Exploration

From Continuity to Contiguity:
On the genesis of consciousness, culture and oral language (Part I)

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ABSTRACT

Based on my previous model and supported by a biophysical interpretation of nervous cell, nervous system, memory, mind and phylogenesis, I further propose a *tensorial-relational model*, aimed at providing a paleoanthropological and physicalist's explanations of the genesis of *consciousness*, *culture* and *oral language* among human communities.

Part I of this four-part article series includes: Preamble; 1. General Premises; 1.1 Towards bridging the Darwinist model of evolution; 1.2 The Tensorial-Relational Model; and 1.3 Quantum descriptions of signal transduction in biological systems.

Keywords: Tensorial-relational model, tension-gradient, quanta-gradient, mnemopoiesis, dissipative system, anticipatory system, epigenetic function, continuity, contiguity, sensing-intuition dichotomy, thinking-feeling dichotomy, cavity resonator, acoustic-musical faculty.

Preamble

By comparing the finds dating from the Lower Paleolithic period (c. 2.7-2.4 MY to c. 300-120 TYA) with finds dating from the Middle Paleolithic (c. 300-120 to c. 45-30 TYA), it is assumed that the *inner life* (insight) of our distant ancestors underwent a slow process of *psycho-relational and psycho-biological individuation* (incubation and settling of a distinct and relatively autonomous *neuro-psychological identity*), a process started c. 2.7-2.4 MYA (Homo Habilis?), that only recently, in a time ranging from about 300 TYA (Homo Sapiens?) onwards, led to the formation of the relatively autonomous and independent psychic complex which we call *epigenetic function of the real*, or *(self)consciousness*.

The establishment of the *epigenetic function of the real* marks the transition from an adaptive and supra-adaptive behaviour focused on the *sensing-intuition mental bipolar dimension* (C.G. Jung) and based on the primacy of the (quasi)*unconditioned identification* (*relation of continuity*) of individuals with their natural habitat (a phylogenetically inherited behavior that has in itself the neuro-psycho-relational conditions to enable the *neurological-minded system homo* to overcome the stereotypical behavior common to all non-human animals), to a behavior integrated by the *thinking-feeling mental bipolar dimension* and based on the primacy of a *conditioned identification* (*relation of contiguity*) of individuals with their natural habitat, a behavior that breaks the relationship with the existing in a *subject that interprets* the relationship and an *object that is interpreted*, thereby initiating to all intents and purposes the *cultural*

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production.

Disengaging itself from the *adaptive strategies* inherited via phylogeny (strategies that establish the constraints that must be followed to adapt to natural habitats) humans communities undertook a slow and difficult elaboration of *epigenetic adaptive strategies*, increasingly directed to adapt the natural environments (domestication processes) and the individuals themselves (social processes) to the needs and purposes elaborated and assumed by the communities.

The slow process that went from *encoding (musically)* to *codification (syntactically)* of *oral language* became a consequence of the transfer of a portion of the *psycho-physical energy* or *libido* (C.G. Jung), gained through the optimization of socio-cultural and technological strategies employed to satisfy the requirements associated to survival and reproduction, from the plane of *oro-pharynx*, as anatomical organ for the feeding and breathing, to the plane of *oro-larynx*, as anatomical instrument for *intentional emission of sounds* (vocalization and phonation).

In more recent times (from about 40-15 TYA, Upper Paleolithic, onwards, *Homo Sapiens et faber*) the cultural and neuropsychological evolution of adaptive strategies based on domestication/ socialization, did recognized to the apotropaic use of the *magic-word* (which allows to set different physical levels of reality in relation to each other) an added value (the function of naming things as an act of legitimation of reality and the function of giving to individual an own name - *semantic baptism* -, as an act of initiation that assigns to individual a new value of reality) that puts the *generatrix power of oro-larynx* (where the *pneuma* is transmuted into *speech* by which the *World is re-created*) in open competition with the *generatrix power of women's uterus* (where the *pneuma* is transmuted into *offspring* by which the *progeny is re-created*).

1. General Premises

The wing structure of the Bumblebee, in relation to its weight,
it is not airworthy, but he does not know this and flies anyway.
Anonymous

The investigation and interpretation of reality can have several paradigmatic models of reference. The most studied and applied models in the fields including anthropology, are based on Descartes' dualism and classical Physics, which are also the pillars of Darwinist theory of evolution.

The one I will apply, namely *Tensorial-Relational Model*, to advance an explanation of the events that have led to the *arising of consciousness*, *culture* and *oral language*, it stems from applying my previous *Endo-Dynamo-Tensive Model* [1] to the hypothesis independently developed by me [2] and by Sá-Nogueira Saraiva [Saraiva 2006, 2010] on the evolutionary scenario that led to the settling of a distinct and relatively autonomous *neuro-psychological*

identity of the human being, i.e. to the settling of an *I/Me* vs *Other than I/Me*, and from adopting an approach to the interpretation of natural and cultural phenomena which rests on a framework outlined by multidisciplinary contributions, such as Ilya Prigonine's *Complexity Theory* [3], Luigi Fantappiè's *Unified Theory of the Physical and Biological World* [4], Humberto Maturana's *Biology of Cognition* [5], Robert Rosen's *Relational Complexity* [6] (later being called *Relational Science* or *Relational Biology*), Chris King's model of *Supercausality* [7], Sá-Nogueira Saraiva's *Functional Ethology* [8], Francisco Varela's *Neurophenomenology* [9], Carl Gustav Jung's *Analytical Psychology*, and last but not least Robert G. Bednarik's paleoanthropological contribution [10] aimed at demonstrating that "*humans became human not through natural processes that modified their skeletal structures, but by processes that enabled them to develop culture, cognition and technology on a scale removing humans far from all other primates in those areas*"[1].

1.1 Towards bridging the Darwinist model of evolution

Chuang-Tzu levels all things
And reduces them to the same Monad.
But I say that even in their sameness
Difference may be found.
Although in following the promptings of their nature
They display the same tendency,
Yet it seems to me that in some ways
A phoenix is superior to a reptile!
Po Chüi (772 AD-846 AD

The conventional model is based on a static and reductionist view of reality. According to this model, there are fundamental, irreducible pieces of reality conceived as tiles of a mosaic (*building blocks*). From their combination, derive the objects and phenomena that we observe, inside and outside of us. Each different combination is headed by a code. If you know the code, and have the material to be combined, and the tools to operate, you can artificially reproduce that particular natural combination. A certain combination of *building blocks* generates a certain structure, which generates certain processes that respond to certain functions. Following this investigative and interpretative approach, the scientists are hunting for key pieces and hidden codes at all levels, atomic and supra-atomic, inorganic and organic, animate and inanimate. They are seeking pieces and codes of all kinds, including pieces of concepts, pieces of consciousness, pieces of thought, pieces of life and the codes for the architecture of brain and cells and the like. They assign a primary ontological value to the *building blocks*, and consider the relationships

[1] R.G. Bednarik, *The origins of symboling*, Signs online, Vol. 2, 2008, p. 83

and interactions that we observe as a fact derived and subordinate to their existence. In this perspective, for modern molecular biology phylogeny is a strong succession, logic and computational, of biochemical events orbiting around the building blocks of the biological phenomenon, the *nucleotide bases*, the *alphabet of the language of life* (A, G, C, adenine, guanine, cytosine and T, thymine in DNA; A, G, C and U, uracil in RNA), from which combination and recombination would derive the *phyletic descent* (to this line of thinking belongs the belief, denied by evidence, that the complexity and the evolutionary degree of a species is directly proportional to the number of genes present in its genome).

By adopting the same *genetic deterministic* perspective, it is stated that the ability to comprehend grammar and to control the mouth movements necessary to produce words it would be a consequence of the presence of an allele of the FOXP2 gene[2] (the *language gene*), more active in females than in males, by which females would enjoy an advantage in learning language. The modern human variant of the FOXP2 gene has been found recently in the bones of two Neanderthals from Northern Spain[3]. The implication would be that Neanderthals could comprehend and produce something like modern speech but, obviously, nobody would believe that language development can be based solely on a single mutation in FOXP2[4]. There are several other factors that enable speech, including neuropsychological and neuromotor skills. Among these are profound anatomical changes that make the human supra-laryngeal pathway entirely different from any other mammal. The larynx has descended so that it provides a resonant column for speech (but, as a side-effect, it exposes humans at the risk of choking on

[2] This gene encodes a member of the forkhead/winged-helix (FOX) family of transcription factors. It is expressed in fetal and adult brain as well as in several other organs such as the lung and gut. The protein product contains a FOX DNA-binding domain and a large polyglutamine tract and is an evolutionarily conserved transcription factor, which may bind directly to approximately 300 to 400 gene promoters in the human genome to regulate the expression of a variety of genes. This gene is required for proper development of speech and language regions of the brain during embryogenesis, and may be involved in a variety of biological pathways and cascades that may ultimately influence language development. Mutations in this gene cause speech-language disorder 1 (SPCH1), also known as autosomal dominant speech and language disorder with orofacial dyspraxia. Multiple alternative transcripts encoding different isoforms have been identified in this gene.

[3] Krause et al., *The Derived FOXP2 Variant of Modern Humans Was Shared with Neandertals*, Current Biology (2007), doi:10.1016/j.cub.2007.10.008. Available at: https://pgl.soe.ucsc.edu/krause07.pdf

[4] The relationship between genes and observable traits is indisputable. Tall parents tend to have tall kids. Dark-haired parents have dark-haired kids. That traits are inherited has been clear since Mendel codified his famous Laws of Inheritance, inferred from statistical observations of over 29,000 pea plants. In classical Mendelian genetics, separate genes encoding for separate traits are passed independently from each other to their offspring. Thus, there is a clear mapping between genetic information, or genotype, and observable traits, or phenotype. A single gene (technically a locus or genetic location) encodes for a single trait and is not influenced by the other traits a person possesses. Furthermore, environmental factors have little influence on most Mendelian traits. Famous examples that fall into this framework include sickle-cell anemia and cystic fibrosis, each caused by a mutation to a specific gene. However, it is now clear that the simple assumptions underlying Mendelian genetics are not applicable to most traits and diseases. Nearly all phenotypes, from height and eye color to diseases such as diabetes, emerge from extremely complex interactions between multiple genes (loci) and the environment. In contrast to Mendelian genetics, where one can easily identify the gene that encodes for a particular trait, for many traits there is no simple mapping from genotype to phenotype.

food), and the nasal cavity can be closed preventing vowels from being nasalised and thus increasing their comprehensibility.

Anyway, one thing is to recognize that ill-defined, temporally variable, hard-to-quantify traits such as speech, consciousness or cultural preferences rely on the availability of specific phylogenetic requirements carried on and transmitted by the genic activity, another thing is to identify these traits with it, which is not only an unhealthy and dangerous idea, but beside this is patently wrong. As Nigel Goldenfeld and Leo Kadanoff wrote[5]: *Use the right level of description to catch the phenomena of interest. Don't model bulldozers with quarks*. That is to say that while it is certainly true that all the properties of a bulldozer result from the particles that make it up, like quarks and electrons, it is useless to think about the properties of a bulldozer (its shape, its color, its function) in terms of those particles. The shape and function of a bulldozer are emergent properties of the system as a whole. Just as you can't reduce the properties of a bulldozer to those of quarks, you can't reduce the complex behaviors and traits of an organism to its genes or to its neurons.

The Darwinian theory of evolution is conceived in the womb of Positivism, which is based on the postulates of classical Physics (that have been proven wrong by General Theory of Relativity and Quantum Physics), which is based on the Cartesian dualism *res extensa* vs *res cogitans* (which leaves to God what belongs to Him, the *res cogitans*, and gives to classical Science what is of classical Science, the *res extensa*, forcing science to exclude *a priori* the mental phenomenon from its field of investigation), which is the post-Galilean expression of the work of rehabilitation of Platonic thought carried by medieval Thomism.

Like its predecessor and first author of a *theory of evolution*, the French naturalist Jean-Baptiste Lamarck (1744-1829), Darwin conceived and formulated his historical truth, based on evidence derived from an extensive collection of the empirical data in his possession, of what according to the creationist paradigm was considered *without history*, i.e. created *ad hoc*, giving an interpretation of life on Earth in conformity with the perspective of knowledge developed by the positivist thought, the Anglo-Saxon in particular, that in the XIX century was solidly and irreversibly ascended to the rank of the *doctrine of the Faith in Science*.

His vision of Nature was *deterministic*. For a man of his time, determinism matched the doctrine expounded by the mathematician and astronomer Pierre-Simon de Laplace in *Système du monde* (1814). This doctrine, which would dominate the scene until the conceptual revolution caused by quantum physics, can be summarized as follows:

[5] Nigel Goldenfeld and Leo P. Kadanoff, *Simple Lessons from Complexity*, Science **284**, 87-89 (Apr 2, 1999). Available at: http://guava.physics.uiuc.edu/~nigel/articles/complexity.html

a) the universe is governed by *causality*;

b) in the history of the universe every state of matter is determined by what precedes and determines the following, in a manner analysable by means of Newtonian mechanics;

c) causality allows predictability;

d) the phenomena are described according to the *mechanistic* and *deterministic paradigm* which draws strength from the precision and rigor of Newtonian mechanics;

e) the *case* does not exist, it is a concept relative to the limits of human capabilities: it is inconceivable that there are events which fall outside a *law*;

f) the causal network of the Universe is however too complex for it to be reconstructed by the human mind; because of this all the physical knowledge can only be based on *probabilities* (approximations for lack of data).

The *modus operandi* of evolution is made of tests and especially of *errors*. The only factor of order is *natural selection*. This transforms a improbability in a probability: it makes out of a *fortuitous event* (the appearance of a *random variation*) the beginning of a process that, considered in retrospect, seems addressed from the beginning along a certain direction, but only because any other paths have been cleared and what we see is the sole survivor, or the most visible among the survivors. Darwin showed that the same causes that produced conservation, stability and balance could produce instability, destruction and transformation. The serene, majestic, luxuriant look of Nature coexisted with its tragic aspect. Nature was both cruel and beneficent, avaricious and prodigal.

But how individual differences within a species are produced, which are the building materials with which it operates *natural selection*? The starting point was the recognition of a *spontaneous variability* of the species in Nature, namely the fact that even in the same environment individuals of the same species differ all from each other, even if imperceptibly. This variability is called *spontaneous* because it is a constant of Nature, is present in all environments and in all conditions. Its causes are, according to Darwin, the most diverse (climate, food, lifestyle, weird effects of sexual reproduction, etc.), but the variation alone does not explain the evolution. In fact, not all the changes are of equal importance, not all can initiate an *evolutionary line*. Each may be more or less advantageous than others, depending on the circumstances: all must pass through the sieve of the environment, which has the final say.

The decision is made at a higher level, no longer individual, but ecological, that of *natural selection*. The formation of new species is thus the result of two distinct processes: *the unpredictable and constant appearance of variations and the strict selection exerted by the environment*. The changes, according to Darwin, are not only spontaneous, but also *random*. This

concept is crucial in his theory. Speaking of *random variations* Darwin does not mean that they *do not have a cause* (and a law that determines them), but that are due to *complex and unknown causes*: the term *random* is to indicate *our ignorance of the causes, not their absence*.

But the *random* term has also another meaning, logically distinct but inseparable from the first: *the variations are not oriented to favour the survival of the individual*. The single variation is not in itself the right answer to the needs arising from the environment; in other words, it is not born to adapt the organism to the environment, does not in itself guarantee the survival and reproductive success; indeed, in most cases the variations are unnecessary or indifferent, some even harmful: eliminated the latter by *natural selection*, the others remain, as we say today, *floating*, waiting for the *environment to give a ruling on their fate*. This, however, does not give instructions to the organisms on how to change, but is merely judging, so to speak, their spontaneous behavior. In Darwinian theory, the organism does not change to adapt: varied and just. The changes are produced in many directions, without correlation with the needs of survival. Whether and which of these changes are adaptive is determined by the complicated network of ecological relationships that makes up that particular environment: *the variation proposes, the selection disposes*.

Well, this is a very interesting paradigm, but it is not what Physics suggests today. It is what classical Physics prescribed more than a century ago, before it was showed to be wrong.

1.2 The Tensorial-Relational Model

> *It is the twisted nature of cosmic symmetry-breaking, which makes the combined action of the nuclear and electromagnetic forces capable of forming around a hundred different types of stable nuclei, through the mutual interaction of strong force attraction, electromagnetic repulsion of the protons, mediated by weak force conversion to neutrons.*
> Chris King

The model I propose, namely *Tensorial-Relational Model*, to advance an explanation of the events that have led to the *arising of consciousness, culture* and *oral language* among human communities, it stems from applying my previous *Endo-Dynamo-Tensive Model* to the psycho-physical plane, i.e. *tension-energy plane*, of reality.

The *Tensorial-Relational Model* is based on a *Relationship Theory* in which the only relevant fact under the psycho-physical profile is the relationship between different *events*[6] (Alfred North Whitehead) in space-time. According to this model, each element of reality, at any level of

[6] An *event* is intended as concrete primary element of the Universe, a knot of relations not isolated nor isolatable from the whole in which it is comprised.

observation, is a micro system of relations, set in a macro system of relations. Nothing of what we observe exists in and by itself. Everything we can think of, observable and unobservable (ie *virtual*), instead of being made up of building blocks, or even quantized, in its ground state consists, as I'm going to clarify, of *tenso-relationship systems*.

To clarify the meaning of these statements, and the effects they may have on the interpretation of the issues also examined in this work, we first need to set the ontological scenario within which to place the *energy phenomenon*, as well as the biological, neurological and mental one, and this is a journey that will take us to paragraph 1.5.

According to my *Endo-Dynamo-Tensive Model*, the establishment of a physical dimension based on a *relational dynamic* it arises as a consequence of a *cosmogonic event*, namely the *supra-liminal auto-perturbation* (*tensorial symmetry breaking*) of *a primary, irriducible and intrinsically dynamic state of tension*, ontologically assumed as the physical background from which emerge all the differences in potential, all the interactions or forces and all the physical and psychical relationships. A second supra-liminal perturbation (*tensorial transition*) leads to the constitution of the spacetime system of correlative interactions between *gradients of tension* that we know as relativistic dimension or dimension of an *exited tension-gradients distribution* or **ET-GD** (mass and energy free dimension). A third supra-liminal perturbation leads to the constitution of *a non-exited energy-quanta gradients distribution* (zero point quantum field), from whose perturbation (supra-liminal oscillatory motions and/or charge densities of energy-quanta and impulse) takes shape the quantum and supra-quantum dimension (the dimension of the *exited energy quanta-gradients distribution* or **EEQ-GD**), where the *relation(ship)* is somehow explicated and may possibly be observed and directly experienced.

Every object or phenomenon of the quantum dimension is assimilable to a *vibrational system* (describable via a mathematical tool known as *wave function*), that vibrates with a certain *frequential configuration*, a certain *oscillatory or phase modality* (*rhythm* of oscillation) and a certain *intensity*, maintaining an uninterrupted local and non-local *relationship of interference* with other vibrational systems.

The phenomena of interference between the oscillatory modalities of the *energy* flows and *impulse* involved in the perturbation/excitation of the quantum field give rise to *coupling-phase* (*oscillatory resonance*[7]) able to trigger the *phase transitions* that lead, according to QED (Quantum Electrodynamic Field Theory), to the structuring of matter (*domains of oscillatory coherence* vs *domains of oscillatory incoherence*). In particular, each localized (in space and/or

[7] In physics *resonance* or coupling-phase is a condition under which an oscillating system responds to an alternative driving force with the maximum amplitude. Such condition may exist when the frequency of the driving force matches the natural (non-damped) oscillatory frequency of the system. Thus, in case of an imposed oscillating electromagnetic field, a biological system (e.g., a cell) will respond in a measurable manner only to those exogenous oscillations (i.e. alternative driving force) that match the natural (endogenous) EM oscillations of such system.

in time) form of confinement (tensorial, energetic, massive, subatomic, atomic, supra-atomic, biological, cosmological), ie delimited by a boundary[8], is a *tenso-vibrational* micro-environment and corresponds to an *oscillator* or a *resonant cavity* (*cavity resonator*), a *stationary* system organized around a particular tensorial/frequential configuration of perturbations (tensions/oscillations), existing thanks to the relationships of interference it has with the endogenous and exogenous tenso-vibrational environment[9].

The final result is the diversification of the structuring of the phenomena affecting the *exited energy quanta-gradients distribution* (EEQ-GD) regime in *four orders of phenomena* relatively autonomous and independent, associated with just as many physical varieties, the first belonging to the territory of the ET-GD, the second to the territory of the EEQ-GD and the other two to the territory of the Hyper (cosmological) and Middle Dimension (H-MD):

- **Tensorial phenomena** (*tensorial varieties*: differentiated *vs* undifferentiated tensions; qualia; images)
- **Energy phenomena** (*electrodynamic varieties*: wave fields and matter fields; wave-particle duality; anti-symmetrical/chiral composite quantum states and symmetrical/achiral composite quantum states)
- **Condensed matter phenomena** (*thermodynamic varieties*, gas/liquid/solid, and *chemical varieties*, inorganic/organic)
- **Biological phenomena** (*autopoietic varieties*)

The *condensative varieties* of the EEQ-GD and of the H-MD derives from different correlations among *tensorial gradients* on the one hand, and, on the other hand, from different correlations among *anti-symmetrical/chiral composite quantum states* (fermions[10]) and *symmetrical/achiral*

[8] Every structuring process of a system of correlations endowed with a degree of subsistence (condition of resonance) such as to make it distinct and/or distinguishable (even when not observable) from the context of the relationships it forms part of; in general, a *confinement process* is equivalent to a phenomenon of *localization*.

[9] In this sense the terrestrial environment is to all effects a tenso-vibrational environment and every biological structure/system corresponds to an *oscillator/resonant cavity* tuned on the particular tenso-vibrational configuration of the environment to which it belongs.

[10] The particles described by symmetrical wave functions are known as *bosons* and obey the statistics of Bose-Einstein. The particles described by anti-symmetrical wave functions are known as *fermions* and obey the statistics of Fermi-Dirac. Quantum-relativistic mechanics demonstrates that the property of being described by symmetrical or anti-symmetrical wave functions depends on the nature of the particles. In particular it is unequivocally linked to their spin:

- particles with *semi-whole spin* are fermions (e.g. electrons, protons, neutrons); all the elementary particles that make up matter are fermions;
- particles with *whole spin* are bosons (e.g. photons).

All the elementary particles responsible for the forces that hold fermions together are bosons.
Since the exchange of two identical particles is mathematically equivalent to the *rotation of each particle by 360°*, the symmetrical nature of the wave function depends on the spin of the particle after the rotation operator has been

composite quantum states (bosons), corresponding to different *coherent oscillatory configurations* (*domains of oscillatory coherence*) that oscillate with a *non-linear pattern to the rhythm impressed by a carrier frequency modulation*.
Each oscillatory configuration corresponds to a *figure of interference polarized in space* (fermions) interfaced (entangled) with a *quasi-tensorial figure of interference polarized in time* (eg Nambu-Goldstone bosons; spin network), while the transitions between one oscillatory configuration and another correspond to the suppression of certain oscillatory modes or *rhythms* and certain *tensorial gradients*, which go from being *explicated* to *implicated* (David Bohm), and to the amplification of other oscillatory modes and tensorial gradients that go from being implicated to become explicated.

In other words, on quantum and supra-quantum level the weft of each energy phenomenon, condensed or rarefied, originate from the ongoing and self-organized warp of *tensorial gradients* constantly regenerated similar to themself (in order to keep a *global quasi-symmetrical condition*) by the interaction between the *quasi-continuous* (**fractal**) and non-uniform distribution of *monopolar/achiral gradients of non-hertzian potential* (bosons→symmetrical wave function[11]; *scalar* component of the electromagnetic wave) and the quantized and non-uniform distribution of *dipolar/chiral gradients of hertzian potential* (fermions→anti-symmetrical wave function; *vectorial* component of the electromagnetic wave).

Furthermore, the *four orders of phenomena* relatively autonomous and independent affecting the EEQ-GD regime can interact thanks to three types of correlative dynamics or couplings:

- **Phase Conjugate Dynamics** (of the type *Frequency-Phase Correlative Dynamics*);
- **Spin Coniugate Dynamics** (of the type *Phase-Tension Correlative Dynamics*);
- **Tension Coniugate Dynamics** (of the type *Tension-Tension Correlative Dynamics*)

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applied to it. Particles with whole spin *do not change the sign of their wave function after a 360° rotation*, as a result, the wave function sign of the system as a whole does not change. Particles with semi-whole spin *do change the sign of their wave function after a 360° rotation*. In accordance with the *Pauli exclusion principle*, two fermions can not share the same quantum state, while bosons can. This translates into a strong resistance to fermion compression. This resistance creates the *rigidity* of ordinary atomic matter.

[11] *Postulate of symmetrization*: The observables of a system of identical *n* particles are represented by auto-added operators invariant through any permutation of the particles. The pure states of the system are represented by Hilbert space vectors which are *symmetrical* (bosons) or *anti-symmetrical* (fermions) due to the exchange of any pair of particles.

The states of a quantum system of *n* particles can therefore be either *symmetrical* or *anti-symmetrical* due to the exchange or permutation of interacting particles. This interaction is also called *exchange force* (or Heisenberg-Majorana exchange force) and is *attractive* (plus sign) for symmetrical states and *repulsive* (minus sign) for anti-symmetrical states.

However, the **global balanced relationship** that sets up this interfacing, namely the fact that the forms taken by energy-matter always remain similar to themselves (self similarity) is endowed by a cascade of **unbalanced relationships**. That is to say that **locally** (in space and/or in time) the universe of (self-similar) transformations, where nothing is created and nothing is destroyed, it is constantly shifted towards the component polarized in space or towards the component polarized in time. When this has to happen we speak of *transitory* quantum or supra-quantum *symmetry breaking*. Moreover, when this unbalanced state becomes *stationary* we may observe some very strange phenomenon, e.g. cosmological *black holes* when it is dramatically shifted towards the *figures of interference polarized in space* (space collapses), and terrestrial **living systems** when it is shifted towards the *quasi-tensorial figures of interference polarized in time*. That is: **in biological systems it prevails the component polarized in time and are themselves polarized in time**.

According to this model, then, there aren't pieces of a mosaic, but *relationship systems* (that in the ground state corresponds to pure *Tensorial-Relational systems*). Their identity and their existence is determined by being part of a particular system of relationships which manifest themselves solely in the correlative and functional availability of a complex series of *energetic and/or tensorial relationships*. Talk about hidden codes or pieces of thought or consciousness or life or whatever, without specifying that it is a scientific artifice, which can be provisionally adopted to facilitate the investigation of a certain object of study, does not make sense. Any building block corresponds to a piece of our mapping out of the territory and not to the territory, that is to say that reality becomes composed and change its composition according to the ordering function of the mental and instrumental investigation that we are adopting.

1.3 Quantum descriptions of signal transduction in biological systems

Phonons are the tiniest particles of sound.
Phonons are to sound as photons are to light.
It takes billions of phonons to make up a sound.
Phonons oscillate, echo, reverberate etc.
*at the sub atomic level in the quantum soup***.**
Pauline Oliveros

In 1972, the Chilean biologist and philosopher Humberto Maturana coins the term *autopoiesis* (*auto*, self, and *poiesis*, creation) in order to give a definition of a living system disconnected from specific functional characteristics, such as mobility, the ability to reproduce, metabolism, but based exclusively on the system as such. In practice an *autopoietic system* is a system that responds to the laws of *thermodynamics of non-equilibrium*, that constantly redefines itself and that internally it sustains and reproduces itself.

The autopoietic dynamic of the cell is organized around biochemical and biophysical

autocatalytic patterns (ie self-accelerated) regulated by continuous and non-linear fluctuations of *selective energy transfer* between intra and extra environment. The *transmembrane selectivity* is the central element of the *autopoietic dynamic*. There is a *catalytic core* capable of interacting with the environmental substrate so as to produce the components that form the membrane. A membrane thus defines and separates this network of coherent interactions from and to the environment so that it can realize an autonomous but not isolated unit.

Living systems are *transient systems* tuned on *state variations* or *stimuli* (perturbative events as *frequency variations*, *phase variations*, *tension variations*) of the internal and external environment: their subsistence depends on their ability to adapt to (specific) applied perturbations. To adapt they must be, at first, *selectively excitable*. *Selectivity* is an essential condition for the existence of an *autopoietic system*. An example of biological selectivity is *enantioselectivity*. Biological systems are *enantioselective*, i.e. they strictly select the *enantiomeric forms* of the molecular species of which they consist (biological reactions synthesize and use always and only one of the two enantiomeric forms of a given molecule). The enantioselectivity of biological systems is the reason for their *homochirality*, namely the presence of groups of molecules that have all the same enantiomeric configuration (e.g., the amino acids are all in the *levorotatory configuration*, while the ribose and deoxyribose of the nucleic acids have only *dextrorotatory configuration*). Enantioselectivity, homochirality and autopoiesis of biological phenomenon seem related to the phase transition of water from liquid state to *semi-crystalline* or *glassy and super-coherent state* of biological water [11].

Selective energy transfer between intra and extra environment is associated with the production and transduction of *electromagnetic/electromechanical signals* (coherent scans of *state variations* or *stimuli*) that come into play in the oscillatory interconnection and in the biophysical processes of *transmembrane tuning* (coupling phase). In particular, quantum description of signal transduction in biological systems makes use of two models:

- the Fritz-Albert Popp's model, that describes the intra- and intercellular communication by introducing the notion of *biophotons* (coherent electromagnetic oscillations, longitudinal polar optical vibrational modes with frequencies in the ultraviolet)

- the Alexander Davydov's model, that describes the interaction of the vibrations of NH-groups (amide I vibrations) of protein molecules with hydrogen bonds by introducing the notion of *solitons*[12].

Any living system from a whole organism down to a single cell or an organelle contains charged particles (ions) or polar molecules and functional radicals of molecules. A flux of such charged particles within a living system owing to the diffusion of ions or conformational changes of polar molecules causes *extremely low intensity endogenous* (i.e. generated by the living system itself)

[12] A *soliton* is a scalar wave-particle, or longitudinal wave at half-integer spin (Fermions), whose diffusion occurs at low speed, without energy loss.

oscillating Electro-Magnetic (EM) *field*. Thus, living systems are known to emit (endogenous) *electromagnetic oscillations*. The individual's spectrum of such endogenous oscillations is rather complex because of superposition of oscillations from different sources within an organism.

The broad spectrum of frequencies of the endogenous EM oscillations represents the broad spectrum of sources of such oscillations within an organism. Basically, two regions of the whole spectrum of EM oscillations of biological systems may be specified: the region of *extremely low frequencies* (corresponding to the infrared light), and the region of *high frequencies* (corresponding to the ultraviolet light). The high-frequency end of the spectrum of endogenous EM oscillations corresponds to the emission of so called *biophotons*.

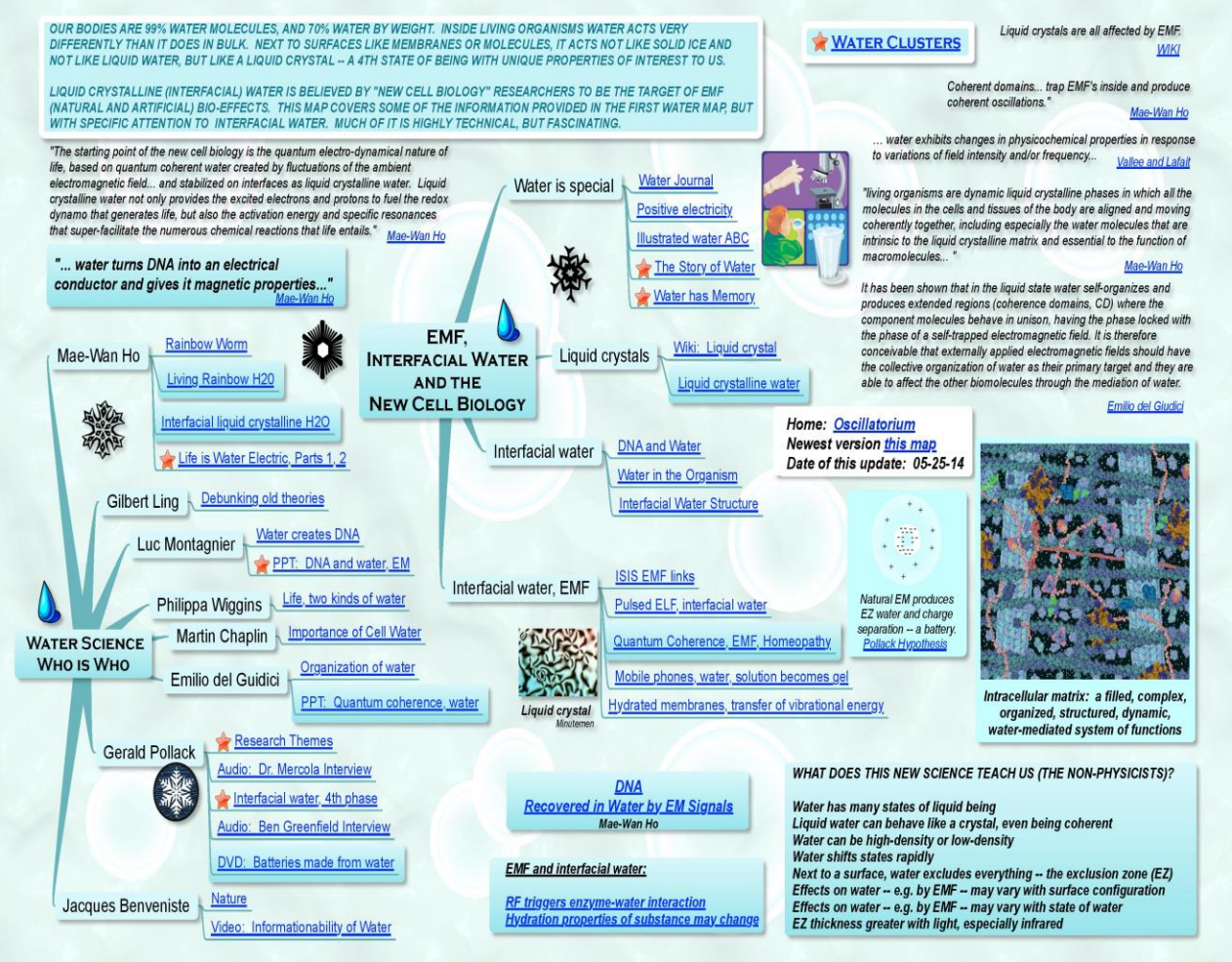

Fig. 1 Clusters of Interfacial Water (Image source: www.oscillatorium.com/id54.html)

The notion of biophotons has been coined by the Marburg group formed around biophysicist Fritz-Albert Popp: *biophotons* are single (mass-free) *energy-quanta*, being continuously emitted by all living systems. They are a subject of quantum physics and display a universal phenomenon

attributed to all living systems.

According to Popp, intra- and intercellular communication occurs through the mutual absorption and emission of biophotons and is effected by means of *resonance phenomena* (coupling-phase). The results of the effects of the endogenous electromagnetic fields of biological systems on the inherent coherency of life-supporting processes in individual cells, cell populations, and living organisms suggest that natural integrity is supported mostly by non-linear interactions between environmental and endogenous extremely-low-intensity electromagnetic oscillations.

The other quantum description of signal transduction in biological systems uses the A. Davydov's (Davydov 1976) [12] model that describes the interaction of the vibrations of NH-groups (amide I vibrations) of protein molecules with hydrogen bonds. Davydov has coined the notion of *soliton*, a *quantum quasiparticle* representing an excitation of amide I propagating along the protein α-helix. The elementary excitations within the α-helix are given by the *phonons* (a *phonon* being a quantized mode of vibration, a coherent electromechanical oscillation) that correspond to the deformational oscillations of a *lattice*.

Phonon is a *quasi-particle* but behave just like any other elementary particle at low energies (longitudinal polar vibrational modes lowest in frequency). But if we look at phonons closely, we do not see smaller parts that form a phonon. We see the atoms that form the entire lattice. The phonons are not formed by those atoms, the phonons are simply *collective motions* of those atoms. This makes us to wonder that photons, electrons, atoms, etc, may also be emergent phenomena just like phonons. They may not be the building blocks of everything. They may be collective motions of a deeper underlying structure, that in first approximation we can describe as a *lattice-like field*.
A lattice is a synonym for the *symmetric frame work* of a crystalline structure, a 3-dimensional array of regularly spaced points coinciding with the atom or molecule positions in a crystal. The discretization of any continuum model automatically turns it into a lattice model (physical lattice models frequently occur as an approximation to a continuum theory). More generally, a lattice is a coherent distribution (a grid) of points and/or vibrations (e.g. phonons, solitons, photons) in space and/or time.

Lattice-states can be found at different levels of energy organization : bosonic (spin grid), fermionic, atomic, supratomic.

With regard to biological systems, the cytoplasmatic fluid, the amniotic fluid, the cerebrospinal fluid and the cerebral white matter (i.e. neuroglia), are examples of lattice-like states with a high ability to convert the mechanical vibration (phonons) in quanta of electromagnetic energy (photons) and *vice versa* (piezoelectric effect).
In evolutionary terms, the differentiation of the biological phenomenon can be seen as

differentiation of the levels of integration between structural and functional units and the lattice-states in which they are immersed.

(*Continued on Part II*)