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Mind-Brain-Body System's Dynamics

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Abstract

All the current computational mind-brain models are based on the mechanistic (*mechanical philosophy*) and deterministic vision of the world, conceived in the sign of Cartesian dualism and Newtonian physics, which operate in every sector of knowledge and know-how by reason of a universal *mechanistic orde*r. At present the Western theories about the position of *human mind* in Nature can be reduced to five: *Materialism*, *Metaphysical idealism*, *Dualism*, *Holism*, *Quantum*. Based on the identification of two distinct and imbricated physical planes of reality, namely the plane or domain of *tension* and the plane or domain of *energy*, a relationship-based alternative explanation of the *mind-brain-body system* non-linear dynamics is advanced. The paleoanthropological and psychologic roots of the anthropopoietic process are discussed. As advanced in previous works, a cosmogonic hypothesis is summarized on the possible derivation (and subsequent coexistence) of the physical dimension defined by the Planck constant from (with) a physical dimension defined by a non-uniform distribution of *tension* gradients, the "raw material" of which the mental phenomenon it's made of. Biological systems are defined as non-linear dissipative systems embedded by super-complex anticipatory systems relying on thermodynamics of non-equilibrium, at the phase boundary between chaotic and ordered (coherent) regimes. The role played by nerve cells in the phylogenetic diversification process is also discussed. In conclusion, an anthropological, phenomenological and physical interpretation of *mind*, *consciousness* and the *mind-brain-body system's dynamics* is advanced. Mind is not an intrinsic property of matter, nor a state of matter. Mind is a particular way of being of *tension* in relation to *energy*, made available when the autopoietic dynamic of a biological system is mediated by the neurologic relational module. Mind is grafted on the stream of sensations (state variations) elapsing within the neuro-dependent dynamics while *energy* merges into *tension* on the edge of chaos, that is, a stream of state variations experienced as *events*, *i.e.* knots of relations non isolated nor isolatable from the whole in which they are comprised, whose value and relevance is species-specific dependent.

Subject Areas

Anthropology, Biophysics

Keywords

Tension Domain *vs* Energy Domain, Deterministic Chaos, Spin-Internal Motion, Tension|Energy <Ť|Ê> Exotic Objects, Mindedness, Mind-Brain-Body Dynamics

1. General Premises

The brain being indeed a machine, we must not hope to find its artifice through other ways than those which are used to find the artifice of the other machines.
It thus remains to do what we would do for any other machine;
I mean to dismantle it piece by piece and to consider what these can do separately and together.

Nicolaus Steno
Nicolaus Steno's lecture on the anatomy of the brain (1669)

The Newtonian determinism taught that the physical world is governed by iron laws and everything in the physical world is predictable and thus ultimately controllable. According to it a physical system is comparable to a mechanical system, that is, made up of independent macro and microscopic parts that interact only with adjacent parts, developing a behavior that is deterministic over time. This is the principle on which all the current computational models of the brain are based. In most of the scientific literature, *mind* is considered an epiphenomenon of the *body* (particularly the *brain*). Brain is considered the seat of mind, mind is the software and brain its hardware. The current neurobiological approach tries to explain the mind as a byproduct of physico-chemical processes involving the billions of neurons in the human brain and its various components are the thought process, emotions, intelligence, awareness, consciousness and the like.

The mind would correspond to a cognitive system comparable to an information processor, subdivided into different components or modules, functionally interconnected by as many circuits or neural networks, which may extend into multiple brain areas. The task is to associate to each module the statistically most relevant neuronal circuit in relation to function. The result is a map of anatomical-functional correlates that link certain psychodynamic requirements to certain neurodynamic requirements, from whose state of integrity depends on the quality of an individual's relationship life.

However, the current neurobiological approach it fails to explain mind's physical consistency and the experiential aspect of the subjective state of being

oneself, or the "*I*" experience which everyone experiences in day to day life. It even fails to explain how billions, or millions, or thousands, or even tens of neurons work together to produce the brain's activity[1]. A key clue to explaining how we are drawing up increasingly detailed and complex functional maps of the brain, human and otherwise, and yet have still barely scratched the surface of the astonishing Central Nervous System (CNS) is to be found in Rene Descartes' classical physics-based dualistic and reductionist approach (mind and matter belong to two totally different planes of reality, science can deal only with the investigation of *res extensa*, excluding *a priori* the possibility of investigating the fictitious, subjectively experienced plane of reality *res cogitans*, interestingly, contemporary neuroscientists are looking for an explanation of something, namely *mind*, using tools that have been designed not to deal with it, which leads them to believe that mental activity is produced by neuro-electromagnetic-brain activity) and even more in Nicolaus Steno's suggestion that we should **treat the brain as a machine**.

The mechanistic (*mechanical philosophy*) and deterministic vision of the world, conceived in the sign of Cartesian dualism and Newtonian physics, will inspire one of the two souls of the Enlightenment, the *Technophilous soul*, whose utilitarian vocation, conceived in the West and exported all over the world thanks to four Industrial Revolutions, will operate in every sector of knowledge and know-how by reason of a universal *mechanistic order* [3]. In this regard, Matthew Cobb writes [4]: *"Machine" has meant very different things over the centuries, and each of those meanings has had consequences for how we view the brain. In Steno's time the only kinds of machine that existed were based on either hydraulic power or clockwork. These soon proved limited in the insights they could provide about the brain in terms of its structure or function, and no one now looks at the brain this way. With the discovery that nerves respond to electrical stimulation, in the nineteenth century the brain was seen first as some kind of telegraph network and then, following the identification of neurons and synapses, as a telephone exchange, allowing for flexible organization and output (this metaphor is still occasionally encountered in research articles). Since the 1950s our ideas have been dominated by concepts that surged into biology from computing—feedback loops, information, codes and computation. But although many of the functions we have identified in the brain generally involve some*

[1]According to [1], the human brain contains approximately 85 to 100 billion of neurons (the brain of a birdhas 100 million neurons; the *octopus* has 300 million neurons in its brain; the smallest primate in the world may be the baby *Philippine Tarsier*, which probably has around 500 million neurons in its brain; for comparison, adult *macaque monkeys* have around 10 billion neurons, and the largest *whale* brain has around 500 billion neurons), most of which are concentrated in the cerebellum, whose total and congenital absence (complete primary cerebellar agenesis) does not bear any limitation to the cognitive functions [2], but various limitations in the coordination of the body, the movement of the tongue and in the articulation of speech (dysarthria). Excluding neurons in the cerebellum, the majority of the neurons that remain, about 15 - 20 billion, are concentrated in the cerebral cortex. Each neuron may contract more than 15 thousand synaptic connections with other cells, both with neurons and with glial cells (→ gup junctions), the number of which is significantly higher than that of neurons (ratio of about 10 - 50: 1).

kind of computation, there are only a few fully understood examples, and some of the most brilliant and influential theoretical intuitions about how nervous systems might "compute" have turned out to be completely wrong. Above all, as the mid-twentieth-century scientists who first drew the parallel between brain and computer soon realized, the brain is not digital. Even the simplest animal brain is not a computer like anything we have built, nor one we can yet envisage. The brain is not a computer, but it is more like a computer than it is like a clock, and by thinking about the parallels between a computer and a brain we can gain insight into what is going on inside both our heads and those of animals. Exploring these ideas about the brain—the kinds of machine we have imagined brains to be—makes it clear that, although we are still far from fully understanding the brain, the ways in which we think about it have become much richer than in the past. (…) *A number of scientists are now realizing that, by viewing the brain as a computer that passively responds to inputs and processes data, we forget that it is an active organ, part of a body that is intervening in the world and which has an evolutionary past that has shaped its structure and function. We are missing out key parts of its activity. In other words, the metaphors we use shape our ideas in ways that are not always helpful.* (…) *Despite the tsunami of brainrelated data being produced by laboratories around the world, we are in a crisis of ideas about what to do with all that data, about what it all means. I think that this reveals that the computer metaphor, which has served us so well for over half a century, may be reaching its limits, just as the idea of a brain as a telegraph system eventually exhausted its power in the nineteenth century.*

Over centuries Western philosophers have questioned the position of *human mind*, understood as *mind endowed with consciousness* (a mind without *consciousness* is like a boat without helmsman, a condition that in addition to being unfavorable for navigation on the rough seas of life, is definitely useless in a world conceived in order to satisfy Homo Sapiens et Faber will to power), in Nature and several theories have been formulated, but at present the alternatives taken into consideration can be reduced to five:

1) *Materialism*. Mind is a product of the brain, or more accurately a by-product of the survival functions that the brain realizes for the organism. As organisms become more complex, they require more complex "computers" to head for food, the partner and the various resources needed to survive and reproduce. At a certain point of this development mind appears. There for mind is not the primary datum of the real world: it is an "epiphenomenon" which really manifests itself only in those that possess sufficiently complex brains.

2) *Metaphysical idealism*. Mind is a fundamental reality: matter is nothing but an illusion created by human mind. In the evolution of the universe, mind was the first reality, and it is still the first (and perhaps the only) reality. The material universe is nothing more than the creation of human mind when interpreting, resorting to its peculiar mental-consciousness nature, the world around. We find

this alternative in all post-Neolithic internal representations of the external reality, including the Eastern one. Oriental philosophies, e.g. the *Vedic doctrine* (particularly the last portions of the Vedas referred to as *Upanishads*) from India, do not subscribe to the Cartesian body-mind dichotomy. Instead, these philosophies consider mind (*manas*) and body respectively as the gross and grosser aspect of an underlying unitary reality. The ancient seers (the *rishis*) of the East proclaimed in the Upanishads (the essence of Vedas) the *Unitary* approach of *Non-duality* (*Adwaitha*) and considered the outer world as an extension of "*Self*". They argue that the only thing that exists is *unconditioned Consciousness* (called by various names and degrees as "*Brahman*", "*Purusha*" etc.). The world as we see it is just a projection of the *unitary unconditioned Consciousness*. The *individualized conditioned consciousness* is explained as a perceptual error due to ignorance (*Avidya*) which begets a feeling of *"I" ness* (*Asmitha*). Because of attachment to objects by way of love, desire, liking (*Raaga*) and hatred dislike or aversion (*Dwesha*), the *individualized conditioned consciousness* gets entangled into the web of the world, forgetting the true nature of *Self* as *universal-unconditioned Consciousness* [5].

Accordingly, mind is the subtle form of matter and therefore of the body and its components, which are to be considered as grossest forms of matter. Consciousness, however, is considered finer than "*mind-matter*" and all pervasive, omnipresent and omniscient. Here *consciousness* is explained in the singular and as the only reality, but appearing in its manifestations as plural due to ignorance (Avidya) or to the identification of *one self*, *i.e.* the feeling of *"I" ness* (egoism), with the instrument of perception and their functions and experience (Asmitha). The *one* appearing as *many* is then a perceptual error.

3) *Dualism*. Mind and matter are both fundamental but completely different: in humans they are associated through the brain. The manifestations of the mind cannot be explained by the systems that manifest it, nor by the extraordinarily complex brains of human beings. In the case of human beings, mind is associated with a material brain, but this brain is only the seat of mind and does not identify with it.

4) *Holism*. Matter and mind constitute a whole that cannot be divided, neither theoretically nor practically. The distinction (introduced in Western thought by Descartes) between mind and matter is completely unfounded: ultimately mind and matter form a single integrated. We must accept them and treat them in this light, without worrying about the place and the form in which they manifest themselves.

5) *Quantum model*. Matter and mind are both real but are not fundamental: they evolve together starting from an even deeper level of reality. The roots of both matter and mind extend into a deeper layer of reality which in itself is neither mental nor material. Matter and also mind have evolved starting from a common cosmic womb: the energy field of the quantum vacuum (*zero point quantum field*). Interestingly, the emerging Quantum model relies on the fact

that it is fashionable to consider Quantum Mechanics as a replacement for the phrase "anything goes" and once anything goes, you can have anything you want, including a Quantum Mind.

Aim of the present work is to put forward a *relationship-based alternative*, which rejects as false and misleading the atomistic (Newtonian) and pyramidal (Darwinian) vision of reality, affirming that every element of reality, physical and psychical, it exists only as a relationships system embedded into other relationships systems. What we observe, at any level, are not *building blocks of reality* but intertwined *patterns of reality* [6].

Throughout Western's civilization history the interest concerning *consciousness*, *i.e. conscience*[2], has occupied a privileged position compared to that reserved to **mind**, which has become a priority object of interest and research only starting from the second half of last century, when the growing interest in Artificial Intelligence and its applications has pushed many researchers and many scholars of different scientific fields, to deal with the mental phenomenon (with the precise aim to turn it into a phenomenon likely to be simulated, reproduced and controlled) [6].

[2]In English the Latin word *cumscire* (*conscience*) is generally translated as *consciousness*, which indicates a psychic function, namely an unstable and ever-changing process, often understood as a psychic condition, a *state of consciousness*. The etymological profile of the word *conscience*it can be traced as follow. *Con-science* is derived from the Latin *cum-scire* (*scire* to know, *cum* together, *to-know together*, *to know assharing*, the *knowledge givenby the knowledges*), but also *con-scientia* (with-wisdom, in a wise), in turn derived from the Greek *σύνοιδω* [*synoido*], composed of *syn* (together) and *οἶδα* [*oida*] (knowledge), hence *knowledge originating from knowledges*, coming from the Sanskrita root *chid* (cut, separate, break, distinguish), analogous to the proto-Indo-European root **sker* (trace a furrow).

From its etymological profile derive two different meanings. The first is linked to the Sanskrita root *chid*, akin to the proto-Indo-European root **sker*, and establishes the intrinsically discriminative nature of conscience-consciousness, its tendency to emerge, to operate in the world and on the world, *cor-rupting* (from the Latin *rationem putare*, establishing a relationship) whatever it encounters. In this meaning, conscience-consciousness discriminates by developing and integrating the selective function exercised by the psycho-perceptual activity (which in turn develops and integrates the selective function exercised by the neuro-sensory activity, which in turn develops and integrates the selective action prefigured in the confinement processes that shape manifestation), and operates following a process of transformation of the separation properties in reunion properties and *vice versa*, which corresponds to exercising the power of direct separation of concrete quantities (calculating). In terms of numeration, in the strict sense of the word, this corrupting-calculating is based on counting the objects of a whole, which means assigning each of its constituents a metaphor-sign (acoustic, mathematical, verbal, mental, gestural, graphic, etc.) corresponding to a number that is part of the natural series of integers, starting from unity and proceeding in order until completing the elements of this set that thereby assumes, arbitrarily, the characteristics of a *sequence*[2]. Hence, counting is equivalent to introducing an order of sequential separation in an otherwise undivided set, while calculating-corrupting is equivalent to subjecting a sequence to a re-combination. The second meaning is linked to the prefix *cum* of *cum-scire* and *syn* of *synoido* (but also of *syn-esis*) and affirms the relationship of dependence that subordinates consciousness (con-science) to the archetypal presupposition of all the anthropopoietic relational categories: on high is Sky, below is Earth, in the middle Homo. In the human body this archetypal presupposition means that the discriminating possibility of conscience-consciousness depends on the availability and quality of the synergic relationship (from the Greek *synerghìa*, from *synérghein*, conjoined action, composed of *syn*, together, and *érghein*, acting) that elapses between the territory of *bio-energetic dynamics* (biological selectivity), the territory of *neuro-sensorial activity* (animal sensing) and the territory of *psychic-mental-cognitive activity* (human sensing-intuition → thinking-feeling).

Historically the Western concept of (conscience) *consciousness* is shaped, as discussed in [7], by the cultural-religious background that precedes and accompanies the 800 years (from 509 BC, founding date of the Roman Republic, to the Nicaea Council, 325 AD) of domination and expansionism, first of the Roman Republic and then of the Roman Empire, in the Euro-Mediterranean area and in the Near and Far East.

Consciousness (conscience) it represents the compromise reached by the theological/theoretical synthesis which since the dawn of the first millennium AD attempted to re-harmonize, for the sake of Imperial stability, three contemporary visions of the World, linked to as many cosmogonic and social interpretations and as many versions of the word ***anima*** (*ànemos*/*pneuma-ruah-animus*, all terms translatable by *wind*, *gust of air*, *breath* and all pointing at the *breath of Brahman* from Vedic cosmogony): the Hellenistic Platonic-Aristotelian version, the Old Testament Hebrew version and the New Testament Judaic-Christian version.

As *consciousness* has made its way into our peculiar *mindedness*, we have projected it onto the World, creating a world populated by various entities endowed with some degree of human consciousness, some in the image and likeness of our *conscious*, some in the image and likeness of our *unconscious*. Accordingly, when we map the territory we make use of our mental categories. This refers to the way we behave within the World, shaping the external world on the basis of our internal world (no matter how sophisticated our investigation tools can be), mixing what is the map with what is the territory. This, in fact, is what we have been doing at least since Middle Paleolithic times. When the features we choose from time to time as indicative and distinctive of our humanness, become the reference measure for our mapping, we apply, for good and for bad, an anthropocentric point of view.

Interestingly, this anthropopoietic activity has never and will never run out, but only changes its shape. At present times, in our technocentric Era, the attention that was once reserved to the forces of Nature is reserved to the forces of Techno-Science, giving way to cybernetic machines equipped with intelligence and consciousness.

2. At the Roots of the Anthropopoietic Process

The paleo-archaeological record through which we groped to reconstruct, at least in general and with reasonable uncertainty, the essential features of the behavioral life of our distant ancestors lived during the Lower Paleolithic period (ca. 2.7 - 2.4 mya to ca. 300 - 120 tya), are (controversially) of few genres (variously classified) and are becoming increasingly scarce and fragmented as passing from the most recent finds, dating from the second half of the Lower Paleolithic (ca. 900 - 700 to ca. 300 - 120 tya), to the oldest anthropogenic finds dating from the first half of the Lower Paleolithic (ca. 2.7 - 2.4 mya to ca. 900 - 700 tya) [8], and even earlier [9].

The information we can glean from these anthropogenic finds vary according to their chronology and depend on the type and provenance of records that we have available, namely *utilitarian* and *non-utilitarian* anthropogenic finds.

Utilitarian finds are mainly *artifacts*, *i.e. tools*, dating back to the first half of the Lower Paleolithic like *simple pebble tools*, *quartzite pebble tools* and *flakes* (India), *chopping-tools* (Eastern Hemisphere), *handaxes*[3] and *cleavers* (Middle Est, Africa, western Europe), *bifacial-tools* and *flint tools* (western Europe, Jordan), all of them sharing a minimalist and essential shape, made according to a synthetic spatial perspective of a *mirror-symmetrical type* (double-sided) [11] [12] [13] [14] [15], a symmetry (*mirror symmetry*) which reflects a *two-dimensional spatial perspective* (bipolar) and a based guidance on the horizon.

Non-utilitarian artifacts, *i.e. palaeo-art finds*, from this period are [16] *beads* and *pendants* from the Acheulean of France (at Saint-Acheul); iron hematite (*ochre*) *fragments* (occurring together with Acheulean *bifaces* and exotic *quartz crystals*), the processing of which may have provided a pigment used for coloring objects, bodies or surfaces, from Wonderwork Cave, in the northern Cape region of South Africa; numerous *manuports*, *i.e.* natural objects that were collected and carried by hominids because of some outstanding properties, such as *quartz crystals* from the Lower Acheulean of Singi Talav (India), Choukoutien (China) and Gudenus Cave in Austria; the *red jasperite cobblewith distinctive natural markings* (that makes the cobble looking like an anthropomorphic shaped face with eyes and mouth) from Makapansgat Cave in South Africa, which was collected by a hominid about 2.5 - 3 mya; the *Erfoud manuport*, in the form of a fossilized fragment of a *cuttlefish* with natural phallic resemblance, from an archaeological site near the towns of Erfoud and Rissani in eastern Morocco, which was collected by a hominid about 300 tya [17]; an *engraved bone fragmen*t from the Acheulean of Sainte Anne I, France, which bears *ten short cuts* along an edge.

[3]Around 1.5 mya a new kind of artifacts developed from simple Oldowan broken (flaked) rock tools. These artifacts, known as the *Acheulean*, is typified by one type of tool, perhaps the most successful tool ever used: the *biface handaxe*, a basic, essential and functional tool produced and utilized for subsistence and adaptation's needs.*Homo ergaster* and/or *erectus* made this tool for over a million years as did later members of the *Homo* genus. *Homo erectus* made handaxes everywhere they could find the appropriate kind of rocks, with little stylistic variation, all of them having the same *almond-* or *teardrop-shape* from any angle. Why? Given that*technique* is the daughter of the *process ofabstraction* and that it has been driven by social and cultural production that require instruments, and that *technology* is the know-how meant as intentional ideation, production and application of manuals and/or instrumental *techniques* (procedures) aimed at the satisfaction of anthropic purposes, the reason for which the style and form of handaxes (like that of other anthropogenic finds from Lower Paleolithic) were consistent for a very long time over a wide geographic range, from the Middle East to Europe and Africa, it could be due by the fact that the ability to shape a stone in the form of handaxe was *hardwired* in the *sensing-intuition interactive dynamics phylogenetically inscribed into the neuropsychological relational module* of early *Homo* (see below in the text for explanation on the subject), much like the ability to make a particular kind of nest is *hardwired* in the *sensing interactive dynamics phylogenetically inscribed into the neurological relational module* of birds, the ability to make a particular kind of cobweb is *hardwired* in the *sensing interactive dynamics phylogenetically inscribed into the neurological relational module* of spiders, the ability to make a particular kind of hive is *hardwired* in the *sensing interactive dynamics phylogenetically inscribed into the neurological relational module* of hymenopters, etc. [10].

Utilitarian finds from the second half of the Lower Paleolithic are artifacts that provide some likely clues on Paleolithic humans migration flows (a series of quartz stone axes, found in Crete and dated between 800 to 130 tya suggest that already from the second half of Lower Paleolithic perhaps *Homo erectus* and certainly *Homo heidelbergensis* built rudimentary boats for sailing in the open sea [18]); *stone tools* (*choppers*, *bifaces*, *scrapers*, *blades*, *handaxes* and *spikes*) [19] belonging to the so called *core-tool tradition*, developed and diversified in terms of their intended use [20], but also because of the location of their makers perspective, a fact of great importance in the *process of psycho-relational individuation-nucleation* that has transformed the inner life and the relational approach of human communities, because it indicates that the human position, in the binocular perception of reality, is taken as the psycho-spatial coordinate that gives a sense of depth to the reality itself: the human actor's position, as psycho-spatial coordinate for the depth, is the dependent variable which orients the two-dimensional extension of the line and the one-dimensional point (dot) generating the *tridimensionality*[4].

Non-utilitarian finds from this period are *stone carvings*, such as *cupules* [22] [23] (a shallow, non-functional cup-like depression, cut into the surface of a rock as an engraved dot) and *petroglyphs* found in Bhimbetka and Daraki-Chattan Caves, India (dated between 700 to 290 - 200 tya), lines and dots as engravings which add the size of the depth to the two-dimensional perspective, creating the suggestion of three-dimensionality; artifacts with *zoomorphic and anthropomorphic forms* realized according to a two-dimensional spatial perspective; specimens of *anthropomorphic statuettes* or figurines classified as *Venus* (*Venus of Tan Tan*, Morocco, dated between 500 to 300 tya; *Venus of Berekhat Ram*, Israel, dated between 500 to 230 tya) [24]; *iconic figures* in the graphic art of eastern Europe and Asia such as some of the paintings in Kapova Cave and Ignatiev Cave and two mammoth engravings, one each from Mal'ta and Bereliokh, Siberia, and perhaps one figure from Hayonim Cave; *geometric or non-iconic marks* such as the numerous *geometric signs on portable objects* from Russia, Ukraine, Siberia and India, best exemplified at Eliseevichi, Mezin, Kirillovskaya and Mezherich (but also occurring, less pronounced or in smaller numbers, at Patne, Mal'ta, Afontova, Kavkaz, Balinkosh, Klinets, Timonovka, Suponevo, Novgorod-Severskaya, Avdeevo and Gagarino), in the first Palaeolithic art discovered in China, in several *engraved objects* from the Levant (espe-

[4]With respect to the 3-dimensional sense Wynn observes [21]: *Perhaps the most critical new spatial concept is the understanding and coordination of multiple points of view. The intentionally straight edges and parallels on some of the Isimila bifaces require attention to a stable point of view, which is a projective notion. More complex still are the regular cross sections of many of these bifaces* (…) *Unlike the spatial concepts used for earlier tools, these projective notions allow the internal frame of the artifact to be controlled by the external relation of perspective. A second spatial concept to appear by* 300,000 *years ago is that of a "Euclidean" space, that is, a space definable by a three-dimensional coordinate grid* (…) *The acquisition of this constellation appears to have hinged on a single breakthrough in spatial thinking, the invention or discovery of perspective* (…) *The evolution of these concepts of space reflects, I think, the development of a very distinct concept of self as an actor in an independently existing world. Such an awareness is at the heart of human understanding.*

cially the Urkan e-Rub II plaque and an Upper Besor 6 *ostrich eggshell fragment*) and in Blombos Cave, southern Africa.

The finds from the Middle Paleolithic (Europe) or Middle Stone Age (Africa) [25] or "later Early Paleolithic" (LEP) in the Chinese chronological scheme [26], ca. 300 - 120 to ca. 45 - 30 tya, include *pictographs*, *petroglyphs*, *survival flukes* (rock paintings in deep caves), *proto-sculptures* or figurines, iron hematite (*ochre*) *fragments* such as those found in an archeological site near Twin Rivers, in Zambia, South Central Africa, dated ca. 270 tya, abundant and varied types of tools and other hand processed stone artifacts belonging to the so called *flake-tool tradition* [27], some of them showing a clear propitiatory-magical significance, as well as some evidences on the evolution of fire control. Their processing and typological variety are in favour of a substantial refinement of the skills used in the manufacture of materials such as stone, bone and wood showing that in humans' psyche was taking place a mature process of elaboration and structuring of the objectives pursued with their production, an evidence of the settling of the three-dimensional perspective orientation assumed by humans in their relation with the surrounding.

From now on it develops an anthropocentric orientation which entails a progressive detachment from the *relationship of continuity* or *phylogenetic* (*quasi*) *unconditioned identification* with the natural habitat, determining a drift towards a problematic epigenetics *relationship of contiguity*, or *epigenetic-conditioned identification* with the surrounding, which, in overcoming the relationship of continuity, re-creates the world in the form of *internal representation* (first *magic*, then *symbolic* and later on also *semantic*) *of external reality*.

In this regenerative and representative psychophysical process, the *undivided unity composed by the individual and its natural habitat* is cleaved into a territory and its mapping. In the tension, fraught with uncertainties, created by this splitting, the (quasi) absence of intentional supra-adaptive purposes[5] in early humans is facing and integrates with the rising humans' *state of consciousness*, and from its anthropo-centric orientation flows the fully supra-adaptive behavioral which we call, to all intents and purposes, *cultural production*, where by **culture** is meant:

- The ongoing overcoming of stereotyped behavioral patterns via intentional, circumstantiated, not occasional, epigenetic ideation, programming, organization and implementation (for adaptive and supra-adaptive purposes) of

[5]It should be stressed that it is not possible to conceive the ongoing transformation process of human cognition, as if it has been composed and divided by *jumps*. All forms of behavior observed at a certain period of time within a given species, are always somehow prefigured, among that same species, in earlier behavioral forms. That is to say that any behavior undergoes over time a more or less observable process of diversification, going from a phase in which its effectiveness it is not fully established, to a phase in which it is. In human species it has never been a behavior completely free of intentionality! However, the behavioral intentionality (stricto sensu) it has been for a long time overshadowed by the prescriptive action (eminently unconscious) exerted by the *sensing-intuition mental function*. For this reason, its impact on the behavior adopted by the human communities in the course of Lower Paleolithic, does not seem compatible with the establishment of a fully cultural and linguistic production.

cognitive behavioral strategies. In the animal kingdom, all behavioral dynamics that do not satisfy, in whole or in part, the above criteria should be considered as interactive dynamics belonging to the relational module of a given *neurological-minded organism*, governed by the phylogenetic diktat and bound to stereotypy.

From Lower Paleolithic to the first half of Middle Paleolithic, the action produced by the encounter between human *mind-brain-body* and the environment was limited to ensure the performance of adaptive phylogenetically prescribed functions, with few but significant deviations from the phylogenetic prescription, which already from the first half of Lower Paleolithic attest to how the human species were phylogenetically endowed with the possibility to overcome the behavioral stereotypy, to which are irreducibly bound all other animals. Throughout this period, from 1.5 to 2 million years, the *psychic basin of attraction* around which it has revolved the human psychodynamics, was essentially composed by what C.G. Jung [28] calls **sensing-intuition bipolar psychic dimension**, an *irrational psychic dimension* composed by the psychic function **sensing**[6], that due to the action carried out by the *six sense organs*[7] allows the individual to maintain an adequate state of attention to, and behave depending on, the environmental stimuli (*energy* and *tensive* state variations), and the psychic function **intuition**, which it provides the individual a pool of raw psychic contents, prescriptive but not descriptive (*archetypes*[8]) that lend themselves to nourish, and to be fertilized by, the relationship with the environment. With the *psychological*

[6]*Sensing* is one of the four poles of mental functions introduced by C.G. Jung in his *Psychological Types*, where he introduces a hierarchy of mental functions in two mental bipolar dimensions (dichotomies). These are *sensing* (*attentiveness* by means of the sense organs) coupled to *intuition* (*awareness* in unconscious way or *being aware* of unconscious contents) and *thinking* (function of intellectual cognition; the forming of logical conclusions) coupled to *feeling* (function of subjective estimation). When one of the poles of the two dichotomies predominates over the others, it defines the dominant function of a person or a community of persons.

The *sensing-intuition* dichotomy represents the way in which an individual receives information. According to Jung *sensing* and *intuition* are called *irrational functions*. *Sensing* refers to the means by which an individual knows something exists, derived by his/her neuropsychological-sensory system. *Sensing*, *i.e. attentiveness* by means of the sense organs, is the (species-specific) psychic function common to all vertebrate, upon which it develops their relationship with the environment and each other. *Intuition* is knowing about something without conscious understanding of where that knowledge comes from. The *irrational function*, according to Jung, is typical for mental and perceptual activity that predominantly (and, for the most part, unconsciously) operates with opportunities, *i.e.* various possible outcomes and sensations result from some premises and sensations, mostly driven by unconscious processes. In humans, all the forms of behaviour, including *cognitive behaviour*, and communication, including *oral language*, are rooted on the psycho-physical plane of (*tension*)*sensing-intuition* (belonging to the psychic territory as it was before being populated by conscious and unconscious contents) [10] [29].

[7]The Central Nervous System is the organ-system of sense for *tensive state variations*, or *tensive stimuli*.

[8]*Archetypal structures underlie all recurrent, "typical" (panhumanly typical, not culturally or personally typical) ideas, images, categories, situations, and events that arise in experience. They contain no inherent content, but exist "at first only as forms without content, representing merely the possibility of a certain type of perception and action". Archetypes may manifest as "a priori, inborn forms of 'intuition'". And as the instincts impel us to act in a distinctly human way, so do the archetypes impel us to perceive and understand the events we instinctively respond to in a distinctly human way* [30].

birth of human individuality[9] (Middle Paleolithic) and the subsequent acquisition of a distinct identity from the environment (*relationship of contiguity*), indispensable prerequisite for the establishment of what we call *self-consciousness*, the psychic environment changes radically its structure and the **bipolar psychic dimension sensing ↔ intuition** is integrated with another fundamental bipolar psychic dimension, in this case *rational*, composed by the *psychic → mental function* **thinking** (see below for explanation on the distinction between psychic/mental/cognitive function), that through recourse to logical processes tend to derive *mind-facts* from the raw object (archetype[10]), and the *psychic → mental function* **feeling**, which tends to assign a value to things depending on the characterial predispositions and expectations of individuals who experience it[11].

From this time onwards the human being begins to entertain a dialogical relationship with the environment, mediated by the state of tension that develops between the *phylogenetic content* (→ independent variable), which gives-form (in-form) to the bipolar psychic dimension *sensing ↔ intuition* and the *epigenetic content* (→ dependent variable), which in-form the bipolar psychic dimension *thinking ↔ feeling*, and to identify itself as an agent of mediation between Earth and Sky, between the consistency of a reality perceived through the six sense organs, and supported by the psychic function *sensing* (→ Earth), and the consistency of a reality intuited through archetypal psychic contents, and supported by the psychic function *intuition* (→ Sky)[12].

[9]The human animal is the only animal phylogenetically predisposed to favourably diverge from the *relationship of continuity* with its natural environment (an option that for every other animal species is synonymous with disease, death, extinction), to converge towards a *relationship of contiguity*. That is, humans are the only animals phylogenetically endowed with the possibility to overcome the boundaries of stereotypy in a non-occasional, stable, functional and lasting way, a possibility that can only be realized when humans beings start perceiving themselves as *something else from their environment* (from a *relationship of continuity* to a *relationship of contiguity*), a splitting condition out of which the human being become a *subject-object* reflected by the mirror of oneself mind (*psychological birth* [10] [29] [31] [32] [33]).

[10]*My views about the "archaic remnants", which I call "archetypes" or "primordial images," have been constantly criticized by people who lack a sufficient knowledge of the psychology of dreams and of mythology. The term "archetype" is often misunderstood as meaning certain definite mythological images or motifs, but these are nothing more than conscious representations. Such variable representations can not be inherited. The archetype is a tendency to form such representations of a motif—representations that can vary a great deal in detail without losing their basic pattern* [34].

[11]The *thinking-feeling* dichotomy refers to how a person (or many) processes the information. The function *thinking* allows a person to understand the meanings of things. The function *feeling* is the method by which a person qualifies the value of conscious activity. This process relies on logic and careful mental activity. According to Jung *thinking* and *feeling* are called *rational function*, because it typical for mental activity that consciously operates with, judges or analyzes received information.

[12]When the human's state of mind, endowed by the tensive-relational dynamics ruled by *sensing-intuition*, which goes together with specific anatomical and functional organization of the human's neuropsychological-sensory system, is integrated by the *thinking-feelingmental bipolar dimension*, the phylogenetic scenario change dramatically, as the human-animal and its environment from being an *interconnected/interacting/interfering unit* becomes *subject-object* of a relationship conditioned by an *internal representation of the external reality* conceived, initially via *symbolling* (from the second half of Lower Paleolithic) and then also via *semantics* abilities (from late Middle Paleolithic onwards), in the settling process of the psychological complex, relatively autonomous and independent, that we call *epigenetic function of the real* or *self-consciousness*.

The introduction of *oral language*, *i.e. the ongoing overcoming of phylogenetically prescribed and sensing-intuitively tuned emission of sound signals via intentional*, *circumstantiated*, *not occasional*, *thinking-feelingly communication based on the human acoustic-musical faculty*[13] *and realized thanks to the ideation*, *programming*, *organization and production of conventional*, *musically encoded* (*rhythm and timbre*) [35], *semantically codified and emotionally vivified*[14] [37] *phonetic sounds*, in human communication would have an enormous impact on the life of human communities and on the embryonic state of their cultural production. From a humanness that did not communicate through *codified oral language*, switching to a humanness that slowly discovers that it can communicate through the *Logos* that gives voice to the *anthropopoietic process*. From this point on, the speech that in-form will shape the world. One of the most important consequences would be the competitive relationship that came to be created, still existing, between the *oropharyngeal-laryngeal cavity*, as anatomical instrument for the *gestation-generation of articulatesounds*, and the *uterine cavity*, as anatomical site for the *gestation-generation of life*. In fact, the most revolutionary invention of all time, namely *oral language*, from the apotropaic use of the *magic speech* (which allows to put the vibrational matrix of different physical planes of reality in relation to each other) gradually up to the social use, first oral and then written, of *speech-logos* (which by putting different individuals and communities in relation to each other catalyzes cultural production), lays the foundations for the overpowering of the *male gender* over the *female gender*:

- The function of *naming things*, as an act of reality legitimacy, and the function of giving a name to things and people (*semantic baptism*), as an act of initiation that assigns a new value of reality, puts the *generating power of the oropharyngeal-laryngeal cavity* (which gives voice to the *breath*/*pneuma*/*ruah*/*prana*

[13]All biological systems, from the less to the most integrated, are organized, functionally and structurally, for adaptive purposes, in order to respond, as a fundamental priority, to the needs for interferential efficacy. Such needs may have to deal with the geo-environmental and bio-environmental variables, which determines the biological limits and possibilities, conveyed by the genic setting, to generate interference, that is transfer of tension-energy from a biological oscillating system, endowed with its peculiar oscillation frequency and rhythm, to another. One of the ways for this explication to take place, is on the *acoustic plane*, which in vertebrates results in an *acoustic-musical interference attitude* and in the anatomical systems and structures to support it. All anatomical and functional systems responsible for issuing detailed sound scans endowed with coherence (signals) are vibrational environments themselves, configured as cavity resonators. The circumstantiated emission of complex and coherent sounds, characterized by their own rhythm and timbre (signal), by an animal considered in its natural habitat it establishes, via sound-consonances and dissonances, an interferential adaptive relationship with other animals and with the acoustic qualities of the vibrational environment of belonging. In reproducing the rhythmical matrices that enliven the environment in which it lives, the human animal can rely on a particular adaptive and supra-adaptive aptitude, which I call human *acoustic-musical faculty*, essentially intuitive and imitative, pre-symbolic, pre-rational and pre-verbal, a peculiar and ready to use, innate faculty that it takes place on the human psychic plane of *sensing-intuition*, making the human being a *polyphonic* and *polyrhythmic* animal.

[14]*Emotion is the chief source of all becoming-conscious. There can be no transforming of darkness into light and of apathy into movement without emotion* [36].

that becomes speech and which ends up being governed by the *male gender*) in open competition with the *generating power of the female uterus* (which gives life to the *breath*/*pneuma*/*ruah*/*prana that becomes offspring*).

Through the *Breath-Sound-Word*, through its magical and mysterious power, through the interpenetration of the phylogenetic relational module that develops on the acoustic plane and the epigenetic *discerning function* (to obtain mental-facts from raw material) introduced by the process of individuation-nucleation of consciousness, through its attitude to give form (Logos-Conscious) to the formless (Kaos-Unconscious), the World ceases to be only lived, to also be interpreted. With the shocking *re-birth* in the *Womb of the Breath-Sound-Word*, humanness sees itself induced to mirror itself in its own non-being the World[15], but only an extremely vulnerable part of it, forced to make sense of the painful and never completely resolved detachment from the *relationship of continuity* with the environment, which with a universal projective action (transfert) is assimilated to the *Womb of the Great Mother Earth*. And here, in the lacerating attempt to mend the wound caused by moving away from the *Mother Breath*, the human being finds refuge in the *archetypal triad* (*Axis Mundi*) that is the basis for all internal representations of external reality, both pre-rational and pre-verbal and rational and verbal:

- henceforth and forevermore its place in the world will be between Earth (material) and Sky (immaterial), elective agent of connection (medium) between its own image reflected by the mirror of the soul of Earth and its own image reflected by the mirror of the soul of Sky, each with its quote of *consciousness*.

Hence, a psychodynamic distinction between *psychic function*, *mental function*, *cognitive function* can be made:

- The **psychic function** is the relational capacity, distinctive, involved in the phylogenetically prescribed arrangement of the human psychic environment (*insight*), *i.e.* its species-specific *tensive basin* (the particular *tensive warp* on which it can be weaved the *energy weft* of the genus Homo) in whom are dissolved all the *phase transitions* (bifurcations) who went to meet the **psychism** of the biological phenomenon in the course of phylogeny, passing through the neurological transition up to the bifurcation that led to the emergence of the genus Homo.
- The **mental function** is the explicated, modal and procedural, form of the psychic function. It refers to the process of in-formation who went to meet the human psychic → mental environment in the relationship with the environment. *De facto*, the psychic function and the mental function have always

[15]This reflective relationship summarizes the identity of the human psychological birth, its being *potency-dynamis* related to *action-energheia*, its giving itself as the presupposition of the possibility, a possibility that becomes inevitable, to leave the relationship of continuity with the World. To get out of a relationship that, like any other animal, keeps the human being in a dimension of *in-fusion ante-rem* with the World-Mother Earth Womb, to enter the dimension of detachment from it, in a relationship of contiguity full of unknowns and therefore tragic.

been compresent (what varies is the prevalence of one over the other), and they point to the Jungian concept of *archetype* (psychic raw material) and to that of *collective unconscious*. From the psycho-dynamic point of view, these two functions qualify the constitutive arrangement, and the dynamics, of the psychic → mental environment, which precedes the psychological birth of the genus Homo (from second half of Lower to Middle Paleolithic).

- The **cognitive function**, is the relational capacity, gained from the particular differentiation, and subsequent arrangement, of the psychic → mental environment, after the psychological birth and, in particular, by the development of *oral language*, and by the maturation of *cognitive thinking* (→ bipolar psychic dimension *thinking-feeling* → *logical-abstract thinking*), understood as the ability to overcome the phylogenetic prescription in planning significant actions for meaningful purposes.

Animated by the sedimentation of the psychic → mental dynamics, the exercise of *intelligence*[16], *i.e. the ongoing subjective attitude and ability to select* "*between and inside*", *weaving and tuning to each other and within them different things*, *for adaptive or supra-adaptive*, *utilitarian or non-utilitarian needs*, comes out from the incubation stage where has operated for about two million years, entering a phase in which the *epigenetic learning process* (→ dependent variable) integrates and shapes the *phylogenetic prescriptive action* (→ independent variable), bringing to maturity the formation of mental functions and adaptive and supra-adaptive skills that can also make use of relational modules other than the one (phylogenetically prescribed) that has characterized the social life of human communities from Lower Paleolithic to Middle Paleolithic, that is different from the *imitative module*, which is based on the **imaginific function**[17] (→ bipolar psychic dimension sensing ↔ intuition) and mediated by the human *acoustic-musical faculty*. Disengaging itself from the adaptive strategies inherited via phylogeny (strategies that establish the constraints that must be fol-

[16]The word *intelligence* comes from the Latin *intellegentia* (or *intelligentia*), which in turn comes from the verb *intellĕgo* (or *intelligo*), derived from *lĕgo* with the addition of the prefix, which is also a preposition, *inter*, "in the middle", "between" (or of the adverb *intus*, "inside"). The Latin verb *lĕgo* is related to the Greek verb *légo* with which it shares the same Indo-European root **LAG-*/**LEG-*, which it expresses the idea of harvest, collect, gather, pull together and tune different things, connect, from which the Sanskrit *lagati*, "to bind to", "to attach". From this root, the Greek *légo* has developed the lexical form of the "collecting-braiding-talk" (meaning "to collect, braiding the sounds and tune the words in a phrase"), that refers to the dichotomous nature of the *lógos*, the ordering function of the *lógos* as "logic-word" (speech, truth, principle, law, reasoning, discernment), and the function as medium of the *lógos* "magic-word" (intelligible sound, en-chant, *mythos*, mantra, symbol), while the Latin *lĕgo* has developed the lexical form of the "collecting-braiding-read" (meaning "collecting with the eyes the graphic signs of the words, pronouncing them within onself, in silence"), from which *lex*, "the law" (as code that collects and concretises the general principles of the *ius*), and *re-ligio*, "religion" (renew the bond with alterity).

[17]From the Greek *eidolopoios* or *idolopeo*, which produces *images*. The term *imaginific* refers to self-organization of physical massless and energyless objects on the *tensive plane*, *i.e.* spectra of coherent correlations of *tensive objects*, which we call *images*. *Mental images* are spectra of coherent correlations of tensive objects supported by the neuro-electro-chemical activity, generated into the relationship elapsing between environment ↔ NT-CNS ↔ environment, belonging to **psychism**.

lowed 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 also 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 feeding and breathing, to the plane of oro-larynx, as anatomical instrument for intentional emission of sounds (vocalization and phonation).

Between Middle and Upper Paleolithic, the action carried out by the *imitative module* in the relational life of human communities of *Homo Sapiens et Faber* was progressively integrated by contents that were first *magical* (psychic function), then *symbolic* (mental function) and finally (from Upper Paleolithic onwards) *ideative* (cognitive function).

3. Tension Domain vs Energy Domain

3.1. Tension Domain

As discussed in [38] our phenomenological reality is marked by the coexistence of manifested states (*explicated*), and unmanifested states (*implicated*) (David Bohm), and by the alternation of rarefied states and condensed states, whose dynamics respond to the prescriptive but not descriptive action of a *poietic principle* (which produces development and structure) called *self-organization*. The action exerted by self-organization is contextualized in the constitution of physical objects called *strange attractors*, *sized* as *fractals* and *configured* as *holograms*. A strange attractor is a *pole of syntropic*[18] *stabilization*, locally unstable but globally stable, which introduces *a variable and convergent quota of in-formation*[19]

[18]S*yntropy* (a symmetrical law of entropy) is a quantitative measure of the degree of *internal organization of a system* (Luigi Fantappiè), connected to a set of elements or factors that change in unison according to a certain orientation(not randomly but coherently). For any system state our knowledge of it usefully knows how to associate a level of *entropy* or *internal organization-lack of the system*, calculable by means of a precise mathematical formula. If this level is not the theoretically possible maximum, then this means that with the same system state there is associable also a*balance of non-entropy* or *syntropy*, *i.e. internal system organization*, which remains "automatically" defined as a complementary quantity of *entropy*, and that it can therefore be described and represented in an equally useful and manageable way. Etymologically the word *syn-tropy* is composed of the prefix *syn* which comes from *sun*, meaning *together*, *at the same time*, plus *tropos*, referring to what *changes*, is subject to *transformation*, which possesses an *orientation*, a *direction*, hence the meaning of *syntropy* becomes *a set of elements or factors that change in unison according to a certain orientation (not randomly* but *coherently*, e.g., *in phase*). *Statistical entropy* (Ludwig Boltzmann), indicate the *divergent transfer of the number of degrees of freedom of a system*, *i.e.* the process of rarefaction of *in-formation* (see next foot-note) contained in it.

[19]A measure of coherence or structural "*complexity*" of surrounding system related to various entropic processes in physical world, that is the measure of in-formation amount, related to a certain object, may be a complexity of its internal structure (sintropy).

(*negentropic process*[20]) [39] in the dynamics of a system, favouring the establishment of *correlative patterns* (coherence). In performing its polarizing action on the dynamics of the confinement processes, the strange attractor stabilizes a warp of *polarized hysteresis*[21] *domains* embedded by a weft of *self-recombining mnesic-like processes of a chaotic type*. The quantitative measure of its ability to stabilize a warp of *polarized hysteresis domains* embedded by *correlative patterns* between *self-recombining mnesic-like processes of the chaotic type*, is referred to as *mnemotropy*[22], while the qualitative measure of its ability is referred to as *mnemotropic action*.

Such hyperchaotic system has a complex dynamic behaviour linked to a *polarized hysteresis cycle* [**Figure 1**], called **Twisted-Pinched Hysteresis Loop** (T-PHL), which represents the most elementary and less integrated form of self-recombining behaviour (feed-forward) induced by the strange attractor's *mnemotropic action* within the *confinement processes*.

The combined action obtained via

- *poietic action* (which produces development and structure) namely *self- organization*,
- *syntropic action* (which induces coherence, *i.e.* correlative patterns, in the dynamic of a system), contextualized by the formation of *strange attractors*, *i.e. poles of syntropic stabilization*, and

[20]*Negentropic processes* belongs to *thermodynamics of non-equilibrium*, *i.e.* are those whose occurrence is accompanied by a negative total entropy change, that is by a net decrease in the entropy of the universe. Often, the term *negentropic* is used as a synonym of *syntropic* while their respective meanings are different albeit complementary: an action inducing coherence in the organization of a system (syntropy) is always sustained by a convergent transfer of in-formation (negentropy). The thermodynamics of non-equilibrium pertains to systems (open systems) for which the achievement of thermodynamic equilibrium (thermal death) is prevented by interactions with the outside, *i.e.* upon continuous exchange of matter and energy with the surrounding environment (an open system is one whose dynamics, *i.e.* system's endogenous variables, is influenced by the input of some exogenous agents). In any macroscopic mechanical process, at least a part of the energy involved in the process is dissipated as heat.

[21]Following the *holographic principle* proposed by Gerardus't Hooft and developed by Leonard Susskind and Juan Maldacena, *hysteresis* is a *non-linear phenomenon* that leads to the absorption and *registration* (retention of the absent) by a system of a part, at times infinitesimal, of the effects provoked by a given *perturbative event* applied to the system. The phenomenon of absorption and *registration* of the *variations in state* or *state variations* connected with the exposure to the perturbative event means that the response of the system to a new perturbative event depends also to a variable extent on all its previous (and futures: *anticipatory systems* tuned on *converging waves*, *i.e. negative energy*, for which time is inverted and flows from the future to the past [40] [41]) *state variations* and all its previous (and futures) reactions to the current-like exposure. Consequently, the physical sizes relating to the perturbations applied are not perfectly reversible (they have a non-linear pattern) and describe curves known as *hysteresis curves* or *cycles*.

[22]The confix "*mnemo*" of the compound word "*mnemo-tropy*" stay for *memento*, *memory*, *reminiscence* (Plato), in relation to *what endures*, *what remains*, from which come the Greek verb *mimnèsko*, which means *remember,* and the word *mnème-es*, which means *memory*, giving the Latin *mnesi-s*, but also *mens*, meaning *mind*. The suffix *tropos* stay for anything that *changes*, that is subject to *transformation* and that possesses an *orientation*, a *direction*. Accordingly, the compound word *mnemotropy* possesses two meanings, one extensive and one intensive. The extensive meaning is *memory-of-becoming,* that is, *transformed with coherence* (*orientation, direction*) *has a memory of the ongoing transformation*, an overall memory of the variables and variations involved in the confinement process. The intensive meaning is *memory into the becoming*, *i.e. that which transform with coherence resorts to lasting processes of memory.*

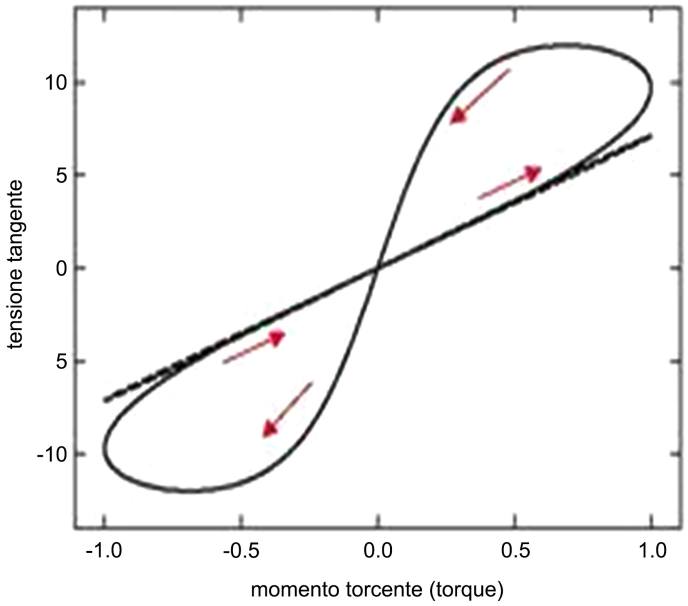

Figure 1. Twisted-Pinched *tangent tension-torque* Hysteresis Loop. Within the context of the *structured tensive domain* (see below) on the abscissa of the schematic diagram of the *Twisted-Pinched Hysteresis Loop* (T-PHL) are shown the values of the *torque* (twisting moment) while on the ordinates are shown the values (fractalized) of the *tangent tension* (tangential to the *line of symmetry of reflection*, *i.e. event horizon*, of the *structured tensive domain*). The line orthogonal to the axis passing through the poles of the loop represents the *line of symmetry of reflection* of the loop, and by extension represents the event-horizon generated by the transition from non-structured to *structured tensive domain*. The positive and negative values related to the hysteresis cycle of the *twisted-pinched loop* indicate respectively the polarization of the *toroid* and *poloid* components of the *structured tensive domain* topology. The point of decussation of the direction of flow (polarization of the *tangent tensions*) constitutes the point of torsion (twisted-pinched/angle of polarization) where the domaine transitions take place. Within the context of the *structured tensive domain* the tri-quadri-*n*-dimensional hologram derived from the bidimensional geometry of the Twisted-Pinched Hysteresis Loop generates a *fractalized holographic hysteroid* of the *toroid-poloid* type in three, four, *n* dimensions (see Figure 2). Dynamically, the T-PHL can be thought of as a combined movement, with one or more degrees of freedom around the line of symmetry and the line passing through the poles of the loop, between the two helixes of the loop folded in on themselves. The degree of torsion at the point of domain transition of the twisted-pinched loop, and the degree of rotation that elapses between the positive and negative values of the *differentiated tensive fractions* linked to the toroid-poloid *structured tensive domain* topology, are variable. This variability is associated to the diversification of the self-recombining behaviour (feed-forward) induced by the strange attractor's *mnemotropic action* within the *confinement processes*. The structure and the dynamic of the T-PHL constitute the matrix of all the structuring processes of physic and para-physic (*psychism*—see below) phenomena including human neurological and psychic (mind-brain-body system) phenomenon. Neurologically, e.g., the decussation of the nerve fascia at a trochoid-encephalic level (mammals) reproduces the structure and dynamic of the T-PHL, the vertebral column and the neurological adjuncts (spinal cord and intra-foraminal spinal ganglions) correspond to the event-horizon of the Neuraxial System (animals with bilateral symmetry), while the cerebrospinal fluid (CSF) and the neuroglia represent the hydro-dielectric substrate which acts as a *milieau* for the neuro-electrochemical hysteresis cycles [42].

- *mnemotropic action* (linked to a stabilized warp of *polarized hysteresis domains* embedded by a weft of *self-recombining mnesic-like processes of a chaotic type*),

is at the base of the overall state of every confinement process or system of confinement processes. That is, each form of manifestation, at any level, is in a state which is a function of the degree and level of integration and synergy elapsing between these three actions, which is referred to as *mnemopoiesis*.

Each element of reality, at any level of observation, can be treated as a *micro system of relations*, set in a *macro system of relations* (systemic approach). Nothing of what we observe exists in and by itself (anti-atomistic and anti-vitalistic approach). Everything we can think of, observable and unobservable (*i.e. virtual*[23]), instead of being made up of *building blocks*, or *discrete units* (quantized), consists of one or more than one of the following relationship systems (enactivist approach):

1) *tensive-relationship systems*, which depend on, and belong to, an underlying *non-uniform tension*[24]*-gradients distribution* (**tension domain**);

2) *spin-internal motion relationship systems*, wrapped by/intertwined with a *tension*|*energy* <Ť|Ê> *exotic objects* frame, which depend on, and belong to, an underlying *non-uniform spin-internal motion gradients distribution* (**relativistic domain**);

3) *energy*[25]*-impulse relationship systems*, which depend on, and belong to, an underlying *non-uniform field without quiet mass but endowed with energy and impulse* (*zero point quantum field*, non-exited regime of the **quantum domain**);

4) *anti-symmetrical*/*chiral composite quantum states* (fermions) and *symmetrical*/*achiral composite quantum states* (bosons) *relationship systems*, which depend on, and belong to, an underlying *non-uniform fermions-bosons gradient distribution* (exited regime of the quantum domain, **supra-quantum domain**)

Accordingly, the Universe we are experiencing shows two coexisting and integrated phenomenological domains:

- a *tensive domain*, *i.e.* a *para-physic domain*, also coined as **psychism**[26], grafted on *tensive-relationship systems*, which substrate our *psychic dimension* (experienceable only in the *first-person perspective*, centered upon one's own mind-brain-body system),
- an *energy-impulse domain*, grafted on *relativistic*, *quantum* and *supra-quantum relationship systems*, which substrate our *physic domain* (experienceable also in the *third-person perspective*, which enables us to take the viewpoint of someone else).

[23]We speak of virtual dimension (and virtual particles) as of that dimension (and particles) not directly observable, but whose influence makes itself felt and confirms the theoretical predictions.

[24]I assume *tension* as the *ability to induce and polarize interference phenomena* in the context of the *non-uniform tensive gradients distribution* and therefore in the context of the *para-physic domain* (psychism) governed by the laws of *tensive-dynamic*.

[25]I assume *energy* as the *ability to induce and polarize interference phenomena* in the context of the *non-uniform energy and impulse gradients distribution* and therefore in the context of the *physic domain* governed by the laws of *electro* and *thermo-dynamic*.

[26]The term *psychism* (C. G. Jung) refers to the warp of fractalized, stationary but unstable patterns of *undifferentiated tensive fractions*, on which engages a network of *differentiated tensive fractions*, named *tangent tensions* (see below for explanation).

Usually by *tension* is meant the effect or the state produced by a *potential difference* or by the application of a *force*, but within the present cosmogonic scenario, **tension** refers to **Implicated Tension (IT)**, the cosmogonic premise of all potential differences and of all forces, the background of all confinement processes both physical and para-physical. All that there is in the fundamental, irreducible, protodynamic physical state (**implicated endo-dynamo-tensive state**), is *tension in potency and not in action* (*Implicated Tension*), bearing within a *motion pulse* also *in potency and not in action*, namely **dynamis** (linked to the Chinese *wu-wei*, action-without-action, to Vedic *Dharma* and to Aristotle's *Prime* (*Immobile*) *Movers*, or *Unmoved Mover*), the *potency correlated to the action* (*energheia*), *efficient cause* connected to the *motion* and its quantitative and qualitative effects, the *inherentpotency* or intrinsic possibility of a *body* to be translated into an *action* that may be realized or not, a *value of reality* (dimensionless) only possible with respect to the *real action realized* (*entelecheia*) [43].

The establishment of these two coexisting and integrated phenomenological domains:

- it arises as final consequence of a *cosmogonic tensive transition sequence* (due to *symmetry breaking*), ontologically assumed as the cosmogonic process that goes from the *supra-liminal self-perturbation* of a fundamental, irreducible, non-exited but intrinsically dynamic **state of tension**, to the Big-Bang (or the Big-Crash).

The cosmological transitions that precede and induce the Big-Bang (or the Big-Crash), *i.e.* prior to the establishment of our **energy-tensive dimension**, can be summarized as follow:

1) The *non-exited regime* of the *ground state of tension*, which is characterized by a *reflectance index* of one (total)[27], *i.e.* a *tensive super-symmetrical* [44] *statedevoid of structure* (continuous, isotropic, homogeneous, unperturbed), and therefore devoid of matter-energy-space-time, is going to be perturbed by a *supra-liminalself-reverberation of dynamis associated to IT*.

2) The supraliminal auto-reverberation of *dynamis* introduce a discontinuous and anisotropic factor, a *twisting moment*, namely *torque*[28], determining the appearance of a frame of *tensions tangential to the IT tensive symmetry plane*[29], which is tantamount to the breakdown (desymmetrize) in the *IT tensive super-symmetry* (tensive super-symmetry breaking [45]).

3) The frame of *tensions tangential to the IT tensive symmetry plane*, together with *torque*, acts as twist = -ing-force. Since no other perturbations are allowed except for its self-perturbation, the *ground state of tension devoid of structure* it

[27]Given an incident perturbation on a surface (here assumed as *event-horizon*), the quota of perturbation that the surface (event-horizon) is able to reflect is called *reflectance*. It is represented by the relationship between the intensity of the perturbation reflected and the intensity of the incident perturbation on the surface (event-horizon) and is of an a-dimensional size.

[28]Torsion is a state of stress set up in a system by twisting from applying *torque*. Hence, torque acts as a force and torsion as a geometric deformation.

[29]The supra-liminal auto-reverberation of *dynamis* breaks down the isotropy and continuity of the *non-exited regime* of the *ground state of tension*, by introducing a discontinuous and anisotropic factor (a *twisting moment*, namely *torque*), that results in the extraction of *tensive objects* (*tangent tensions*) as effect of the fragmentation of IT super-symmetry.

exploits both its own reflectance and the propulsive action exerted by the arising twisting-force to neutralize it.

4) The latter is reflected/projected onto a hyper-state wrapped, that is, confined, into a hidden wall domain, a continuous global property introduced by what could be assumed as the first cosmogonic *tensive transition*. All successive *bifurcations* are derived from this one via *homomorphism* (basic dynamic-structure equivalence).

5) The result is the establishment of two imbricated and coexisting tensive regimes, a *non-exited regime devoid of structure* (void; reflectance index equal to one) and an *exited regime endowed by structure* (*non-uniform tension-gradients distribution*, space-time-mass-energy free; reflectance index less than one), each delimited by its own (virtual) *Reflection Symmetry Line* or *Mirror Symmetry Horizon*[30] [46].

6) The non-uniform tension-gradients distribution's topology, having its *Mirror Symmetry Horizon* as frame of reference, it may be thought of as a biaxial or tetra-toroid [**Figure 2**], also coined as *external toroid*, consisting of *twisted loops* that refer to a *frame of explicatedtangent tensions* (differentiated tensive fractions), warped around an *internal poloid*, which refer to a *foam of implicated tangent tensions* (undifferentiated tensive fractions), surrounding a involuted "donut hole", a wormhole devoid of structure and dynamic (void), that refer to the *non-exited regime* of the *ground state of tension*. The twisted loop shown in **Figure 2** (bottom right) describes a *Twisted-Pinched Loop* where the directionality of the event-horizon (*Mirror Symmetry Horizon*) in the upper ring assumes positive values and an anterograde polarization until the *twisting-reversing switch* at the point of intersection (*pinching point*) with its anti-horizon, to assume negative values and a retrograde polarization in the lower ring (as discussed in [47] for a "Weyl lifted" low energy string theory's geodesic completeness across gravity/antigravity boundaries). The structured tensive domain it may show a *holographic configuration* (each fraction contains the complete in-formation recorded—via *mnemotropic action*—in the whole, but from different angles/perspectives), and a *fractalized-superfluidstructure* carrying a *monopolar-achiral*[31] *tensive potential*.

[30]The presence of reflection symmetry is defined by letter *m* (the first letter of French word "miroir" or English "mirror"). Numbers of reflection planes possessed by a given body are not included in the formulas of symmetry groups because it has been proved that if the reflection symmetry takes place at all, its order is equal to that of the rotation symmetry. Any object lacking reflection symmetry has arbitrarily defined left and right configurations matching each other by a reflection. Such objects are called *enantiomorphic*.

[31]A perturbation at *n*-dimensions is called *achiral* when it can be superimposed on its specular reproduction on $n + 1$ dimension. A perturbation at *n*-dimensions is called *chiral* when it cannot be superimposed on its specular reproduction on $n + 1$ dimension. Chirality is *an innate property of a chiral perturbation, its* "*intrinsic*" *handedness*, is a pseudoscalar property that remains invariable with an operation of symmetry of the 1st order and changes sign with an operation of symmetry of the 2nd order. *Prochirality*, or *prostereoisomerism*, is the property of a perturbation, or of an *achiral* part of it, to become *chiral* if one of its two linking relationships is replaced by a new one. This passage presupposes the existence of a *stereogenic center* or a *stereogenic axis* or a *stereogenic plane* and corresponds to the substitution or addition of a variable or group of variables to the perturbation that *desymmetrizes* the achiral part. When this process of *desymmetrization* presupposes not one (prochirality) but two passages we speak of *pro-prochirality*.

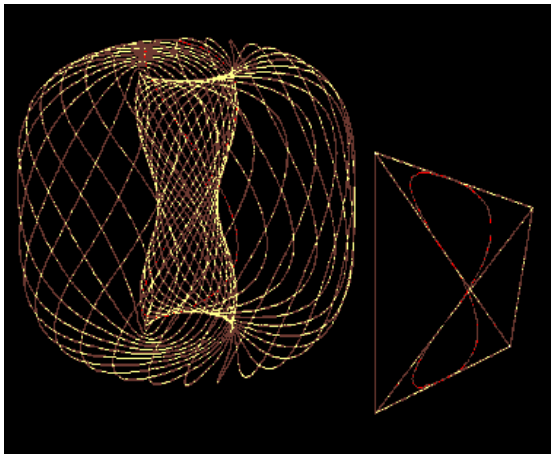

Figure 2. Biaxial or **tetra-toroid**, also coined as *external toroid* warped around an *internal poloid*, as drawn here has 27 identical loops. Compared with ordinary toroid coil, the main differences are twisted loops instead of the plain toroid loops and the involuted "donut hole". While 27 closed loops are presented to show a tetrahedron relationship, all loops can be one continuous twisting line. (Image source: http://harmoniouspalette.com/TetMold.html)

7) When, due to interference phenomena between tensive gradients, the intensity of the perturbative action exerted by the explicated component (differentiated tensive fractions,) of the tangent tensions' frame (toroid), exceeds a critical threshold, the non-excited regime of the non-uniform tensive-gradients distribution is warped (tensive superposition) by an excited regime.

8) The twisting moment of the structured tensive domain's exited regime becomes the seat of a *stereogenic center* able to desymmetrize its achiral component, that is, able to desymmetrize its *monopolar-achiral tensive potential*, which is thus exposed to the possibility of being transformed into a *dipolar-proprochiral tensive potential*.

9) The exited regime of the structured tensive domain opposes to this possibility. Due to self-organization phenomena, the destabilizing action exerted together by the twisting moment and by the differentiated tensive fractions (toroid) it exceeds a critical threshold, triggering a new cosmological tensive transition [**Figure 3**], namely the Big Bang (or the Big Crash), which determines the constitution of the *non-exited relativistic domain regime* (at energies much smaller than the Planck scale), where tension becomes manifest in the form of the Weyl invariant low energy string theory's *dynamical string tension* [47], and where *space* and *time* are prefigured by what Einstein's GR define as *spacetime continuum*.

10) The Big Bang (or the Big Crash) is the (cosmological) *self-recombining condensative event* to which the *dipolar-proprochiral tensive potential* undergoes, turning into a *dipolar-prochiral tensive potential*, whose rotational ↔ torsional stabilization (*dipole rotational symmetry*) generates what the spacetime continuum is made up of, namely *spatiotemporal holographic fractions* called **spin-internal motion** (*zitterbewegung*, self-dynamism not dependent upon

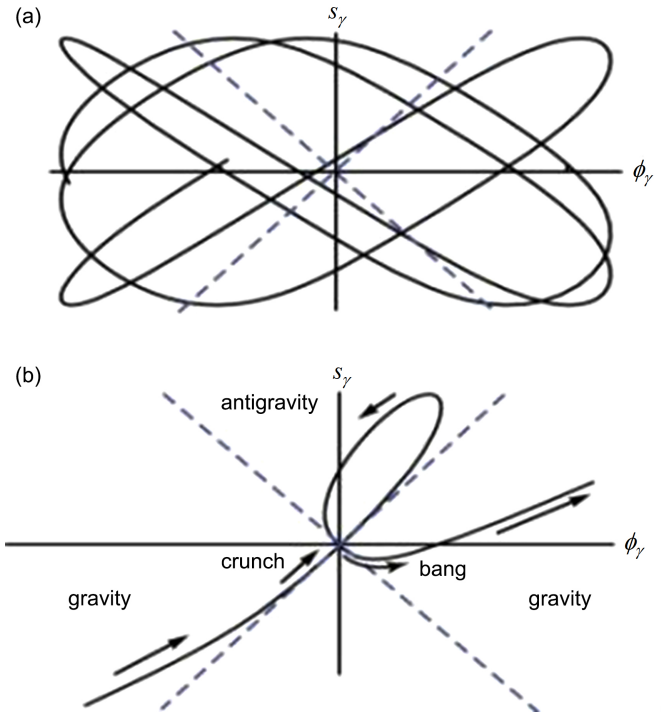

Figure 3. Geodesically complete spacetime requires the antigravity (negative gravitational "constant") loop. (a) The cosmic singularity $a_E^2 \propto \phi_\gamma^2 - s_\gamma^2 = 0$ corresponds to the ±45 degree lines in the $\phi_\gamma - s_\gamma$ plane, which form the "lightcones". (b) The singular solutions to the Friedmann equations ending in a big crunch or beginning with a big bang correspond to trajectories confined to $\phi_\gamma^2 - s_\gamma^2 > 0$ on the left and right quadrants. Any given branch connects continuously to another branch across the gravity/antigravity intersection by passing through the origin tangentially to one of the dashed lines while being perpendicular to the other. (Image source [48])

external factors) [49] [50], which on the event horizon that separates tension domain from energy domain take the hybrid form of *tension*|*energy* <Ť|Ê> *exotic objects*[32], namelystationary and fractional objects in a state at the boundary between tension and energy (*tension*|*energy* <Ť|Ê> *event horizon*) endowed by a *dynamical string tension* and a latent-kinetic potential, which become the seat of a latent *prochiral stereogenic center*, therefore, *spacetime* itself becomes the seat of a latent prochiral stereogenic center.

11) The relativistic domain's topology reproduces that of the structured tensive domain, with the difference that the toroid is composed by an *explicated tension*|*energy* <Ť|Ê> *exotic objects* frame, while the poloid by an *implicated spin-internal motion* foam, surrounding a involuted "donut hole" devoid of

[32]Where <Ť|Ê> refers:

- to the topological *boundary* that separates *tension domain* Ť from *energy domain* Ê, namelythe common *event horizon* with respect to which what is the *lastinternal* for one is the *first external* for the other (for a discussion on the subject see: Tozzi, A. (2020) Are Borders Inside Or Outside?, available at: https://www.researchgate.net/publication/341787420_ARE_BORDERS_INSIDE_OR_OUTSIDE
- to the *internal hysteresis state* of the spacetime warp where the two domains come together, collapse, overlap and reverse (see **Figure 1**).

structure and dynamic (void), related to the *non-exited regime* of the *ground state of tension*. It shows a *holographic configuration* and a *fractal-superfluid structure* (cfr. with [51] *hydrodynamic superfluid background field*) carrying a (latent) *dipolar-prochiral tensive potential*.

12) When, due to interference phenomena between *spin-internal motion* gradients, the intensity of the perturbative action exerted by the *explicatedtension*|*energy* <Ť|Ê> *exotic objects*frame (toroid) on the *dipole rotational symmetry*, exceeds a critical threshold (breakdown in the gauge symmetry of the rotational group), the *dipolar-prochiral tensive potential* ceases to be present only in latent form, a *Coriolis potential* and a *Coriolis force*[33] is generated to oppose the rotational ↔ torsional breakdown, making *spacetime continuum* shift to its exited regime, which is tantamount to be warped by a *zero point quantum field* carrying a *dipolar-chiral kinetic potential*.

13) Zero point quantum field is a *non-exited*, *non-uniform gradient distribution of oscillatory motions and charge densities of energy-quanta and impulse regime*, a field *without quiet mass but endowed with energy and impulse*, an *extended system of spatial and subliminal electromagneticoscillations* (called zero point oscillations because unable to excite the field) whose activity is described by using acoefficient of proportionality known as *quantum of fundamental action* (the Planck constant **h**, the smallest entity of divisibility of energy per time unity), that relates the *frequency* (**v**)of oscillation of the field with its *capacity to generate interference*, *i.e.* with its *energy* (**e**), establishing that the value of energy (**e**) of a *quantum oscillator* is given by the product of its frequency (**v**) through the constant $\mathbf{h} = 6.63 \times 10^{-34}$ Joule/sec, that fixes the energy index at which the transition from the *explicatedspin-internal motion domain* to the *zero point quantum field* it occurs:

$$\mathbf{e} = \mathbf{hv}$$

The *energy* (capacity to generate interference within the physic dimension) *of a quantum oscillator* is the **quantum interface** that places the oscillator in a biunivocal relationship with the *relativistic domain* and with the *quantum* and *supra-quantum domain*.

3.2. Energy Domain

The phenomena of interference between the oscillatory modalities of the *energy* flows and *impulse* involved in the perturbation/excitation of the zero point quantum field comes to be affected by *coupling-phase* (*oscillatory resonance*), which, according to *QED* (Quantum Electrodynamic Field theory), is able to

[33]A conceptual picture of the interpretation of Einstein's field equations is that the presence of matter-energy curves space and time. Torque is considered as a property of the stress-energy term, and the Coriolis forces are derived as secondary properties resulting from the torquing of matter-energy in spacetime. Hence, resulting Coriolis effects are driven by torquing on spacetime and therefore spacetime geometry is modified. Contrary to all physical intuitions, by rotating a fluid we make it change its physical properties, make it "stiff". Coriolis force is not just deflecting moving bodies, but opposes their displacement by trying to *restore them to their initial position*.

trigger the *phase transitions* that lead to the *exited energy-quanta and impulse gradient distribution of oscillatory motions and charge densities* (referred to as *EEQ-GD*, that is E*xited* E*nergy* Q*uanta*-G*radients* D*istribution*) and to the structuring of matter (*Coherence Domains* vs *Incoherence Domains*). In particular, each *localized* (in space and/or in time) form of confinement (tensive, radiative, massive, subatomic, atomic, supra-atomic, biological, cosmological), *i.e.* delimited by a *boundary* (even if virtual, an *event-horizon* it may be considered as a boundary), is a *tensive-vibrational* micro-environment and corresponds to an *oscillator* or a *resonant cavity* (*cavity resonator*), a *stationary* system organized around a particular tensive/vibrational configuration of perturbations (tension/phase/oscillation), existing thanks to the relationships of interference it has with the endogenous and exogenous tensive-vibrational environment[34].

The final result is the diversification of the structuring of the phenomena affecting the *exited energy-quanta and impulse gradient distribution of oscillatory motions and charge densities* (EEQ-GD) in *four orders of phenomena*, relatively autonomous and independent, associated with just as many physical varieties, the first belonging to the territory of the *exited regime of the structured tensive domain* (referred to as *ET-GD*, Exited Tension-Gradient Distribution), which manifest itself in the form of the Weyl invariant low energy string theory's *dynamical string tension* and on which spacetime continuum is grafted, the second to the territory of the quantum domain (*QD*) while the other two to the territory of the supra-quantum domain (referred to as *H-MD*, that is H*yper*, *i.e.* cosmological, and M*iddle*, *i.e.* ordinary, D*imension*):

- **Tensive phenomena** (*tensive varieties*: differentiated *vs* undifferentiated *tension*; spin-internal motion, *tension*|*energy* <Ť|Ê> *exotic objects*)
- **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/glassy, and *chemical varieties*, inorganic/organic)
- **Biological phenomena** (*autopoietic varieties*[35], from *colloid lyophilized bubbles* onwards [10].

The overall state of every confinement process or system of confinement processes, at any level of observation, is referred to as state of *mnemopoiesis*, which is established by the ongoing combined action elapsing between the 1) *poietic action*, namely *self-organization*, 2) *syntropic action*, which translates

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

[35]In 1972, the Chilean biologist and philosopher Humberto Maturana coined 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. 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.

into the formation of *syntropic nuclei* called *attractors*, and 3) *mnemotropic action*, linked to a stabilized warp of *polarized hysteresis domains* embedded by a weft of *self-recombining mnesic-like processes of a chaotic type*.

To better visualize the multidimensional scenario within which a state of *mnemopoiesis* is established, we can resort to Augusto Sabbadini's metaphor of the pond and the fish[36].

Imagine a muddy pond where we are fishing. A fish swims in the pond, but we cannot see it because the water is cloudy. At a certain point the fish bites. We raise the barrel and see it attached to the hook. In such a situation we naturally suppose that, just a moment before biting, he came to be precisely at the point where the hook was. Until a moment ago we were not able to say where it was: its position was for us, in a certain sense, indeterminate. But it was not an intrinsic, irreducible indeterminacy. It was linked only to incomplete information on our part of a reality that was in itself determined. Now imagine that the fish is a quantum particle and the rod, line and hook are a device that measures its position. Again, until we perform the measurement, the position of the fish is indeterminate. But this is a different and more radical indeterminacy. Rather than a *normal fish*, the particle resembles a *soluble fish*, which, before biting, is found widespread throughout the pond, more densely in some places, less densely packed in others. The uncertainty of its position is not just a lack of information on our part. Where it is denser we are more likely to catch it, where it is poorly dense we have less chance. But its position is intrinsically indeterminate. Nonetheless, miraculously, when the soluble fish is caught, its widespread nature instantly condenses and precipitates into a real fish, perfectly localized, hanging on the hook.

Normal fish and *soluble fish* belong to the *pond of energy*. Normal fish belong to our middle dimension, the three-dimensionality *pond*, where time flows from a before to an after and where the concept of distance and of alternation still make sense, the one we experience through our ordinary senses, with respect to which the laws of classical physics apply. Soluble fish belong to the quantum dimension, the one we cannot experience through our ordinary senses, with respect to which the laws of quantum physics apply, the *pond* where the concept of distance and of alternation, of space and time, completely lose meaning, dissolving into something which contemporary physics calls *zero point quantum field*.

The *condensative varieties* of the EEQ-GD (*soluble fish*) and of the H-MD (*normal fish*) derives both from different correlations among *tensive gradients* (the *pond of tension* from which both *soluble fish* and *normal fish* appear and disappear) supported by *tension*|*energy* <Ť|Ê> *event horizon gradients*, and, on the other hand, from different correlations among *anti-symmetrical*|*chiral composite quantum states* (fermions; anti-symmetrical wave function; *vector* component of the electromagnetic wave) and *symmetrical*|*achiral composite quan-*

[36]From his introduction to the Italian version of David Bohm's Wholeness and the Implicate Order [52].

tum states (bosons; symmetrical wave function; spin network; *scalar* component of the electromagnetic wave), corresponding to different *coherent oscillatory configurations* (domains of oscillatory coherence or *Coherence Domains*, CDs) that oscillate with a *non-linear pattern to the rhythm impressed by a carrier frequency modulation*. Transitions from one oscillatory configuration to another imply that some oscillatory modes (rhythms) and/or tensive correlations are dampened, while others are amplified.

Matter is a way of being of energy. Radiation is rarefied energy. Mass is condensed (compactified) energy. Matter is a combination of the two (an atom is about 99.999999999% radiation). Radiation and mass are a measure of the energy confinement state. Energy (radiative and massive) is a way of being of *tension*. Tension is what is left when energy is taken away, and just as water remains water in each of its states, the solid, liquid, gaseous and glassy, tension remains tension in each of its states, the structured state of tension, the relativistic, quantum and supra-quantum. Any energy-matter confinement process is organized around its *tensive basin of attraction*[37], which can be drawn as a cavity resonator for tensive gradients distributions, whose topological collocation can be traced back, for convenience, to the *imagery space dimension* of a *four-dimensional space* [53] [54] [55]), or, as suggested by string theory, to a *n-dimensional space*.

Each thermodynamic state or phase of matter can be qualified according to its *internal structure* or *order*, that is according to its *correlative structure* (e.g. *gas* is a thermodynamic phase-state of water less correlated than *liquid* which in turn is less correlated than *solid* which in turn is less correlated than *glassy*), and the connection between one phase-state and the other may take place through *phase transitions* (phase transitions from one state to another changes the correlative state of a system but may not change its nature, as is the case of water, which is always water in the liquid, solid, gaseous and glassy state[38]). Accordingly, any elementary constituent of a system it can act one way or another depending on the correlative system it comes to be part of. That is, are the correlative properties of the system that determine its behavior, and not the properties of its ele-

[37]It is very common for dynamical systems to have more than one attractor. For each such attractor, its *basin of attraction* is the set of initial conditions leading to long-time behavior that approaches that attractor. Thus, the qualitative behavior of the long-time motion of a given system can be fundamentally different depending on which basin of attraction the initial condition lies in (e.g., attractors can correspond to *periodic*, *quasiperiodic* or *chaotic* behaviors of different types). Regarding a basin of attraction as a region in the state space, it has been found that the basic topological structure of such regions can vary greatly from system to system.

[38]In living organisms, water can be considered as *interfacial water* [42] [56], due to the fact that there is almost no point in an organism that is not far more than a fraction of a micron from a surface (cell membranes, skeletons of macromolecules, etc.). The interfacial water assumes a glassy appearance and has been studied by several researchers [57] [58], suggesting the possibility that it is of a different phase from that of common water in the liquid state [59]. In particular, it has been found that thick viscous layers of water contiguous to the biological surfaces (called EZ, Exclusion Zone), in which the solutes are not able to penetrate and whose existence in eukaryotic cells was detected for the first time by Mollenhauer and Morre in 1978 [60], remain static when the surrounding fluid is vigorously stirred [61] [62].

All biological envelopes, from cell membrane to epithelial tissue, contain this aqueous phase in a *semi-crystalline state* (likened to the *liquid ice*) or are perfused by it.

mentary constituent taken individually and summed up [63]. When the trajectory described by the becoming of a dynamical system is going to be deflected by a phase transition, for a certain period of time the system is to be in a *state at the phase boundary*, a bifurcation point beyond which the system changes, partially or totally, in a reversible or irreversible way, its massive and/or radiative and/or tensive identity.

According to Quantum Field Theory (QFT), every object or phenomenon of the quantum dimension is therefore assimilable to a *vibrational system* (describable via a mathematical tool known as *wave function*), that vibrates with a certain *frequency configuration*, a certain *oscillatory* or *phase* Φ *modality* (which should not be confused with the thermodynamic phase) and a certain *intensity*, maintaining an uninterrupted local and non-local *relationship of interference* with the vibrational systems it comes to be part of.

The phase Φ describes the rhythm of oscillation of the field and therefore the wavelike aspects of the system. Phase Φ is the parameter that qualifies the dynamics of a phenomenon in relation to its temporal course and in relation to its oscillatory properties, where at each phase Φ corresponds a different energy level, a different vibrational configuration and a different interferential register[39]. Therefore, and contrary to the objects described by Classical Physics, a coherent quantum system is not defined in isolation, but gets defined by the array of its relationships. In biological systems, the phase Φ is connected with the EM potential in a mutual relationship so that we could be able to change the phase Φ of a biological organism by applying an EM potential[40] [64] [65].

We could interpret the biological effectiveness of very and ultraweak EM and magnetic fields just by assuming that the agent at work in the interaction is not the *field* but the *potential* and the mechanism of interaction is the *phase-sharing*[41].

Accordingly, 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*);

[39]At quantum level the phenomenon of *hysteresis* is determined by *radiative relationships*, *i.e.* wave relationships, and *field relationships*, *i.e.* phase Φ relationships.

[40]That is, biological organisms, being coherent, can interact with environment in two basically different ways:

- through the conventional exchanges of energy which amount to the application of mutual forces. This mechanism of interaction obeys to the causality principle, since energy cannot travel faster than light (c);
- through the sharing of the phase Φ with other coherent systems (biological organisms), which amounts to the establishment of a resonance with them [29]. The phase velocity is not bounded above and can be larger than c.

[41]External electromagnetic signals can be selectively damped by tissues, according to their being or not in phase with the possible oscillatory motion of the system's components. This specific *phase-matching* (*i.e. resonance*) feature operates as a very selective mechanism, a sort of filter discriminating among perturbations and stimuli acting on the system, thus protecting it against any noisy perturbative background or even strong actions, which, however, are out of phase with the oscillatory motions allowed by the system's inner dynamics [66].

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

Also referred to as, respectively:

- a coupling of the *frequency* (fermions; particle and quasi-particle behavior) ↔ *phase* Φ (bosons; wavelike behavior) *type*, that is between the *massive plane* (eventually mediated by *solitons* and/or *excitons*), and the *radiative plane* (eventually mediated by *polaritons*[42] and *photons* [67] [68] [69] [70]);
- a coupling of the *phase* Φ (wavelike behavior) ↔ *tension*|*energy* <Ť|Ê> *event horizon* (spin-internal motion, tension|energy <Ť|Ê> exotic objects) *type*, that is between the wavelike component of the *exited energy-quanta and impulse gradient distribution of oscillatory motions and charge densities* and the *exitedspin-internal motion gradient distribution*;
- a coupling of the *tension*|*energy* <Ť|Ê> *event horizon* (spin-internal motion, *tension*|*energy* <Ť|Ê> *exotic objects endowed by a dynamical string tension and a latent-kinetic potential*) ↔ *tension* (differentiated tension) *type*, that is between the *exited spin-internal motion gradient distribution* and the *exited structured tensive domain gradient distribution*.

With regard to human being, the interaction elapsing between Phase Conjugate Dynamics and Tension Conjugate Dynamics takes place (mainly but not only) via Spin Conjugate Dynamics, which means that the interaction between the radiative-massive plane "*body*" and the tensive plane "*mind*", takes place thanks to the interface established by quantum dynamics (a fact that, on the thrust of the process of fascination induced by the quantum world oddities, led to formulate the rather reductive expression *Quantum Brain*), which does not correspond to, and should not be confused with, "*mind*" dynamics (the same process of fascination has led to formulate the even worse expression *Quantum Mind*).

That is, the *mind-brain-body dynamics* can be linked to the trajectory described by the non-linear, rhythmic and continuous transformation of biophysical and biochemical processes coupled to the human's *mnemopoietic* state and governed by a multiplicity of integrated *basins of attraction* (e.g.: riddled basin of attraction; R. Thom's *infinitely intermingled basins* [71]) of the chaotic type and toroid-poloid topology, consisting of a double layered *energy envelope*, *i.e.* an outer layer composed of a *fractal plot of Frequency-Phase Correlative Dynamicsinterference ridges* and an inner one composed of a *fractal plot of Phase-Tension Correlative Dynamics interference ridges*, non-locally coupled (entangled) with the projection, on the *biological species-specific event-horizon*[43], of a fractal distribution of *Tension-Tension Correlative Dynamics* (*tensive core*) [**Figure 4**].

[42]The observation of such quasi-particles in organic microcavities has attracted increasing attention for their characteristic of reaching condensation at room temperature.

[43]The envent-horizon is defined *non-locally in time:* it is a (continuous) *null surface in space-time*, aglobal property of a space-time inertial reference system in-formed by *de-localized (*in *space* and *time) correlative phenomenon*. That is, it is a global property of the entire spacetime.

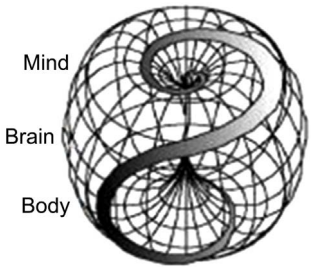

Figure 4. The human energy-tension basin of attraction, *i.e.* the mind-brain-body (de-localized) system, reproduces the fundamental structure characterizing the EEQ-GD, which in turn reproduces the fundamental structure of the *structured tensive domain*. The topology of the quantum dimension is a unitary fractal and resonant object, a toroid-poloid cavity resonator, consisting of an *outer frequency weft* (*Phase Conjugate Dynamics* → Body), an *inner spin weft* (*Spin Conjugate Dynamics* → Brain) and a *tensive-spin internal motion nucleus* (Mind → *Tension Conjugate Dynamics*). Within the relativistic domain, this unitary fractal and resonant object is prefigurated by a diffuse *toroid-poloid vortex* consisting of *spin-internal motion* → *tension*|*energy* <Ť|Ê> *exotic objects endowed by a dynamical string tension and a latent-kinetic potential*, a stationary and fractional (non-quantized) entity within which the motion impulse is only latent. Subjected to a torque and rotational action (induced by *reflection symmetry breaking*) this diffuse toroid-poloid vortex transform into a bi-polar quantum-relativistic loop, named *Twisted-Pinched Hysteresis Loop* (T-PHL), in which the *tension*|*energy* <Ť|Ê> *event horizon* is de-symmetrized in spin-up and spin-down. The final outcome (*quantum dimension*) is a continuous and non-uniform cyclotronic motion of dextrorotatory *vs* levorotatory spin-angular momentum, that in passing through the de-localized point of self-intersection of the loop (the eight-like strip highlighted in the picture) decussate and reverses sign, moving seamlessly from negative values to positive values. The mirror symmetry breaking leading to the biological T-PHL is at the basis of the enantioselective absorption mediated by *biological water* [42] [56], which determines biological homochirality.

If we assume that the phenomena generated by the biunivocal transition elapsing between *pattern of spin-internal motion* and *pattern of tension* refer to a *inertial system* generated by the actual transition, the so generated inertial system may be treated as the *event-horizon* of the *neuro-psycho-physiological information dynamic*, where by *event-horizon* it is meant a *de-localizedvirtual entity* [72], the *space-time boundary* between different planes of manifestation (here *mind* vs *body*), which traces the limits of observability and comparability of the phenomena that lie before and beyond the *event-horizon* (*tension* vs *energy*).

If this is the case, the surfaces of higher order hyperspace fields lay on, and in-form the, human's *neuro-psycho-physiological event-horizon*. Here is where the *tension domain* and the *energy domain* come together.

4. Biological Systems Dynamics Is Tuned at the Phase Boundary between Chaotic and Ordered Regimes

4.1. Biological Systems Dynamics

Living systems are *transient systems* undergoing cyclical processes [73] [74] activated by *species-specific basin of attraction* (riddled basin of attraction) [75]

and tuned on *state variations* or stimuli (chemical and physical perturbative events linked to *frequency variations*, *phase variations*, *tension variations*) of the endogenous and exogenous 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*.

In normal conditions, the cyclical processes activated by the *species-specific basin of attraction* are kept on a level of *self-similarity*, and *scale invariance*, a necessary condition for the functioning and morphology of processes and structures of a biological system, in order to remain functional in their assigned role, even though they transform (e.g., in the process of ageing structures and processes change, but always remain similar to themselves). For this purpose the *riddled basin of attraction* undergoes constant transformation (*deterministic chaos*[44] [76] [77]) from *strange attractor* to *limit cycle attractor*[45] (almost periodic) to *fixed point attractor* (periodic) [78], and vice versa [79].

As long as the degree of uncertainty of the species-specific basin of attraction and its syntropic function (ability to modulate the rhythmic properties of a system) are preserved[46], its self-transformation is reversible (e.g. physiological processes, processes of self-repair and healing), but when the degree of uncertainty and/or effectiveness of the syntropic function are compromised by internal or external causes (alteration or loss of ability to maintain the rhythmic properties of the system), the process of self-transformation can cease at the level of the *limit*

[44]Chaos theory is not about chaos in the sense that people normally understand that term; in fact, it is about exactly the opposite, constituting a search for order within what appears at first to be disorder. In attempting to find an underlying order in the seemingly random shapes of clouds, for instance, chaos theory is naturally concerned with complexities of a magnitude seldom comprehended by ordinary mathematics. Likewise, *catastrophe theory*, which is the chaos theory's closely related mathematical theory originated by French mathematician René Thom, does not necessarily involve "catastrophes" in the sense that most people understand that word, though many of the real-world applications of the idea are catastrophic in nature. Chaos theory and catastrophe theory come back to a basic idea of sudden, discontinuous change that comes on the heels of regular, continuous processes. Though they arose independently, *chaos theory* and *catastrophe theory* can ultimately be traced back to the theory of *dynamical systems*, originated by French mathematician Jules Henri Poincaré (1854-1912). Whereas ordinary geometry and science are concerned with the variables that differentiate a particular entity, dynamical systems is devoted purely to addressing entities as systems moving through a particular state. Catastrophe, chaos, and dynamical systems are part of a larger phenomenon, which came into its own during the twentieth century, known as *complexity theory*. Also concerned with systems, complexity is based on the idea that a system may exhibit phenomena that cannot be explained by reference to any of the parts that make up that system. Complexity theory in general, and chaos theory in particular, involve extremely intricate systems in which a small change may yield a large change later.

[45]The *limit cycle principle* (Mitchel J. Feigenbaum) indicates the limit beyond which a dynamical system in a *continuous cycle*, such as cellular dynamics, can pass (phase transition) from a chaotic state to an ordered state, and vice versa. In the transition between the two states, the *strange attractor* that governs the dynamics of the system is called a *limit cycle attractor*.

[46]A chaotic system is arbitrarily sensitive to perturbation and hence responsive. Sensitivity also prevents a chaotic system from being precisely modelled. It is thus unpredictable, though it may be deterministic. Such systems behave in a way which makes it impossible for an observer outside the system to describe it precisely enough to determine its outcome and hence test its causal nature. The internal model for biological activity is non-linear, dynamically unstable and undergoes transitions to and from chaos.

cycle attractor or at the *fixed point attractor*'s limit, with a relapse on the processes and/or structures that are under its action.

Beyond a certain limit (irreversible exceeding of stress limit), the loss of uncertainty and/or of the syntropic ability of the system determines a local or a widespread reduction in functional freedom (structural and/or functional permanent damage), or a loss of one or more functions, potentially leading to the decline of the biological system, eventually to death.

In the framework of a biology based on coherence, the health of an organism depends on its ability of constructing a well defined phase Φ during the mainly unpredictable variables of life. When this happens, we say that this organism is able to self adapt and, eventually, self repair. The capability of self repair of an organism is enhanced by the presence of a well defined phase Φ in tune with the part of the environment the organism is connected to. A better life quality is then supported by a sharper definition of the phase Φ of each organism. In this interaction the connectedness of the organism is essential, not the amount of exchanged energy, which could on the contrary be harmful when its amount exceeds the threshold of the "energy gap", namely the amount of energy necessary to make the coherent system *boiling* and therefore losing coherence [80].

Contrary to the quasi-finalistic and quasi-linear consequentiality of the phyletic lineage suggested by the Darwinian and neo-Darwinian *arboreal model* of phylogeny, *phylogenesis* itself should be understood as a *basin of attraction of the chaotic type* (*riddled basin of attraction*) *with different attractors and different dissipative/anticipatory structures/systems*, that is:

- the ongoing, non-linear (non-predictable, non-reversible, non-reproducible) process of diversification and integration relying on the *poietic action* (which produces development and structure) exerted by the *self-organization*, to which undergoes the biological phenomenon from its origin, in relation to all the intermediate solutions between *adaptation* and *exaptation*[47], to all the *dissipative/anticipatory* structures/systems solutions and to all the *state tran-*

[47]The concept of *exaptation* was introduced by paleontologists Stephen Gould and Elisabeth Vrba in 1982, to indicate the possibility that in nature the relationship between organs and functions is potentially redundant, in order to allow that a tract developed for a certain adaptive reason, can be "co-opted" or converted to a function even completely independent from the previous one. This functional cooptation, which complements and does not replace the gradual action of implementation of natural selection, was named by Charles Darwin "*pre-adaptation*" and was renamed by Gould and Vrba with the neologism *exaptation*, means precisely that some innovations, appeared during the course of phylogeny, may not be the result of a process of selection toward that specific function, but the reuse for other purposes of an existing structure. An example is the origin of the *wing*, which originally worked as a structure for thermoregulation, to then be "*recycled*" for the *flight*. Another example are the organs and systems involved in the *phonation*. Phylogenetically the organs and apparatus involved in phonation are all born for other purposes than *vocalization* or *singing*. Over the course of phylogenetic diversification, the organs for the production of breath have been formed to supply lungs with air; the larynx appeared in Mammals as gate between the bellows and the external environment; the vocal channel is the first part of the alimentary canal; the organs for phonetics articulation have as a primary function that of chewing; the nasal resonance cavity correspond to the upper respiratory tract and the soft palate has the main task to prevent the backflow of food. Several examples of functional cooptation have recently been found also at the molecular and cellular level, for example in relation to the role of *astrocytes* in *neurogenesis*.

sitions (bifurcations), induced by macroscopic (environmental, climatological, geological, planetary, cosmological) and/or microscopic (biophysical and biochemical) *state variations*, that have affected it, directly or indirectly, in space and time.

Under the thermodynamic-electrodynamic-autopoietic profile, the countless structural and functional solutions that characterize biological varieties, produced in the course of phylogenetic diversification in general, and of that following the Cambrian Period in particular, represent as many *dissipative systems* far from thermodynamic equilibrium, that rely on the availability of *anticipatory systems*. Biological systems are *non-linear dissipative systems* [81] embedded by *super-complex anticipatory systems* relying on thermodynamics of non-equilibrium, at the phase boundary between chaotic and ordered (coherent) regimes. The state maintained at the verge of chaos turns out to be, in some sense, rather stable. This peculiar state is defined as a *self-organized criticality* [82].

4.2. The Metazoans Neuro-Dependent Adaptive Line

Basic organic compounds, such as *biological water*, proteins and nucleic acids, are semiconductors and possess the ability to activate charges without participation of ions [83]. Semiconductors are good converters of chemical, thermal and electromagnetic energy into electric energy, and the other way round. A semiconductor can be a quantum generator of electrons and photons. In an alternating electric field, proteins, amino acids, DNA, RNA, as well as plant and animal tissues are subjected to *electrostriction*, *i.e.* the mechanical deformation of a dielectric (insulator) in the presence of an electric field, and become quantum generators of *phonons* or acoustic waves (a phonon being a quantized mode of vibration). This occurs because the structures in question are at the same time *piezoelectric* (the ability of certain materials to generate an electric charge in response to applied mechanical stress[48]) and *pyroelectric* (the ability of certain materials to generate an electrical potential in response to applied thermal stress), which means they possess the capacity for *thermal* and *mechanical polarization*. Piezoelectrics convert mechanical energy into electric energy, while pyroelectrics convert thermal energy into electric energy [84].

Acoustic effects may take place not only in piezoelectrics, but also in semiconductors. A semiconductor can manage electrons in their induced state. In such cases, non-radiative recombination transmits the energy to the molecular

[48]It is worth noting that macromolecules spend almost their entire lives in states of mechanical stress. Due to the presence of bound ions and electrically charged parts of protein molecules (negatively charged carbonyls and positively charged amino acids), any mechanical shift is accompanied by changes of electrical field, which contribute to maintaining mechanical stresses within macromolecules. A special role in this process is played by charged ligands and first of all by ATP molecules, each of them containing three negatively charged phosphate groups. Accordingly, by binding ATP molecules, the proteins should pass to more stressed and rectified configurations which may play an important role in the signaling cascades associated with several rounds of the protein's phosphorylation/dephosphorylation. Therefore, an essentially mechanical behavior characterized by the presence of long-living stressed conformations play a crucial role in regulating morphogenesis, and can be distinctly traced already on the level of single macromolecules [81].

network in the form of quantum quantized mode of vibration. The transition from the induced state to the basic state has got thus two possibilities: the generation of *photon* or the generation of *phonon*.

At micro- and mesoscopic level life is a result of all the chemical, electrical, magnetic, optical and acoustic events occurring in the living organism, in the system of organic-like semiconductors, piezo- and pyroelectrics. Therefor life takes place not in a chemical or electronic system, but to some extent among these two processes, where photon exchange plays a central role.

Life processes and light are inseparable and internally connected due to their electromagnetic nature. Light plays a significant energetic and regulatory role in living organisms and in the entire ecosystem, for instance in photosynthesis, in the process of seeing, in biological rhythms, etc. The establishment and maintenance of biological structures is based on the process of *photosynthesis*[49] [85] [86], thanks to which the surplus of energy supplied by the photon to the electron in the electronic excitation is converted into binding energy. The inverse process is called *bioluminescence*. In this case there is a transfer of energy from a bond to an excited electron, with the consequent emission of a photon.

Changes in the intensity of photon emission are functionally connected with disturbances of homeostasis and their measurements specify the state of organism's vitality and the capacity for environmental adaptation. The *electromagnetic interface* and *photon exchange* are at the basis of all biological processes and it is thanks to it that a biological system, from the less to the most complex, interacts/interfere with each other and with the environment.

Because of this, the *electromagnetic interface* represent, at the micro-, meso- and macroscopic level, the fundamental *sensory module* of any biological system [87] [88] [89] [90] [91], namely **EM sensory module** [92] (a biological ability that several marine and few terrestrial animal species favored by developing *electroreception*, used in *electrolocation*, *i.e.* detecting objects, and for *electric signaling*).

Prokaryotic cells (unicellular autotrophic anaerobic photo, magneto and chemo-synthetic micro-organisms began to form ca. 3.8 - 3.6 billion years ago). The following constant, increasing, massive, over one billion years lasting O2 (oxygen in the gaseous state) production, carried on by oceanic anaerobic photoautotrophic prokaryotes (cyanobacteria), primitive photosynthetic blue/green micro-algae living in chains-colonies, have increased and decreased the ocean's O2 concentration several times before turning the existing *reducing atmosphere* into an *oxidizing atmosphere*, with catastrophic effects on the prokaryotic cells

[49]With some exceptions given, e.g., by microbes and marine animals that live in aquatic environment at abyssal depths in extreme environmental conditions, such as complete darkness where no photosynthesis may occur, food-limited environment in the presence of extreme thermal gradients and thermal excursions, high hydrostatic pressures up to 300 - 500 MPs (compared to the 0.1 MPs atmospheric pressure measured at sea surface level), whose metabolism is not based on the process of converting light energy into chemical energy but on alternative conversion processes, such as *pyroelectric* conversion (convert thermal energy into electromagnetic energy), *piezoelectric* conversion (convert mechanical energy into electromagnetic energy), and *chemosynthesis*, *i.e.* resorting to energy released by inorganic chemical reactions to produce carbohydrates.

themselves, that are poisoned by the gaseous oxygen, and dramatic effects on the whole environmental (geochemical evidence of a new world-order for the carbon cycle), climatological (ice ages began) and geological conditions (most of the minerals found on Earth will be since formed as *hydrated* and *oxidized* forms due to *dynamic* and *crust* processes).

This process came to a no way back point ca. 2.3 bya, when the oceanic and atmospheric O2 concentration rate reached irreversible levels incompatible with anaerobic cell's metabolism, giving way to the first and greatest mass extinction ever happened (also called the *Great Oxygenation Event*, GOE) [93]. Eventually, the mass extinction escaping prokaryotes, together with primitive anaerobic eukaryotes lacking *mitochondria* and *plastids*, who appeared out of different prokaryotic cells symbiosis less then 1 billion years after prokaryotic cells formation, took shelter deep in the ocean floor, far from the ocean's surface, or reduced themselves, via *encystment*, into a stripped-down, dormant form, or turned into *endospores*-like formations.

Some of the prokaryotes and most of the primitive eukaryotes who escaped extinction underwent a ca. 600 million years lasted non-linear biological transmutation, which turned cell's metabolism from anaerobic to aerobic (oxidative metabolism, *photosynthesis*), and cell's composition from lacking in *organelles* (the membrane-bound compartments within a cell such as the *nucleus*, mitochondria, chloroplast), to be equipped with them (e.g. mitochondria derived from purple bacteria, the plastids from cyanobacteria, and the nucleocytoplasmic component from archaebacteria), in particular with the *nucleus* (a-nucleated cells *vs* nucleated cells), where the heritable genetic material is located, to give way (ca. 1.9 - 1.7 bya) to a new, highly integrated and complex form of cell, the fully established *eukaryotic cell*.

Eukaryotic cells themselves underwent a ca. 700 million years lasted non-linear biological self-organization process that brought to the formation of the first multicellular organisms (the most ancient hybrids of multicellular organisms were metazoans, fungi and marine sponges, which formed ca. 1 bya).

Until the Cambrian Period, biological dynamics revolved around the development of biochemical and biophysical strategies, aimed at fulfilling energy requirements. From the Cambrian onwards a new solution amongst energy requirements started to sketch a second way for the *development of life* on Planet Earth: adaptation by diversification of *behavioural strategies*.

Diversification of behavioral strategies require *cell differentiation*, the process by which cells specialize, acquiring or enhancing their ability to perform a specific function[50]. With *cell differentiation* the whole clusters of unicellular orga-

[50]All cells have the fundamental properties of living protoplasm, *i.e.* metabolic activity (synthesis, respiration), excitability, the conduction of excitation, the ability to receive stimuli from the environment and to respond by movement, secretion or other ways, plus the capacity to reproduce. When a cell specializes it loses none of these fundamental properties related to biological life, but it differs because it potentiates one of these properties. Generally speaking, when a cell specializes in a particular function, it also modifies its morphology.

nismsthat have colonized the planet until then, distributed over one or more areas and linked by a common adaptive and bio-energetic gain, found the way to come together, a process of in-formation governed by the self-organization of specific associative patterns induced, in the short and long range, by resonance phenomena (via *Phase Conjugate Dynamics*; *Spin Coniugate Dynamics*; *Tension Coniugate Dynamics*), involving various kind of cellular and molecular species, to become *localized cells colonies*, specialized and joined by a common structural and functional link, defined and identified in the construction of *different tissues*, organs and systems of organs, that operate coherently and in synchrony for the survival and unity of the *multicellular system*. From being a composed, integrated system delimiting (membrane) a multitude of sub-cellular structures and molecular units, more and more unicellular organisms stopped "dancing alone" to become one with an *integrated specialized cellular ecosystem* (multi-cellular organism), consisting of differentiated cells, specialized according to the role and function they must play to be part of a choral unit[51].

In multicellular organisms of the animal kingdom (from *Metazoa* to us), the distribution of the various functions among different and increasingly specialized tissues is integrated by a new tissue, the *Nervous Tissue* (NT), whose functional unit is the *nervous cell* (in association with *glial cells*[52]), *i.e.*:

- a *generator of electromagnetic radiation* in ultrahigh range of frequencies with the wave length comparable with linear dimensions of the cell itself;
- a *rhythmogenic center* with exogenic modulated frequency;
- a *receptor unit* playing selective function on *state variations* (stimuli) and *functional interface* between innervated tissues;
- engaged in supporting and integrating the *energy-transfer* function exerted by the catalytic cellular core (CCC), formed by the Golgi apparatus, the centrosome and *microtubules* (MTOC, Microtubule Organizing Center [98], the structural units of the cell cytoskeleton, highly polarized polymerized proteins.

In accordance to energy and geo-environmental constraints that have guided phylogeny in the process of diversification of biological functions and corresponding structures/systems, the zoological neuro-dependent line adapts itself to the unconditioned variables imposed by the environmental pressure diversifying

[51]In vertebrates, Central Nervous System (CNS) functional and morphological organization follows exactly this pattern. At increasingly specialized and diversified behavioral strategies, pointing at species-specific CNS functions, also corresponds a distribution of different, morphologically and/or functionally specialized *neuron-glial colonies*, whole groups of cells belonging to species-specific Coherent Domains of the CNS *basin of attraction*, each of them in a *relation of continuity* with all the others, where the single behaviour is prescribed by the colony's choral interference network, and described by a unanimous and synchronised dynamic, based on self-organized biophysical processes occurring via *Phase Conjugate Dynamics*, *Spin Coniugate Dynamics*, *Tension Coniugate Dynamics*.

[52]Until a few years ago it was thought that the nerve cell was the only functional unit of the Nervous System (NS). It is now believed that this role should be partly shared with other cells belonging to the NS, the glial cells [94] (e.g. they regulate the neuronal synaptic responses associated with learning and memory processes, and share with neurons the role of mediators in the genesis of brain functional skills [95] [96] [97]).

the biological scenario in a multitude of animal organisms, guided by the *genetic stabilization of specific sensory maps* (bearers of a specific ability to generate interference) and *specific neuronal maps* (bearers of specific anatomical and functional correlations), which assigns to species their own capacities, possibilities and tendencies, variously bound to *stereotypy* or open to overcome it.

5. The Mind-Brain-Body Hard Problem

5.1. The Mind-Brain-Body Hard Problem: Mind

> *As individuals we experience ourselves as biologically discrete, as contained within our skins. Thus, we experience ourselves as embodied and largely define ourselves and our boundaries by our bodied experience. But also importantly, despite the ecological reality of our inextricable embeddedness, we are boudaried, defined, and located by others—and, so, we are also embodied by others.*
>
> Vivien Hardham [99]

What is here proposed to define the position of mind in Nature, is a *relationship-based alternative*.

Physically, the *mind phenomenon*

1) rest on the neuro-electrochemical activity, that transmutes the environmental physic variations, filtered and made available by the six sensory organs, into a *non-linear neuro-compatible stream of energy and tension gradients*,

2) is drawn by the tuning (via *correlative dynamics*) of the ongoing non-locally *distribution ofmonopolar tension gradients* (a relationship process linked to the dynamics of the species-specific neurological basin of attraction acting at the edge of chaos on *tension level*), with the ongoing non-locally *distribution ofenergy gradients* (a relationship process linked to the dynamics of the same species-specific neurological basin of attraction acting at the edge of chaos on *wave-particle level*).

By *mind-brain-body correlative dynamics* is then understood an ongoing net of tension and energy gradients, filtered by the mind-brain-body *poietic-syntropic-mnemotropic system*, to become a spooky grid of flowing *images*, *i.e. holographic tension*|*energy* <Ť|Ê> exoti*c objects interference patterns* on the surfaces of higher order hyperspace fields (e.g. on a *hypersphere*, a structure embedded in a 4D space, equipped with a double donut-like shape, which is invisible in the usual 3D dimensions [100]), experienced as *mental-facts* by the subject endowed with consciousness.

A *mental fact* is an ongoing mass and energy free process devoid of space and time coordinates, non-objectifiable, evanescent, a transitory bending hologram of tensions endowed with functional correlations, shaped by behavioral needs (species-specific) in order to become a meaningful flux of images among the stream of otherwise meaningless tensions, constantly flowing in the relationship that develops between the neurological organism which is experiencing it and

the environment of state variations in which it is immersed and with which it interacts. When we sense, perceive, feel, think, we literally turn the spooky grid of flowing *images* that we are experiencing into sensations, perceptions, feelings, thoughts. There is not something or someone separated from the mind-brain-body stream of correlations, which observes it from inside or outside. The idea of "*mentally seeing*" our thoughts, sensations, emotions and the like, as separate "*objects*" that appear and disappear from the screen of our mind, is an illusion determined by the action of consciousness, whose *modus operandi* is to divide, to establish relationships of contiguity.

Mind is not an intrinsic property of matter, nor a state of matter. Mind is a particular way of being of tension in relation to energy, realized when the autopoietic dynamic of a biological system is mediated by the neurological relational module. Mind is grafted on the stream of sensations (state variations) elapsing within the neuro-dependent dynamics while energy merges into tension on the edge of chaos, a stream of state variations experienced as *events*, *i.e.* knots of relations non isolated nor isolatable from the whole in which they are comprised, whose value and relevance is species-specific dependent. When we refer to *human mind*, we are not referring to something made up of something, or to the product of a body-mind mechanic, but to a phenomenon literally implicated in the human neuro-psycho-physiological relationship with its *outer-outsight* (embedded) and *inner-insight* (embodied) [101].

That is, we can speak of "*mind*" only in relation to neurological systems, which we can refer to as *minded biological systems* or simply *minded systems*. Each zoological species is a *minded system* showing its own and distinctive "*mindedness*" and therefore its peculiar behavioral features. Projecting the features and attributes we associate to human mindedness onto non-human animals, or non-neurological biological systems, or inanimate objects, or whatever, can help us to maintain a relationship of continuity with the world, to feel part of it, but is nothing more than anthropopoietic activity.

5.2. The Mind-Brain-Body Hard Problem: Consciousness

As a cell must be irritable to respond to a stimulus, so a neurological organism must maintain a suitable species-specific *level of attentiveness* (state of vigilance or *arousal*) in order to fulfill its adaptive/relational needs. The *mind-configuration* of the *human-neurological-organism*, *i.e.* its mindedness, marks the transition (bifurcation) between a neuro-dependent relationship in which the *neurological-minded system* has an appropriate species-specific *level of attentiveness* but do not and cannot perceive itself as a distinct entity from its environment (a *relation of continuity* which is bounded to a safely behavioral stereotypy), to a neuro-dependent relationship in which the *neurological-minded system* is intended to perceive itself as a *distinct individuality from the environment* (toward a *relation of contiguity* which tends to overcome the behavioural stereotypy), to become a *subject conscious* of his/her relationship.

We can also think at this transition, namely from the *mindedness* common to all animals to *humans' mindedness*, as a *transition of state* or *state transition*. In thermodynamics, a state transition indicates the passage of matter from a state of aggregation to another, *i.e.* gaseous, liquid, solid, plasma.

In psychodynamics, a state transition indicates the passage of *psychism* from a configuration to another, *i.e. tensive-relationship systems* → *structured tensive domain* → *tension*|*energy* <Ť|Ê> *objects* → *neurological organism's mindedness endowed by sensing* → *human's mindedness endowed by sensing-intuition and therefore by consciousness in potency* → *human's mindedness endowed by thinking-feeling and therefore by acting consciousness*.

Consciousness reveals that being can be other to itself, *i.e.* the existence of consciousness implies that being is in some respect other to itself. Consciousness is always directed towards an object (which can include the conscious minded), and in order for the separation of subject and object to exist in the first place, there must be some form of division in being. There could not be a distancing of being from being, as implicit in consciousness, if being itself did not have a property or mode that allowed for such distancing.

If so, the anthropopoiesis animated by the process of distancing induced by consciousness generates *culture*. That is, consciousness and culture go together. Indeed, the essential requirement for making *culture* is given by *recognize one-self as individuality distinct from the environment*, a *psychological birth* that has come to maturity, as discussed earlier, only during the Middle Paleolithic, after a long *psycho-relational* and *psycho-biological process of individuation-nucleation*, started at least 1.7 to 1.2 million years ago with Homo Abilis and almost entirely spent on the fulfillment of the requirements associated to survival and caring for offspring. After this long *process of individuation-nucleation* was perhaps starting from the later generations of Homo heidelbergensis (*archaic humans*) and certainly with Homo Sapiens (and therefore from about 300 - 150 thousand years ago onwards) that the *psychic territory* of the ***imaginific***, from **phylogenetically differentiated** as it was it turned out more and more **epigenetically differentiated**, by the sedimentation of the psychic → mental complex relatively autonomous and independent, which we call *epigenetic function of the real* (pre-rational and pre-verbal) or *conscience*, or *self-consciousness*, or *conscious awareness*, or simply *consciousness*. The clues we have in support of this hypothesis are based, as stated above, on the interpretation of finds dating back to a period of time ranging from the second half of Lower Paleolithic to Middle Paleolithic.

Consciousness will be a measure of the ongoing psychic disposition given by the *process of individuation-nucleation* to which our splitting condition has been subjected since then.

From an anthropo-neuro-psychological point of view the phenomenological definition of consciousness would be: *the neuropsychological warp on which is interwoven the weft of the ongoing faculty and ability to ideate*, *program and*

engage, *not occasionally and not by domestication nor by artificial programming*, *an adaptive and supra-adaptive behavior not ruled by the phylogenetic prescription and based on distancing of being from being*.

Consciousness is not a substance, it is not an entity, it is the phylogenetic and epigenetic result of the process of individuation-nucleation of the human mind-brain-body dynamics: it is a relational possibility that distinguishes us as human beings, which for no reason can be taken as a yardstick to "measure" the behavior of non-human animals, or worse yet as an inherent-immanent property of the Universe.

6. Conclusions

A frog in a well cannot discuss the ocean, *because she is limited by the size of her well*.

A summer insect cannot discuss ice, *because it knows only its own season*.

A narrow-minded scholar cannot discuss the Tao, *because he is constrained by his teachings*.

Now you have come out of your banks and seen the Great Ocean.

You now know your own inferiority, *so it is now possible to discuss great principles with you*.

Chuang Tzu (Zhuangzi)

The relationship elapsing between *mind-brain-body* it has nothing to do with *transmission of informations*, *exchange of meaningful messages*, *decryption of encrypted code*, *computational encoding of bit of informations* (if the genesis of the biological and mental phenomena had to be based on the precepts of Information Theory, there would be no living nor minded systems at all). The given definition of *mind-brain-body system* is formulated in relation to human being according to the tension *vs* energy line of investigation.

The **mind-brain-body system**, namely the *psycho-neuro-physiological dynamics* caracterizing an alive and vibrating human being, it can be seen as an *autopoietic system* strung between the *Exited Tension-Gradients Distribution* (ET-GD) and the *Exited Energy Quanta-Gradients Distribution* (EEQ-GD), governed by the *syntropic action* of a *Holographic Strange Attractor*, able to develop different degrees of integration and to carry out different functions, that responds to the laws of *psychodynamics of non-equilibrium*, that constantly redefines, sustains and reproduces itself. The autopoietic dynamic of the *mind-brain-body system* is organized around *biophysical autocatalytic patterns* (*i.e.* self-accelerated) regulated by continuous and non-linear fluctuations of *selective tension transfer* between the *outer-outsight* (embedded) and *inner-insight* (embodied) environment. The *trans-neurological selectivity* is the central element of the autopoietic *neuro-psycho-physiological dynamics*. There is a *diffuse and integrate neurological intercellular relationship system*, supported by a dense network of physical and chemical signals (via synapses, gap junctions, intra-extracellular

fluid, plasma membranes, Amniotic Fluid, Cerebrospinal Fluid) capable of interacting with the environmental substrate so as to produce the net of *soliton waves*, *i.e. neuro-electro-chemical impulses* or *nerve impulses* or *action potentials*, that qualifies the *sensory/receptor system activity*. *Selective tension transfer* between intra and extra environment is associated with the *production and transduction of tensive signals* (coherent scans of *tension-state variations* or *tensive-stimuli*) that come into play in the *tensive interconnection* and in the biophysical processes of the *Nervous System tuning* (via *Phase Conjugate Dynamics*; *Spin Conjugate Dynamics*; *Tension Conjugate Dynamics*). That is, all *neuro-psycho-physiological in-formation dynamics* is carried, transformed and made available as *holographic tension*|*energy* <Ť|Ê> *exotic objects interference patterns* on the surfaces of higher order hyperspace fields (species-specific neuro-dependent event horizon) which are *non-locally resonant* with the intermediate EM field generated by the *neuro-psycho-physiological* activity. Under the *syntropic action* of a *Holographic Strange Attractor*, all the mnesic traces (retention of the absent) that in-form the becoming of this dynamic will give shape to a subset of tension gradients, a *fractalized holographic hysteroid*, namely the *psychic basin of attraction* or *anthropo-psychic basin of attraction* of the human species.

Resorting to the fisher and the pond metaphor used in section two, we could compare mindedness to the neurological species-specific way of fishing in (to be coupled with) the *pond of psychism*. The whole neurologic organism is the fisher, its body is the rod (*normal fish*) and the line (*soluble fish*), its NT → CNS is the hook. While it is taking place, and only when it is taking place, the action of fishing causes the fisher to experience (via correlative dynamics) a flow of state variations → sensations, whose consistency, although of aleatory, evanescent, spooky nature (they belong to the *psichism pond*), takes on a species-specific relational value. When the way of fishing of the fisher, its mindedness, is integrated by consciousness, the ongoing flow of sensations can be experienced as mental images and, eventually, the world can take on a meaning.

Ontogenetically, mindedness can be altered or compromised in two different ways:

- By altering or compromising the species-specific relational conditions that allow the neurological organism to fish (e.g. as an effect of a natural or anthropic catastrophe that disrupts its habitat, or as an effect of forced separation from its habitat, or as an effect of relationships able to destabilize its relationship of continuity or contiguity with its habitat, etc.).
- By altering or compromising the physical and/or chemical integrity of the *line* and/or the morpho-anatomical integrity of the *hook* it uses for fishing.

In the first case we speak of *psychic damage* (psychism → psychic function → mental function → cognitive function), in the second case we speak of *organic damage*. In any case, what comes to be altered is always a system of non-linear relationships.

The positivist and neo-positivist building-blocks based interpretation of the physical (*res extensa*) and of the psychic (*res cogitans*) reality, together with the Darwinian interpretation of phylogeny as a linear, progressive and ascending evolution of biological systems, can be useful for utilitarian purposes, but are two misleading ways of mapping the territory which lead to false conclusions. It is time to change our interpretative paradigm on physic and psychic reality.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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