. Euclidean geometry ST is a perfect ST in its constrained universal set. Once established, Unified Theory of Forces (Theory of Everything) may be accepted as a “universal ST” to explain the forces which unify the space and the quantum world by means of same axioms. Most of the scientific STs are perfect STs, because they cannot abide inconsistencies and contradictions, they do not rest on contradictory information and false logical thinking, but they hold on tautologies; also, when it is understood that there are flaws and defects in the ST; the ST is re-organized and renewed.
Figure 3. Outer world: Macro-Cosmos. 1 meter: we are at a forest on Earth. 100 meters (10² m): We are at the sky. 10 000 meters (10⁶ m, 10 km): We are above the clouds. 1000 km (10⁷ m): We are at ionosphere. 10 000 km (10⁸ m): We are out of the planet Earth. 10 million km (10¹⁰ m): We are at the orbit of Earth around the Sun. 1 billion km (10¹² m): We are above the orbits of Mercury, Venus, Earth, Mars and Jupiter. 100 billion km (10¹⁴ m): We are out of the solar system. 1 light year (10¹⁶ m): We are above the solar system, and see many stars as small. 100 light years (10¹⁸ m): We are somewhere in the Milky Way galaxy, see lots of nebulas and other galaxies. 10 000 light years (10²⁰ m): We are about to leave the Milky Way galaxy. 1 million light years (10²² m): We are in total emptiness, we leave Milky Way galaxy, we are surrounded by many other galaxies, 10 million light years (10²³ m): We come to sheer emptiness and this is the limit where our radio waves can reach, we do not know the beyond, probably dark matter and emptiness and black holes.
Figure 4. Inner World: Micro-Cosmos. $10^{-1}$ m: We are at the leave of a tree. $10^{-3}$ m: We are at the level of plant cells $10^{-5}$ m (10 microns): We are inside the cell $10^{-6}$ m (1 micron): We are at the nucleus of the cell. $10^{-7}$ m: We are at the chromosome level. $10^{-8}$ m (10 nanometer): We are at the DNA level. $10^{-9}$ m (1 nanometer): We are at the histones and blocking blocks of chromosomes and DNA level. $10^{-10}$ m (1 Angstrom): We are at the carbon atom level, carbon atom cloud. $10^{-11}$ m (10 picometers): We are at the electron orbiting level. $10^{-12}$ m (1 picometers): We are at the empty space of the atom, in-between electrons and the nucleus of the atom. $10^{-13}$ m (100 Femtometers): We are coming closer to the nucleus of the atom. $10^{-14}$ m (10 Femtometers): We start to see the nucleus (protons, neutrons) of the carbon atom. $10^{-15}$ (1 Femtometer): We are at the level of hadrons, quarks and other inner particles of the nucleus of the carbon atom.
For instance, **astronomy** is a perfect ST, while **astrology** is a defective and faulty ST, because astrology has defects and flaws in the elements, events, postulates, parameters, logic and the mathematics of its system, no matter how ancient it is. To give some examples of the false logic and defective axiomatic system of astrology, that has been accepted as a perfect ST for many centuries:

- **Astrology** accepts only 12 zodiacs as an axiomatic system. However, astronomy has established that there can be more than 12 zodiacs at a given coordinate in the space, for the planet Earth there can be 13 zodiacs. *(Defective axiom)*
- **Astrology** accepts that universal masses and the forces induced by those masses (celestial bodies) may have an influence on the protein structure, which constitute the personality traits, of the new-born baby according to the zodiac and constellation configuration the Earth is facing when the baby is born. *(Magical and para-logical, non-scientific reasoning)*. According to the Law of Universal Gravitation (F: Force between the masses; G: Universal Gravity Constant; m₁: Mass-1; m₂: Mass-2; r: the distance between the Mass-1 and Mass-2):

\[
F = G \frac{m_1 m_2}{r^2}
\]

- **Astrology** accepts that, for many centuries, the configuration of the zodiacs, galaxies, constellations and stars in the universe stayed stable; however, astronomy discovered the truth that, the universe is expanding all the time and this configuration changes continually. *(False axiom and para-logical thinking)*
- **Astrology** is very anthropocentric and takes the human beings, the solar system and Earth as the center of the universe. Astronomy proved that this is not the fact. *(Defective axioms and reasoning)*
- **Astrology** according to the current understanding of physics, forces are not transmitted directly between objects, but instead are described by intermediary entities called fields. All four of the known fundamental forces are mediated by fields, which in the Standard Model of particle physics result from exchange of gauge bosons. Specifically, the four interactions to be unified are:

**Strong interaction**: the interaction responsible for holding quarks together to form hadrons, and holding neutrons and also protons together to form nuclei. The exchange particle that mediates this force is the gluon.

**Electromagnetic interaction**: the familiar interaction that acts on electrically charged particles. The photon is the exchange particle for this force.

**Weak interaction**: a short-range interaction responsible for some forms of radioactivity that acts on electrons, neutrinos, and quarks. It is governed by the W and Z bosons.

**Gravitational interaction**: a long-range attractive interaction that acts on all particles with mass. The postulated exchange particle has been named the graviton.

Modern unified field theory attempts to bring these four interactions together into a single framework and perfect GST.

**System Theory** (ST) is very important to define, organize, evaluate, control, and regulate the systems and to form mathematical models in a set of elements of that particular system. General Systems Theory (GST) is a name which has been adopted to describe a level of theoretical model-building which lies somewhere between the highly generalized constructions of pure mathematics and the specific theories of the specialized disciplines. Mathematics attempts to organize general relationships into a coherent-consistent system, a system however which does not need to have any necessary connections with the "real" world around us. It studies all thinkable relationships abstracted from any concrete situation or body of empirical knowledge; actually, it has also been postulated that mathematics and logic is a “reflection” or “manifestation” of the functional structure of our nervous system and of how it works. 2 + 2 = 4; because this equation has its counterparts in the structure of the nervous system, not only because 2 apples + 2 apples add up to 4 apples in the real world, since CNS is a perfect system. If we had perceived (2 apples + 2 apples) as 3 apples or 5 apples, and our logic had decided on to be 3 apples (or 5 apples), then our CNS would be a defective and faulty system. Near to this, a defective and faulty system would not survive and become easily extinct, so no CNS would be perceiving and concuring 4 real apples as 3
apples (or 5 apples) as a result of the 50 million years of evolution of the mammals, or 500 million years of the evolution of the vertebrates after the Cambrian Explosion. Human brain and CNS is also a reflection of the outer world and macro cosmos, while, in micro cosmos, their compositions have the similar axioms and a perfect GST which has same universal laws, some of which have not been yet discovered.

GST (General System Theory) is a series of related definitions, assumptions, and postulates about all levels of systems from atomic particles through atoms, molecules, crystals, viruses, cells, organs, individuals, small groups, companies, societies, planets, solar systems, and galaxies. General Behavior ST is a subcategory of such theory, dealing with living systems, extending roughly from viruses through societies. A significant fact about living things is that they are open systems, with important inputs and outputs. Laws which apply to them differ from those applying to relatively closed systems (Miller, 1956).

When establishing the System Theory, Ludwig von Bertalanffy described two types of systems: open systems and closed systems. The open systems are systems that allow interactions between its internal elements and the environment. An open system, like space, is defined as a “system in exchange of matter and energy with its environment, presenting import and export, building-up and breaking-down of its material components.” Closed systems, on the other hand, are held to be isolated from their environment. Equilibrium thermodynamics, for example, is a field of study that applies to closed systems; so are the biological cellular biochemistry and cellular neuroscience (Bertalanffy, 1969).

“A Universal and/or Perfect General System Theory” should define the basic IDSs (initial determinants) of the system. Mechanical and Electronical Engineering use the main postulates of GST to construct universal systems by means of establishing some universal mathematical connections of the axioms to the systems (such as linear algebra) (Hintersteiner, 1998; Suh, 1990, 2001, 2005). In the below formula, established by Suh, FR is the functional requirement, DP is the design parameters;

**Axiom 1:** The Independence Axiom. Maintain the independence of the functional requirements (FRs).

\[
\begin{bmatrix}
FR_1 \\
FR_2 \\
\end{bmatrix} =
\begin{bmatrix}
A_{11} & A_{12} \\
A_{21} & A_{22} \\
\end{bmatrix}
\begin{bmatrix}
DP_1 \\
DP_2 \\
\end{bmatrix}
\]

**The Determinants of a Universal or Perfect System Theory**

**Some Historical Examples**

By means of investigating and observing already existent and self-coherent, stable perfect systems, and discovering the mathematics in it, it is possible to establish and extrapolate new and similar system theories or a “Universal System Theory” which can be valid in many other systems (such as physical, chemical, biological closed systems). For instance, computer technology used various kinds of information about the neuroscience and the interactions of neurons, to build up many new perfect computer systems.

Benoît B. Mandelbrot tried to discover the mathematics in the system of nature and biology, that is how the new “fractal geometry of nature” and “Chaos Theory” was born in 1980’s (Figure 5; Mandelbrot, 1982; 2004). By means of using the fractal geometry design and mathematics of fractal geometry and the interactions of it with the nature and electromagnetic waves, it was possible to build up antennas in a very small volume by Nathan Cohen, such as the ones in cellular phones, where very powerful antennas were constructed that can attract the nature’s electromagnetic waves into a very small plate (Mondal, 2010; Gianvittorio, 2002; Cohen, 1997, 1999). So, by means of unraveling the mathematics of nature, it was possible to use Mandelbrot-ST of nature in electronics and communication. Also using Mandelbrot’s Set, Julia Set and Lorentz Attractor and many other complimentary system theories, Chaos Theory which finds its practical applications from biology, medicine, neuroscience and quantum physics to weather forecasting, electronical engineering, nano-technology was born (Gleick, 1987; Hall, 1991; Peak, 1994; Mandelbrot, 2004).

When dealing with GST, it is not essential to establish a Universal System Theory in the beginning; a Perfect System Theory will be good enough to establish the axioms and the structure of the SYSTEM. A Perfect ST can always evolve into a Universal ST eventually. It is very important that the new established ST should not be a
defective ST, which cannot survive. Also, an imperfect ST can evolve into a perfect ST first, then into a Universal ST. However, a defective and faulty ST can never evolve into either.

Neurons, neural networks, axons, dendrites, neurotransmitters, neurochemicals, brain and eventually Central Nervous System (CNS) constitute a perfect system and the theories of neuroscience which explain the behavior of neurons, brain, CNS, and the psyche can lead to a perfect ST of the CNS, which can guide and precede to an applicable universal ST, that can also be used in other field systems, such as computer science, social systems, biological systems, electronical & mechanical engineering, etc.

Long before the discovery of action potentials, neuronal receptors, neurotransmitters, synapses, synaptic plasticity, LTP, in 1949, Donald Hebb designed an imperfect system theory for the nervous system and the theory of cellular learning, by means of observing some simple experiments and synthesizing of what was known by then (Hebb, 1949).

Hebbian theory concerns how neurons might connect themselves to become Engrams. Engrams are means by which memory traces are stored as biophysical or biochemical changes in the brain (and other neural tissue) in response to external stimuli (Ramirez, 2013; Bruce, 2001). Engrams can also be explained as a permanent neurophysiological impression left on protoplasm as the result of a stimulus or a lasting trace left in an organism by psychological experience, or simply the recording left behind in the brain by conscious experience. They are also sometimes thought of as a neural network or fragment of memory. The existence of Engram hypothesis suggested by some scientific theories to explain the permanence of memory, how memories are stored or retrieved in the brain. Understanding and explanation of the “Memory” is very important to establish the “Consciousness Theories”.

Hebb’s theories on the form and function of neurons can be understood from the following:

"The general idea is an old one that any two cells or systems of cells that are repeatedly active at the same time will tend to become 'associated', so that activity in one facilitates activity in the other." (Hebb 1949, p. 70)

"When one cell repeatedly assists in firing another, the axon of the first cell develops synaptic knobs in contact with the soma of the second cell." (Hebb 1949, p. 63)
Long after Hebb, Eric Kandel, a Nobel laureate in 2000, provided evidence for the involvement of Hebbian learning mechanisms at the synapses in the Aplysia californica, by defining short term electrophysiological learning and LTP (long term potentiation), that occurred by means of the activation of NMDA receptors and, Na+ & Ca2+ ion influx. (Kandel, 2012).

Hebb had described the interactions of the neurons with a mathematical formula:

\[ w_{ij} = \frac{1}{p} \sum_{k=1}^{p} x_{ik} x_{jk} \]

where \( w_{ij} \) is the weight of the connection from neuron j to neuron i , \( p \) is the number of training patterns, and \( x_{ij} \) the \( k \)th input for neuron i . Hebbian model is a good example of how to derive an imperfect ST from basic observations, then into a perfect ST (Hebb, 1949).

Kandel, who had studied psychoanalysis as a psychiatrist, wanted to understand how the memory worked. His mentor had once said, “If you want to understand the brain you’re going to have to take a reductionist approach, one cell at a time.” So Kandel studied the neural system of the sea slug Aplysia californica, which has large nerve cells in which it was possible to perform electrophysiological experiments and is a member of the simplest group of animals known to be capable of learning (Dreifus, 2012). Working on LTP (long term potentiation) Kandel established the basis of neuronal learning and enhanced post synaptic potentials as a response to repetitive stimuli (e.g. tetanic 100 Hz, 100-500 microamperes electrical continuous stimulation). In 1983 Kandel investigated to identify proteins that had to be synthesized to convert short-term memories into long-lasting memories. Kandel identified CREB as being a protein involved in long-term memory storage. One result of CREB activation is an increase in the number of synaptic connections. Thus, short-term memory had been linked to functional changes in existing synapses, while long-term memory was associated with a change in the number of synaptic connections, which is called “synaptic plasticity” today.

### Defining a System and a System Theory in the Central Nervous System

Central Nervous System (CNS) of the Homo sapiens is a perfect system, which has evolved through millions of years from non-human primates, descending from the mammals. Understanding and constructing a system theory depending on the variables, parameters, functions and the structure of the central nervous system may convey a “perfect system theory” which may in future be valid in neuroscience, psychiatry, psychology, computer science, biology, social sciences and electronics. There are also philosophical aspects of the human CNS, that can have some specific functions such as self-consciousness; self-awareness; self-explanation; problem solving; perceiving the mathematical nature, the reflection of mathematical structure of the universe; developing itself and also having pure logic; learning, storing information and retrieving information; continuing evolving; having a self-conscious psyche with a conscience, etc. (Figure 6).

When we evaluate our CNS, what are the main determinants of a perfect CNS-system?

- It contains some elements which process the information from the outer world in the forms of mathematical units or Engrams. (vision-seeing, sound-hearing, outer world chemical molecules-smelling, shape-temperature-vibration of outer world-touching, outer world chemical molecules of food-tasting). (D1)
- It has basic units that induce electrical, electro-chemical and electromagnetic forces and energy. (Neurons, interneurons, glial cells etc.) These are the functions of IDSs and they can be explained in mathematical functions. (D2)
- It has inner-energy forming systems for the functions (mitochondria, oxidative phosphorylation and ATP). (D3)
- It has basic units that induce capacitor effects and hence produce electro-magnetic fields and conducts this energy (excitable lipo-protein structure of membranes of the neurons). (D4)
- It has a specific energy function called as “excitation” of the basic units, which are called action potentials (AP). By means of APs energy is transferred from one neuron to another. (D5)
- It has a specific energy function called as “inhibition” of the basic units, which are called inhibitory post synaptic potentials (or currents) (IPSPs or IPSCs). By means of IPSCs the transmitted AP energy is modulated, decreased at certain degrees. (e.g. by interneurons and neurotransmitters GABA and Glycin). (D6)
It has quantal units that transfer energy from one neuron to another, or prevent or decrease the transfer of energy (neurotransmitters, neurochemicals, and hormones).

It has quantal units that transfer energy from one neuron to another in a fashion to modulate functions at different areas of the brain (e.g. dopamine and serotonin are excitatory at some receptors of the neurons, inhibitory at other receptors of the neurons). (D7)

It has an electro-chemical energy and force recognizing mechanism (e.g. different receptors of the neurons) (D8)

It has auto-control and auto-feed-back systems (auto-receptors, like alpha-2 noradrenergic receptors). (D9)

It has a recycling system (re-uptake of the quantal units, re-synthesizing of the quantal units, thus reducing the loss of energy and entropy). (D10)

It has a huge combination of circuitry system (millions of neurons and networks are connected and wired into each other forming synapses). (D11)

It has all or none binary mathematical perception and information processing system such as, the current passes (1), the current does not pass (0). (D12)

It has a self-healing and self-defense mechanism (reconstructing mechanisms, immune system). (D13)

It has information recording system (memory processing). (D14)

It has information storage system (memory forming, long term memory). (D15)

It has information retrieval system (recalling the memory packages in either lingual Engrams or visual Engrams as pictures, or some vivid and motion picture memories). (D16) (above 16 determinants are the examples of the known determinants)

Known other determinants of the CNS (D-K-500,501,502...n)

Unknown other determinants of the CNS (D-UK-900, 901, 902...m) which will be understood in the near future.

If we define the CONSCIOUSNESS Function (f©) as self-perceiving, self-knowing problem solving to survive, self-aware, information input learning-storing-retrieving and etc. "perfect system formation"; and the Q function (Q (Dn)) as: to assign a “CNS determinant” to form a self-consistent, self-existing unity in coherence, in accordance, and in cooperation with all other existing determinants with a logical, mathematical, electrophysiological and molecular mechanism (D1, D2, D3,....D16,....DK-500 DK-501, .......D-UK-900, D-UK-901, D-UK902.....Dm ; in D-K-500, or D-UK-900 numbers 500 and 900 are given as an arbitrary examples only), then the Consciousness Function (f©) becomes:

Even though we do not know D-UK901.....D-UKm , it is possible to form a perfect system theory for the CNS, just by means of analyzing and synthesizing the determinants D1, D2,....D16....DK500....D-K9e and derive some possibilities using the basic axiomatic system and basic mathematical logic of the CNS, as Donald Hebb had done long before the discovery of action potentials, synapses, neurotransmitters, etc. and many of the above determinants; but he became to be correct in his assumptions. Asking questions, intuition and imagination can lead to the discovery of undiscovered elements or unknown determinants in a perfect system theory for a perfect closed system; because the system is perfect and to be perfect, we can derive the basic needs and basic inputs/outputs of the existing perfect system from the basic data and information of that particular closed perfect system. Establishing a system theory increases and enhances the insight and intuition of the “problem solver” or the scientist.

For instance, if we did not know the existence of neurotransmitters, but only knew about the action potentials (AP) propagating through neurons and the histological electron microscopic images of the neurons, determining the gaps and micro-meter spaces between the neurons (synapses). We would drive the notion of how bio-electric potentials would travel through the spaces of neural networks in the following possible mechanisms:

a-APs travel through the neurons by jumping from one neuron to another.

b-APs travel through the neurons by means of a kind of electromagnetic effect.

c-APs travel through the neurons by using a quantal effect which swims from one neuron gap junction or intercellular space
to the next one to affect the second following neuron.

After performing some specific experiments or even without doing those experiments, it would be easy to exclude or eliminate the first two assumptions just as a result of analyzing the main axiomatic system of the perfect ST of the perfect closed system of CNS and the basics of electrophysiology. So it is possible to establish some unknown determinants of a perfect system only by means of analyzing and synthesizing the "imperfect ST" in our hand and the main elements, determinants of this imperfect ST, to build up a "perfect ST" for that particular closed perfect system. A "Unifying Holistic Method" would be a way to determine new and unknown other aspects of the "whole iceberg" from the clues of the tip of the iceberg to discover the part under the sea (Figure 7).

**Definition of a Perfect Closed System for CNS and the Brain**

As an initial analysis of a perfect closed system (PCS), if we inquire some of the characteristics of a Self-Aware-Conscious Perfect Closed System (C-PCS), such as the brain and CNS, as we assume them to be perfect closed systems:

1. A C-PCS must exist. A C-PCS must be self-existent. (*reflexive property*)
2. The logical and mathematical rules that are valid in the whole of the C-PCS must be also valid in the parts and miniature pieces of the C-PCS. (*holographic property*)
3. In a C-PCS, the whole will have its own basic properties, characteristics, features and traits in each single part of itself. Basic main characteristics of the main whole will be reflected in the parts of that whole in a C-PCS. (*association property*)
4. By means of investigating the parts and pieces of that specific C-PCS, it may be possible to derive conclusions about the characteristics of the whole itself. (*association property*)
5. A C-PCS should not become extinct and not dissociate easily. A C-PCS should maintain its co-existence with the suitable environment. (*reflexive property*)
6. A C-PCS should construct its miniature, holographic and/or same size models or clones automatically; it should replicate. A C-PCS must be self-replicating (If we accept the body as an element or sub-structure of CNS, it is self-replicating all the time; although the neurons and the brain are said to be not replicating, this can be a defense mechanism to maintain the “information processing” throughout a life span; however, latest findings point out that...
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7. A C-PCS must have a series of final sub-functions (such as analyzing, synthesizing, memory recording, memory keeping, retrieving the information, logical thinking, self-realizing, becoming self-aware etc.) (information processing property)

8. A C-PCS must have series of final functions (thinking, abstraction, mathematical reasoning and modeling, scientific thinking etc.). (information processing property)

9. A C-PCS must be free of defective and faulty functions (such as belief systems, para- logical thinking, magical thinking, emotional and instinctive decisions which interfere and contradict with the basic axioms of the perfect system, etc.) (tautology property)

10. A C-PCS may sometimes violate some of these characteristics (as above, article 9) when the survival of the system is in danger, since survival is the first and the most important axiom of a C-PCS. (reflexive property)

11. To realize these functions a C-PCS must have certain different units and elements working coherently and in cooperation with each other (e.g. neurons). (holographic property)

12. A C-PCS must be self-repairing. (reflexive property)

13. A C-PCS must be a result of an evolution and be still evolving (to become a Universal Perfect System). (evolution property)

14. A C-PCS must have inner auto-control and feed-back systems. (auto-control & feed-back property)

15. A C-PCS must have inner energy producing and energy processing mechanisms (ATP, AMP, GTP, oxidative phosphorylation, mitochondria systems etc.). (energy & anti-entropy property)

16. A C-PCS must have a recycling and economic molecular, auto controlled systems to reduce the increment of entropy, when some units or parts of it are exposed to outer world. (energy & anti-entropy property)

17. A C-PCS must be self-coherent. (tautology property)

18. A C-PCS must be self-consistent and should not bear any logical inconsistencies within. (tautology property)

19. If this C-PCS is a biological system, it should be self-conscious and self-aware. (consciousness property)

20. All the characteristics listed above and others to be added should be connected with each other with a Q function, which create and mold a cooperating-coherent unified coordination within the system (Figure-7). (coherence property)

21. Other. The properties and characteristics of a C-PCS may be increased gradually and there may not be a limit of the numbers of these characteristics.

In a continuing work for establishing a GST or ST for our CNS for defining it as a C-PCS, the basic characteristics can be increased before constructing a stable, robust, solid model. However, the important point, here, is that our brain functions, mind, consciousness can be put into a mathematical theory or a model and a logical perfect ST to analyze and to resolve in better ways in philosophical and neuroscientific aspects. This ST can be used for many other purposes in other fields too, such as in biology, computer sciences and electronics, behavioral sciences and social sciences as in the examples we have given above.

After analyzing the above characteristics of the CNS and the brain as a C-PCS, one might think and argue whether every human brain, psyche and Geist (a German term for spirit adopted by Hegel and Kant) are perfect systems or not! It should always be kept in mind that, even though, CNS and the brain of the Homo sapiens may still be imperfect systems, they may be at the stage of evolving into perfect systems.

Defective and faulty thinking; magical thinking; para-logical reasoning; depending on belief systems -while concurring solutions and results-, which may take their origins from the archaic knowledge of the subconscious and/or collective sub-un-consciousness may even serve as an important function for the survival of the organism or the species as explained in our former articles (Sayin, 2014a; 2014b).
The Conversion of CNS as a Perfect Closed System into the System of Theory of Social Structures

As mentioned in this article, a perfect ST designed and working for a closed system can also be applied to another version of a system; here, such as CNS model can be converted into the modelling of a perfectly working social system, which will be a subject of another article. For instance, using some of the axioms and determinants of CNS-perfect ST we can easily derive the basic needs and determinants of a social theory. Let us assume that we are establishing "a social association or NGO", names as X-NGO, which will have certain aims to fulfill. Instead of X-NGO you can also apply this theory to a Company (X-company). The main determinants of this social system would be as follows (Figure 9):

1- X-NGO (or X-Company) must have elements (human beings and assets). Here, the elements in a social system are the most important. If the perfection of the elements of a social system is very high, then the human error and flaws of the system will be decreased, the system will be more likely to survive and evolve. "Human Error" is the most important flaw of a social system; here we can make the resemblance of a "tower clock" which works and shows time by the resultant force and torque of hundreds of gears, if one gear is broken and/or works deficiently, then the clock shows wrong time or stops. (universal set and tautology property)

2- X-NGO (or X-Company) should be working on a consistent principal, rule and axiomatic system; or should have a constitution or a statue. (coherence and tautology property)
3- The logical and mathematical rules that are valid in the whole of the X-NGO (or X-Company) must be also valid in the parts and miniature pieces of this NGO or Company. (holographic property)

4- By means of investigating the parts and pieces of that specific NGO or Company, it may be possible to derive conclusions about the characteristics of the whole NGO or Company itself. (association property) For instance, if this social unity has some flaws in the structure of the system, then these flaws can easily be recognized and seen when looking at the actions of the NGO or Company.

5- A Company or NGO should not become extinct and not dissociate easily. The Company (or NGO) should maintain its co-existence with the suitable environment, the social system, other NGOs and Companies, within the globalized world. (reflexive property)

6- A Company or NGO must have a series of final sub-functions (such as analyzing, synthesizing, memory recording, memory keeping, retrieving the information, logical thinking, etc.; such as computerized functions and good record keeping; logical decisions; scientific methods in a Company or NGO.) (information processing property)

7- A Company or NGO must be free of defective and faulty functions (such as belief systems, para-logical thinking, magical thinking, emotional and instinctive decisions which interfere and contradict with the basic axioms of the perfect system, etc.) (tautology property). This is essential in a social system, as experienced in history; the social systems which are established and work on scientific basis can evolve and exist. That is how big corporations existed and evolved in the 20th Century in Western Capitalism.

8- X-NGO (or X-Company) must be self-consistent to fulfill its aims. (coherence property)

9- Each person in the system should be consistent with the aims of X-NGO (X-Company). Human error should be decreased to a minimum (tautology property)

10- This X-NGO (or X-Company) should have auto-control and feed-back system to check and determine whether it is working properly (auto control & feedback property)

11- In the social systems, where the elements are human beings, the most important defect may arise from the "human error"; X-NGO (X-Company) should decrease the human error into a minimum to exist and function properly and should delete the error factors to minimize a total resultant error. Many social systems, in history, such as communism, collapsed due the immense resultant driving force of human error. (tautology property)

12- This X-NGO (or X-Company) should process information properly. (information processing property)

13- This X-NGO (or X-Company) should be aware of its own elements and also other rival or hostile NGO's (or other companies). To give an example, most of the successful huge corporations in USA also work with CIA and NSA, getting feed-back and intelligence from them. (information processing property or intelligence property)

14- The main aims and the ultimate goals of X-NGO (or X-Company) should be reflected to each unit and elements. (reflexive and tautology properties)

15- The X-NGO (or X-company) should evolve into a better system with a better organization and income. (evolution property)

16- The elements and the social structure of X-NGO (or X-Company) should be logical, rational and consistent to exist, precede and evolve. (tautology property)

17- An NGO (or Company) must have a recycling and economic, auto controlled system to reduce the increment of entropy or economic entropy (energy & anti-entropy property). In a social system the energy can be defined as:

   a. The Capital, Bonds and Money.
   b. Estate, Asset and Property.
c. The resultant working physical energy and mental energy of the individuals of and NGO or a Company.

18- All the characteristics listed above and others to be added should be connected with each other with a Q function, which create and mold a cooperating-coherent unified coordination within the system to drive a resultant outcome. (coherence property)

19- The properties in cooperation with an existing perfect closed system of X-NGO (or X-Company) can be increased to a certain degree, with adding some new statements and also properties.

20- Other.

The properties and characteristics of a C-PCS may be increased gradually and there may not be a limit of the numbers of these characteristics.

The Importance of Establishing System Theories

This article is only a short introduction to define the brain and CNS as a Conscious Perfect Closed System (C-PCS) and pointing out a similarity of a Closed Perfect System of CNS to social systems. Once an ST on CNS is established pondering on what we currently know about neuroscience, it may be possible to investigate the brain and the psyche, as well as the fields of neurology, psychology and psychiatry in a better scientific context. When we investigate the history of science and neuroscience, actually such a methodology has been utilized as a scientific procedure for the last decades, even though the ST of the neurological system has not been defined or established and such terms have not been articulated. Reductionist approach can be a good discipline to reveal the behaviors of the individual elements and some mechanisms of the system (e.g. neurons, receptors, neurotransmitters, excitable membranes, voltage-gated channels, pores, c-AMP mechanisms, Na+–K+ pump etc.). However, without a holistic approach and synthesizing effort to combine and coordinate this enormous amount of accumulated information and without defining universal laws and axioms, the inter-relations between them, it will be very difficult to understand how the whole system is working. For a holistic approach to evaluate the whole, we need to define and develop such systems and system theories.

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References


Euclid (Euclides), Elements, Volumes 1-13, B.C.


Quantum Zeno Effect in Sleep Disorders and Treatment by the Anti-Zeno Effect

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ABSTRACT

It is proposed on the basis of a recent quantum mechanical approach to the states of consciousness that for those sleep disorders of psychological origin which can be considered to be a Quantum Zeno Effect-type phenomenon of persistence in the waking state due to the inhibition of the transition to the Deep Sleep state, the treatment may very well lie in the application of the principle of accelerating the decay by the introduction of a third state which facilitates the transition as realized in the Quantum Anti-Zeno effect. Steps of practical therapeutic implementation of the program are delineated as an appendix.

Key Words: quantum zeno effect, quantum anti-zeno effect, sleep disorders, insomnia, states of consciousness


1. Introduction

Quantum theory (Stapp, 2007; 2008; Swartz et al., 2005) is gradually proving to be the most versatile and the most successful framework for the investigation of diverse phenomena in the realms of matter as well as mind. It has been proposed that the well-known Quantum Zeno Effect (QZE) (Mishra and Sudarshan, 1977; Itano et al., 1990) plays the most important role in establishing the mind-brain relationship (Manousakis, 2009; Stapp, 2007) through continued attention. That the phenomena in the planes of the physical and the psychical have a lot of parallels and that they can be described by very similar methods was realized long ago by Pauli and Jung (Pauli and Jung, 2008). It has also been proposed recently by the present author (Pradhan, 2010) that the three states of consciousness, viz. waking, dreaming and sleep, experienced daily may be described by the composition of two spin-like quantum mechanical observables characterizing the subject and the object. The formulation is such that it allows for finer experiential modes or levels within each state or band. For example, one can say that the experiential state $\omega_i(\theta_i, t)$ at time $t$ is that of the $i^{th}$ thought-form $\theta_i$. In the waking state $|\omega_i(\theta_i, t)\rangle$ each thought-form has an objective counterpart $\theta_i$ in the external physical world whose neural correlate is perceived as that thought-form or mental image $\theta_i$. Similarly, we can also characterize the dream state at time $t$ as $|\omega'_i(\theta_i, t)\rangle$ (‘$t$’ is the waking time and all our description is in terms of waking time only) when the dream-form $\theta_i$ corresponding to $\theta_i$ is experienced. The continuous streams of such thought-forms make up our daily experience in the waking and dream states.
However, the state of deep sleep $|\omega_3>$ happens to be different since it is characterized by non-perception of either the internal thought-forms or of their external objective counterparts. It is an objectless and thoughtless state of ignorance or unconsciousness that we call deep sleep. The period spent by a healthy adult in deep sleep is roughly 6-7 hrs/day i.e. about one-third of the period spent in non-sleep. The transition to and emergence from sleep is achieved usually through the intermediate state of dream $|\omega_4>$ in healthy and normal persons, although the direct route is also available (Pradhan, 2010). Insomnia (sleeplessness) then becomes a phenomenon in which the transition from $|\omega_3>$ to $|\omega_4>$ through the direct and the dream routes is inhibited due to any one or more of the three factors: (a) Environmental factors (b) Physiological factors and (c) Psychological factors.

In this article, we shall assume that the first two factors are either absent or have been fully taken care of, and that the sleep disorder is due only to the psychological causes i.e. the patient tries to sleep at the appropriate time but because of some thoughts running riot in his head he is unable to 'switch himself off' to move into dream and subsequently to sleep. (It is to be remembered that normally the pre-sleep dreams are not registered as experience unless some disturbance wakes one up in the threshold of one's entry into deep sleep.). Just as a person can come directly to $|\omega_3>$ from $|\omega_4>$ when there is some sudden disturbance (external noise or some other such forceful sensory input), so also the sleeping pills can enforce the direct transition to $|\omega_3>$ from $|\omega_4>$ which is more important in the treatment in acute cases. This is because the dream route requires $|\omega_3>$, the fourth state, which is even more difficult to pass on to compared to $|\omega_4>$ in the case of patients with acute sleep disorder. However, once the acuteness is reduced by medication, the case is not cured but reduces to chronic insomnia.

Thus, we assume that once the patient is led into $|\omega_3>$, the transition to $|\omega_4>$ is automatic and smooth and the central problem then becomes one of effecting the transition from $|\omega_3>$ to $|\omega_4>$ which will lead naturally to $|\omega_5>$ and from then on to $|\omega_6>$.

We propose that this particular type of insomnia can be modeled as a QZE-type inhibition of the transition from $|\omega_3>$ to $|\omega_6>$ due to the persistent experience of the rioting thoughts in the waking state. This persistent experience of the waking state is the psychic counterpart of inhibition of transition due to continuous measurement in QZE in physical systems. We propose further a non-medical treatment of the same disorder basing on the inverse phenomenon of Quantum Anti-Zeno Effect (QAZE) (Kaulakys and Gontis, 1997; Qing et al., 2010), wherein the intentional introduction of an auxiliary state $|\omega_4(\theta,t)>$ facilitates this transition.

In section-2 we paraphrase the problem of stress-induced insomnia as a QZE and in section-3 we present the proposed solution via QAZE. In section-4 we conclude with a discussion of the limitations of the method and other possible applications. In the appendix practical steps of eliminating the environmental and physical factors and of aiding the QAZE transition are delineated which can be practiced under expert supervision for the first one week or so individually or in groups. Afterwards, the patients may be asked to continue the method of perfecting the QAZE-transition themselves. The whole article is written in a manner so that it is easily accessible to doctors, psychiatrists as well as to the patients and lay men.

### 2. Insomnia as Quantum Zeno Effect

The 'experience basis' (Pradhan, 2010) derived by treating subject-object duality in terms of quantum mechanical composition of a pair of spin-like observables yields the four states of consciousness as follows:

- **Waking:** $|\omega_1> = |1, +1> = |½, +½>
- **Dream:** $|\omega_2> = |1, -1> = |½, -½>
- **Sleep:** $|\omega_3> = |1, 0> = (1/\sqrt{2})\{|½, -½> + |½, +½>
- **Superconscious:** $|\omega_4> = |0, 0> = (1/\sqrt{2})\{|½, -½> - |½, +½>

In this article, the fine-structure of the waking state in the form of different perceived thought-forms $\theta$ is taken into consideration following the representation of individual perceptions as quantum mechanical states by Manousakis, so that a particular waking perception is represented by the quantum state $|\omega_3(\theta, t)>$. Similar representation can also be made for the dream state as stated in the introduction. Only the last two do not have any fine structure on account of the uniformity of non-perception in $|\omega_4>$ and the vanishing of all quantum numbers in $|\omega_3>$. Indeed, it has been observed that determinate perceptions do have their neural correlate (NC) counterparts (Stapp, 2007; 2008) in the form of synchronous ~40 Hz oscillations set up in the neural assemblies at different sites of the brain. Thus, considering the central nervous system (CNS) as a quantum
mechanical system with neurons as the basic constituents, we can represent these excitations as quantum states of the same. The CNS and the NC are physical while the thoughts or the perceptions are psychological or mental and this provides the mind-brain linkage.

Therefore, the representation of each waking perception by a quantum state and the successive perceptions as transitions becomes quite straightforward and considering the fact that the waking state is unstable and spontaneously (but randomly in different similar prepared individuals) decays to the sleep state, which transition can be inhibited or accelerated by repeated observations, allows us to draw the parallels with QZE and QAZE.

Now, the majority of secondary insomnia cases happen to be due to psychological factors which delay the onset of sleep beyond limit and the patients complain of uncontrollable thoughts running riot the moment they retire to bed and close their eyes. The problem gets further complicated by the apprehension of recurrence of the same phenomenon every night and this weakens the will of the patients considerably and they complain of recurrent sleepless nights i.e. chronic insomnia. In most of the cases, it is found that the kinds of thoughts that bother them are mostly those of some past or future trouble. It is only very rarely that one gets sleep disorders due to too much of pleasant experiences. Pleasant experiences, fancies and fantasies usually usher in good sleep! It is the unpleasant experiences like disasters and debacles, fears and phobias, failures and frustrations, insults and abuses, mishaps and misfortunes, losses and bereavements, traumas and tortures etc. which one has undergone or is likely to undergo that come to haunt the patient on the bed. The patient may struggle for hours together without getting any semblance of sleep and this phenomenon in chronic cases may continue even beyond a month or so.

This is the case that can be taken up as a classic illustration of Quantum Zeno Effect in the psychological domain, where the continuous cognizance of the problematic thoughts $\theta_{p}$ by the consciousness prevents the momentary slide into the fourth state which could have brought the dream state on, and which in its sequel, would have ushered in deep sleep. It is proposed here that this inhibited transition from $|\psi_{i}(\theta_{p}, t)\rangle$ to $|\omega_{i}\rangle$ due to continuous observation can be removed by recourse to the inverse process of Quantum Anti-Zeno Effect.

In fact, it seems that all cases of insomnia, including the primary ones of unknown causes, whether chronic or acute, can be considered as being effectively due to this kind of QZE and correspondingly can be cured using QAZE. It is clear that the proposed solution will have to be of the psychological type, and hence, non-medicinal, but one that can easily be practiced by anyone suffering from any kind of insomnia. In this respect, when it comes to the choice of an auxiliary state in QAZE for fixing the attention on, it is worth emphasizing that of the many involuntary processes that continue throughout the day including the period of deep sleep the most important and vitally significant one is respiration, and the awareness effortlessly but very effectively can be fixed on the breathing process.

3. Insomnia Treatment by Quantum Anti-Zeno Effect

The insomnia patient’s main trouble is the inability to withdraw the mind from the problematic thoughts and this can effectively be dealt with by introducing another thought on which the attention can be easily fixed. This new thought will be the auxiliary thought-form with a greater awareness and willful attention than the problematic thought-form and it will decrease the frequency with which the problematic thoughts were engaging the attention. The characteristic restlessness of the mind implies that it gets bored of monotony and one-pointedness and if continuously and consciously it is fed with something monotonous it will easily lapse into sleep. Consciously trying to focus on this auxiliary thought-form will gradually bring in the required transition to the fourth state from which the patient will move into the dream and from then on to deep sleep. This is the program of treatment by the anti-Zeno effect.

In many situations in physics, it has been observed that a normal transition is inhibited by the QZE and is accelerated by the QAZE in the presence of the auxiliary state. Further, as required by the theory of QAZE, the auxiliary state is of higher energy (i.e. awareness in the psychological sense) compared to the problem state and admits of transitions back and forth with it. This is precisely the case here but the only difference is that we are considering the application in a psychological setting. The four states of consciousness are depicted in Fig. 1a below, and in Fig. 1b, we show all the transitions as per the QAZE.

As shown in Fig. 1a, for normal persons, the transition from waking to dream through the thin layer of the fourth state is naturally accomplished without any effort and then deep sleep ensues as a
matter of course, while for the insomniac this transition is inhibited by the QZE-type continuous dwelling in the problematic waking state $|\omega_a(\theta_p, t)\rangle$. In Fig. 1b, $|\omega_a(\theta_a, t)\rangle$ is the auxiliary waking state with a different thought-form $\theta_a$, introduced to divert the attention from $\theta_p$, and thus disrupt the QZE. Again, there will be a seeming tussle between $\theta_a$ and $\theta_p$ to engage the patient’s continued attention, and in the beginning the auxiliary state may seem to be an additional complication! It is almost an implementation of the old adage: “set a thief to catch a thief!” But, it works, thanks to the mysterious nature of Quantum phenomena which baffle classical thinking, whether applied to the physical or the psychological phenomena, and one finds to one’s surprise that in a matter of about ten minutes to half an hour or so, the patient will be fast asleep via the QAZE transitions!

Now comes the question of the exact nature of the auxiliary thought $\theta_a$, which is of central importance in the entire process. Although $\theta_a$ could be any pleasant thought-form on which the patient likes to dwell upon for a longer period, it turns out that the most effective, unbiased and natural choice is the ‘attention on the breath’. Just gently trying to focus on the normal, natural, relaxed breathing will do the trick! Initially, if need be, one may count the exhalations one by one serially if the disturbance from the thought(s) $\theta_p$ is a bit uncontrollable, but after the first five minutes or so, one may stop counting and try to concentrate only on the natural breathing pattern without bothering much about the frequency of $\theta_p$. In the first few attempts the patient may feel a little tired or bored of the entire exercise, and may, if need be, allowed to have an accompanying mental utterance of some self-chosen holy name or formula (mantra) depending on the faith and temperament. This has a very helpful effect but it is not absolutely necessary in all cases. Only a little patience on the part of the patient in participating in the whole therapy will work wonders even if $\theta_a$ is only the concentration on the breathing.

It is to be emphasized that the conscious focusing of attention on $\theta_a$ must not be considered as a fight or a battle with the persistence of $\theta_p$, rather, one should deal with the issue in a very mild and gentle manner allowing the mind its own freedom of dwelling on $\theta_a$ every now and then. The only job is to focus on $\theta_a$, and not to fight a battle with $\theta_p$. As many times as it wonders off to $\theta_p$, so many times very calmly and gently it should be brought back to $\theta_a$ without generating any tension or sense of struggle.

4. Discussion and Conclusion
We have proposed for the first time a novel method of treatment of insomnia exploiting the parallelism of the situation involving the states of consciousness with the physics of Quantum Zeno and the Anti-Zeno Effects, which have been experimentally observed in laboratories in many physical systems. A theoretical objection may be raised regarding the efficacy of the procedure in the event of the continuous observation of the breathing leading to another Quantum Zeno Effect involving this new auxiliary state, in which case
the patient effectively has now $\theta_a$ – insomnia in place of $\theta_p$ – insomnia!

This apprehension, however, is without basis since breathing is natural in sleep and is therefore not an obstacle to sleep, while the problematic thoughts are an obstacle. As regards the awareness of breaths which is not natural to sleep, since sleep means non-awareness of everything including breathing, the state of the patient then becomes one of "Yogic sleep" or Yoga-nidra (Sivananda, 2003), which grants all the benefits of sleep (restfulness, rejuvenation, freshness, renewed vigor and vitality etc.) and at the same time takes away all the evils of insomnia (uneasiness, weirdness, heaviness, headache, drowsiness, sloth, stupor, fatigue, etc.), in which case also the patient is cured! Also, note that as far as the cure is concerned it matters little whether the transition to sleep is from $\theta_a$ or $\theta_p$ and whether it is direct or through intermediate states.

In fact, the Anti-Zeno Therapy proposed here has been somewhat in practice in the theory and practice of Yoga and Meditation. In particular, the step-by-step whole-body-relaxation is an essential part of the practice of a Yogic posture known as savasana (the corpse pose) which very often lands the practitioner in deep sleep. Similarly, 'concentration on the breath' is a preliminary technique in the practice of concentration and meditation with a view to making the mind one-pointed and finally thoughtless. But in both the cases, the lapse to sleep is the most undesirable event and is considered as an obstacle, since the continuity of awareness is of paramount importance in all yogic practices, and the onset of sleep obviously deprives one of that. But, the failure (lapse-to-sleep) of the Yoga-meditation practitioner is verily the 'glorious triumph' for the insomnia! And, it seems that finally there must be some truth in alternative therapies like 'Yoga'.

It is worth noting that the problematic thought-form $\theta_p$ is not a singular form but is usually dressed with two or three other associated thought-forms which succeed in keeping the mind revolving, though centered on $\theta_p$. Thus, there is a difference between $\theta_p$ and the auxiliary thought-form $\theta_a$ which is more of a singular nature and thus easily succeeds in getting the mind bored of monotony thereby facilitating the transition to sleep.

The application of quantum theory to understand the dynamics of the mind has, of course, its own limitations. For one thing, the physical systems investigated in relation to QZE and QAZE are more or less of known eigenstates with known energy eigenvalues, while here the corresponding property is the willful attention (or awareness) which evolves with time and thus the states corresponding to $\theta_p$ and $\theta_a$ do not remain fixed with time. The actual dynamics demands that they gradually shift downwards (see Fig. 1b). It may even so happen that as the attention stabilizes more and more on $\theta_p$, and consequently, as the mind starts withdrawing itself, $|\omega_1(\theta_a,t)\rangle$ may slide below $|\omega_1(\theta_p,t)\rangle$, and this may bring in another real but beneficial QZE with $|\omega_1(\theta_a,t)\rangle$. In this case the QAZE transition may very well involve the dream state $|\omega_1\rangle$ itself because of its closeness to the auxiliary state. In such a situation, whether a similar Anti-zeno therapy will be helpful in the cases of dreamful sleep, where $|\omega_2\rangle$ rather than $|\omega_1\rangle$ is the problematic state, needs further investigation.

### Appendix-I

#### Practical Steps of Anti Zeno-Therapy

- The most important part of the proposed delicate method of treatment is the preparation stage for the application of the Anti-Zeno therapy to insomnia cases. It is to be emphasized that the three conditions necessary for an early onset of sleep are: (a) a relaxed body (b) a natural rhythmical breathing and (c) a calm, tension-free mind. In one phrase it is ‘a total relaxation’ of the individual-relaxed body, relaxed breathing and relaxed mind. Therefore, apart from ensuring that the patient has the right kind of cooperative attitude to receive the therapy and a positive attitude towards the efficacy of the therapy the following steps may be noted by the therapist.

- Removal/avoidance of all environmental and physiological factors which have the potential to disturb or delay the onset of sleep i.e. stimulating food, drinks, music and video that excite the mind too much. All sensory inputs throughout the day must invariably be of a soothing nature which helps bring about a calm interior. All kinds of worries, cares and anxieties are to be avoided at all costs.

- Making available all the helpful factors for inducing sleep such as: (a) sleeping on back or on the left side (b) remaining fully engaged in some self-chosen work which the patient
enjoys doing in the most relaxed manner possible during the day (c) regularity of the daily schedule of life etc.

• Instructions may be given directly or through a record-player as commands to start with, followed by a gradual switch over to a very soothing and sweet voice as the patient is guided into deep sleep. The commands in the beginning lessen the vehemence of the problematic thoughts by much; more so if the treatment is in a group. They also have a very positive impact on the overall receptivity of the patient and the fixing of attention on the breath becomes much easier.

• In case of individual patients, constant watch may be kept on the patient’s eyelids for the onset of dream through REM-sleep, in which case the instructions may be switched off to allow for sleep to ensue.

• In group-therapy sessions, the instructor may switch over to the soothing mode after the first five minutes or so.

• The first few instructions should be on lying flat on the back followed by the step-by-step relaxation of the whole body starting with the toes and ending at the crown of the head.

• The whole session should be in a very friendly and warm environment where the patient feels completely relieved and relaxed and fully at home.

These are some of the very helpful practical steps which are essential for the therapy. With experience the therapist will gain strength and the success rate will be very high. After a week of guided therapeutic sessions, the patients should be watched in one or two do-it-yourself sessions before their release. Once the patient gets confidence in the Anti-Zeno practice, insomnia is effectively fully cured.

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References