

A NEW CONCEPT OF ARCHETYPE IN THE PHYSICS OF SELF-ORGANIZATION¹

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ABSTRACT. *This article aims to reformulate the concepts of "archetype" and "entelechy" starting from modern notions of microphysics. It proposes an experimental scheme able to verify the actual existence of such entities under an assumption of final causality, successively reinterpreted as a particular form of efficient causality. The possibility of connections with the domains of the ontogenesis and phylogenesis of living systems is discussed. Subsequently, the scheme is generalized in order to include a concept of psychosomatic connection.*

KEYWORDS: *quantum biology, quantum leap, biological evolution, psychosomatic connection, archetype, entelechy, psychoid*

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Introduction

Many physical systems undergo evolutionary processes associated with a growth of their organization. Among these processes, the most obvious is without any doubt the evolution of living forms and the biosphere as a whole. The biological order is so admirable that many thinkers have wondered, over the years, if very singular forms of correlation between events contribute to determine it. Several authors have considered the possibility of non-local, or even transtemporal correlations, not in any way associated with the exchange of matter or energy.

¹ This paper is not a true article but the development of a talk given on 20/11/2008 at "GabinettoViesseux" of Strozzi Palace in Florence, and replicated on 15/12/2008 at University of Rome III, Dept of Engineering. It is proposed here for the kind invitation of Prof. Konstantin Khroutski. The interested reader is referred for technical details to (Chiatti 2007, 2008).

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Regarding the mechanism behind these magic correlations, every author has his own hypothesis. Thus we have the hypothesis of the "biological point" of Azzi (Azzi 1963), the psi field of Laszlo (Laszlo 2003), Sheldrake's morphogenetic fields (Sheldrake 1981), and so on. In our opinion, none of these assumptions are consistent or believable, although the idea of immaterial, informational patterns involved in biological processes (i.e., *entelechies*) is very ancient and worthy of consideration.

In our opinion, a serious discussion of the problem requires an approach that sees the evolutionary phenomena as particular aspects of the *cosmogensis*, i.e. the process by which the universe comes into being. From a historical point of view, two approaches to cosmogenesis can be distinguished, which we call *synchronic* and *diachronic*; they differ because of the meaning given to the expression "coming into being" of the Universe. The synchronic approach has been dominant from antiquity until the advent of the scientific revolution in seventeenth and eighteenth centuries; since that time it has been gradually supplanted by the diachronic approach. Current science sees the processes of evolution (on a cosmological scale, geological, biological, etc.) exclusively in diachronic terms.

According to the diachronic approach, today certainly more familiar, the processes take place on a "network" of space-time coordinates which label each event. The connection between two events, if any, is causal i.e. consisting of the exchange of a material or energetic signal through spacetime (Figure 1). Two events can also be correlated without being causally related, but this is only if both are connected to a common cause in the past. Finally, even the spatio-temporal network has its own history, which is thought to have originated at a certain time in *the past* (Big Bang). Thus, the origin of time is an event that also belongs to the temporal domain.

According to the synchronic approach, a fundamental a-spatial and a-temporal entity exists; the various events of the physical world originate from this unity through a cascade of subsequent symmetry breakings, i.e. differentiations. Spacetime appears together with them, as a structural aspect of the relationship between them. This process then connects the a-spatial and a-temporal primary unity to the world of the ordinary processes in space and time. It also works in reverse: the various events can be reconnected to the primary unity through the restoration of certain symmetries. In this approach the Universe appears in a single block by a unique act of unfolding-refolding, in all its past history, present and future.

In the period 1700–1850 science was in a phase of transition; the diachronic approach was gaining credit under the influence of the practical success of Newtonian mechanics but the traditional synchronic approach was still followed, especially in fields as morphology and systematics of the living beings. The problem arises of a possible reconciliation between the two approaches, but this reconciliation was not easy. In fact, according to the diachronic approach the temporal sequence of states of a given system is uniquely determined by initial and boundary conditions, so that any additional synchronic intervention is either in conflict with that sequence or is redundant in terms of explanatory power. At the end, the diachronic approach won. With the benefit of hindsight it can be said that conciliation was impossible because

at the time the only known events were the macroscopic states of a system, and then the insertion point of the synchronic unfolding/refolding process in the diachronic causal chain must necessarily be composed of one macroscopic state (see Figure 2).

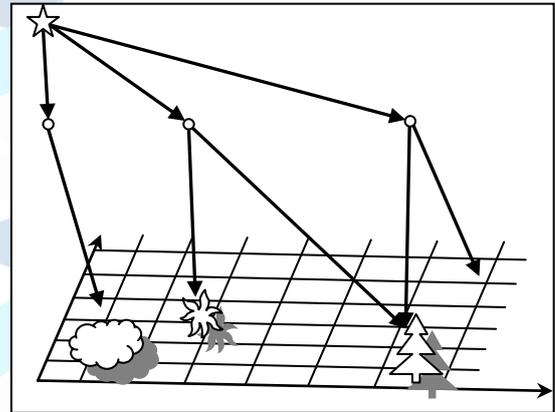
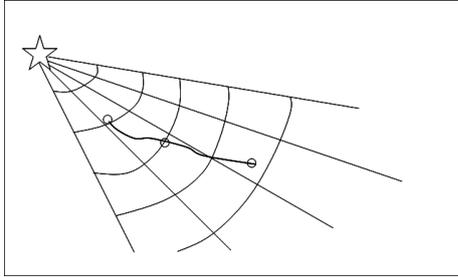


Figure 1 (above): diachronic approach

Figure 2 (right): synchronic approach

1. The proposal

In our opinion, the attempt to reconcile the two approaches should be revised in the light of our present knowledge of microphysics. Today we know that the microworld is described by quantum laws, and any macroscopic process is a stream of elementary quantum processes. The elementary quantum process consists of two events: the first coincides with the creation of the initial state of a micro-object (for example, the creation of a photon with a certain frequency, etc.); the second, which chronologically follows the first, coincides with the destruction of the final state of the same micro-object (for example the absorption of that photon by a detector). The initial state is described by a certain wavefunction, the final state is the result of the time evolution of that wavefunction, which is further transformed by the phenomenon of "collapse". In the terminology of Penrose (Hawking and Penrose 1996, Penrose 2004) the process of time evolution of the wavefunction between these two extremes (U process) is distinct from the extremes themselves (R processes). Very briefly, the Penrose R process indicates how the micro-events are associated with the collapse or reduction (R = reduction) of the wavefunction. This distinction can be traced, in a different form, also to the non-wave formulations of quantum mechanics (e.g. matricial or phase space formulations) and therefore it has an actual physical character which not depends on the formalism.

Now, while the R processes are associated with quantum leaps and are therefore actual physical processes, the propagation of the wavefunction is merely a mathematical artifice for the calculation of probabilities of R processes. This raises the issue that has caused rivers of ink: what connects the two R processes in an elementary quantum process? We do not care to examine the problem here, but we note that in principle such a connection can be both diachronic and synchronic. From a diachronic point of view, the two events are connected by the *continuous* propagation, in space and time, of a persistent "micro-object" endowed with some

spatiotemporal structure (wave, particle...) that runs in a finite time in the space between the two events. In the example considered before, this micro-object is the photon.

From a synchronic point of view, the creation of the photon can be seen as the unfolding, starting from the primary unity, of a complex of qualities called "the initial state of the photon"; the destruction of the photon can be seen as the refolding, in the primary unity, of a complex of qualities called "the final state of the photon." Between the two events no object is propagated; simply a package of physical quantities is "materialized" in the first event and "de-materialized" in the second, simulating a propagation. In the example considered, this package is the photon (Figure 3).

The difference between these two approaches is very important from a practical point of view: according to the synchronic approach the two events are connected through the extra-spatiotemporal primary unity, and this connection is not local. This non-locality has no effect as long as we reason about the propagation of a single photon; but when we consider a pair of correlated photons created together in the same source and then sent to distant detectors, the non-local connection between measurement events and the creation event produces the EPR phenomenology (Figure 4). This phenomenology remains a paradox in the context of diachronic approach¹.

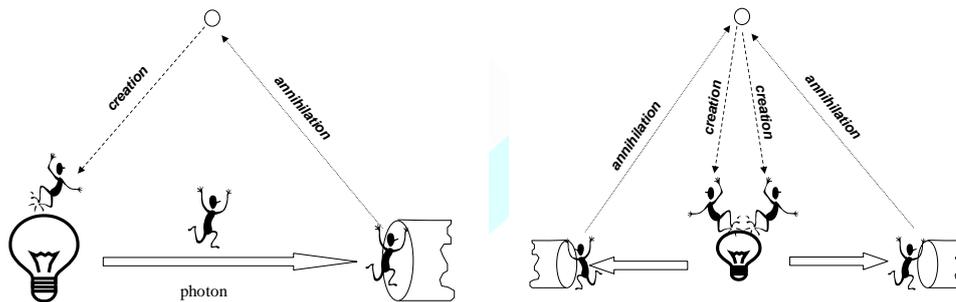


Figure 3 (left): synchronic vs. diachronic view of the propagation of a single photon
Figure 4 (right): idem, for a pair of correlated photons

Of course, strictly speaking, the R process in which the photon is created includes the annihilation of the initial state of the emitter atom, and the creation of its final state; similarly, the R process in which the photon is absorbed includes the annihilation of the initial state of the absorber atom and the creation of its final state.

The essence of the proposal is therefore to unify the diachronic approach (Figure 1) and the synchronic approach (Figure 2) into a single synchro-diachronic approach (Figure 5) in which the events constituting the final outcome of the unfolding of primary unity, or the starting point of the refolding in it, are identified in the R processes of the physical world. These events are considered here as the only actual substance of the physical world.

¹ The well known absence of trajectories for the "micro object" also remains a paradox.

As seen from Figure 5, two R processes can be *causally connected* through the propagation of a wavefunction (U process) if they are the preparation and respectively the collapse of that wavefunction. The propagation of a photon or an electron is an elementary example of such a connection, which is symbolized with a continuous line. However, the fact that *all* R processes of the past history, present and future of the Universe are potentially connected through the extra-spatiotemporal primary unity also establishes the possibility of a correlation *acausal* between them. In the here outlined approach, therefore, the possibility exists of acausal, non-local, transtemporal connections between R processes, not associated with any exchange of matter or energy.

The state of a macroscopic system consisting of a huge number of R processes per second is subject to time evolution laws that are averages of microscopic quantum laws, namely the classical laws. The acausal correlations therefore never come into conflict with the causal sequence of macroscopic states dictated by the classical laws. And yet the micro-events will introduce, in appropriate circumstances, effective *novelties* in this sequence.

This will happen if they trigger *classical* amplification mechanisms whose final outcome will be a choice between alternatives at the macroscopic level. In the classical description of these phenomena, precursor R processes will appear as "noise" or "external signal" without any reference to their non-local and acausal aspect. However, this aspect actually exists and it involves the appearance of a genuine acausal, non-local and transtemporal order at the macroscopic level.

We must therefore focus our attention on systems capable of amplifying micro-events to the classical level.

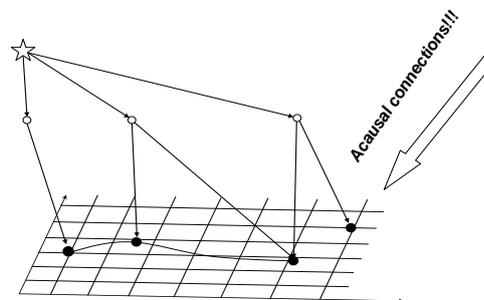


Figure 5: *synchro-diachronic approach*

2. Macroscopic amplification of quantum micro-events

The most classic system of this kind is simply a measurement apparatus. Let us consider, for example, the tube of a Geiger counter penetrated by ionizing radiation. The radiation gives rise to a "R process" which is nothing else than the first ionization induced by it in the filling gas of the tube. The tube works at saturation voltage, thus this event triggers the formation of an avalanche discharge between the external electrode and the central collector. This discharge in turn generates a *macroscopic* output current, which can thus be seen as the effect of a classical mechanism of amplification (the avalanche). Obviously, one can have multiple nested amplification processes, with an intensification of the effect. For example, the current pulse

obtained at the first stage can be transformed into a voltage pulse to the grid of a triode, and the signal can thus be transduced –with a suitable amplification - at the level of the triode current. The final result could be the movement of a pointer on a scale.

This is an artificial apparatus, but biosystems are rich in amplification processes of this type. An elementary example is the direct damage from ionizing radiation. Here the "R process" may be the ionization of an atom belonging to a base in a DNA strand of any organism. This ionization can break the strand, giving rise to a SSB (single strand breaking), which is usually readily repaired by the repair mechanisms involved in the cell nucleus. However, if these fail, the damage is transduced from the molecular to the cellular level by an amplification mechanism *normally* operating within the nucleus that is the production of multiple copies of messenger RNA, which in this case are altered. The final effect is the incorrect synthesis of proteins. Also in this case, there may be nested amplification processes. If the affected cell is subject to reproduction (as it is the case of an embryonic cell, or one belonging to a germinal line, etc.) the damage is further transduced from the cellular level to the over-cellular level by a second amplification mechanism, which is cell reproduction. The final outcome might be macroscopic and consist, for example, of the onset of radio-induced neoplasm.

This type of amplification triggered by a micro-event is rather common in the biological world; for example, in perception (think, for example, the human eye can detect single photons!), in genetics (point mutation), some aspects of embryonic growth, and so on.

If the proposal outlined in the previous section is correct, acausal, non-local and transtemporal connections between micro-events subject to amplification processes such as those mentioned herein may result in the emergence of a *macroscopic* order. This order will remain hidden in the conventional descriptions adopted for macro-phenomena (which nevertheless remain valid). We will call *archetypes* the hypothetical patterns of macroscopic order emerging in this way, and one can easily see that they have little or nothing in common with the Platonic ideas.

3. Archetypes and biological evolution

Let us suppose that archetypes exist. Then some questions immediately arise: do they play a role in the ontogenesis and/or phylogenesis of living systems? For example, the background of "random" mutations which, according to neo-Darwinian synthesis, constitutes one of the prerequisites of speciation, is perhaps connected in an acausal way with the environment and its changes? Or even with the future of the biosphere?

It is interesting to note that already Pauli was asking these questions, as we know from the publication of his private correspondence (Atmanspacher and Primas). Indeed, he formulated for the first time the idea that the wavefunction collapse (the Penrose "R process") was an elementary choice performed by a sort of *natura naturans* (Atmanspacher and Primas; Meier 2001; Peat 2002). Pauli was also perfectly aware of the nature of quantum micro-event of the point mutation.

There is, in biology, a whole tradition that deals with the hypothesis of archetypal interventions in ontogenesis or phylogenesis of living systems. Regarding the latter, its discontinuous trend is of particular relevance (Fondi 2006). The paleontological records related to practically any level of taxonomic classification (kingdom, phylum, class, order, family) shows an almost total absence of clades, or branching involving a divergent evolution. Conversely, the major taxa appear from nothing, to remain more or less long geological periods and then disappear. It is difficult to explain a situation of this kind in a neo-Darwinian perspective because this, assuming selection as the principal factor of evolution, requires phyletic gradualism.

The explanation that one ordinarily gives is punctuated equilibrium. According to this theory the great genetic variation would be concentrated in small marginal populations, in which the exchange of alleles would be faster and the weight of mutations and selection the most relevant. These populations would then be deconfined by cataclysmic events, which disperse them over large areas so creating, in the fossil record, the seemingly *ex novo* appearance of whole taxa. The fossil remnants of native populations would be difficult to find because they are distributed in very limited areas, so that there would be no residual trace of ancestors or of "missing links". The theory is excellent, but the question remains constituted by the fact that the discontinuity presents itself to *all* levels of taxonomic classification.

The hypothesis of acausal connection of mutations according to transtemporal archetypal patterns that lead to the appearance of large taxa imposes itself as an attractive alternative, not even necessarily in contradiction with the mechanism postulated by neo-Darwinism. Of course, the real problem is that we still lack a credible theory of evolutionary mechanism that sees the various factors (mutations, selection, plasticity, symbiosis, learning, structuring codes, etc.) be composed into a single framework. At the moment we have a neo-Darwinian theory, different neo-Lamarckian approaches, a symbiotic theory, a semantic theory, various structuralist theories, and so on. The archetypes should be considered as a possible additional mechanism, and not a substitute or exclusive.

4. Possible experimental tests

The experimental verification of the existence of archetypes is possible provided that certain assumptions are made about their mode of action. To understand the argument, consider the following conceptual experiment, which can be easily realized also in numerous variants.

Let us suppose that identical single photons are extracted – by means of a strong attenuation and filtering- from rays emitted by a very remote light source, like the Sun or a star. These photons are sent towards a half-silvered mirror with equal probability of being transmitted or reflected. The transmitted and reflected photons are sent to two separate detectors that are assumed to be identical and ideal, giving rise to output signals that we will call 1 and 0 respectively. Obviously, a train of N photons incident on the mirror will give rise, in the output of the apparatus, to a sequence of N binary digits, for example, 10110 (Figure 6).

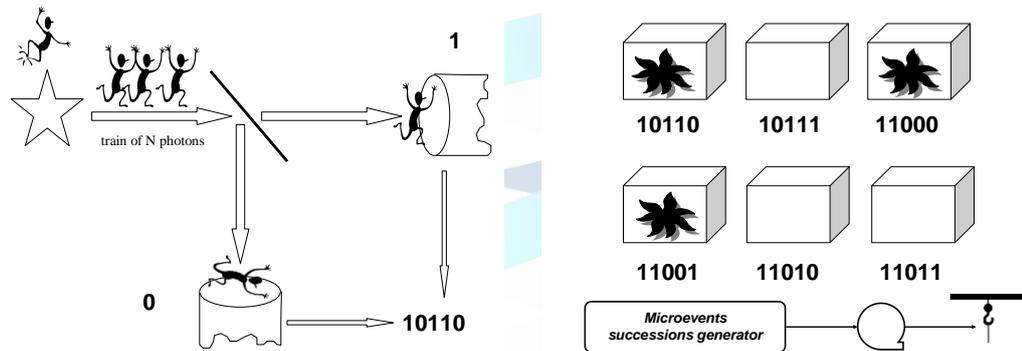


Figure 6 (left): diagram of micro-events sequence generator

Figure 7 (right): the boxes and the actuation device

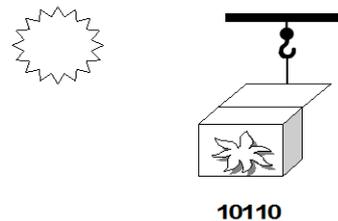


Figure 8: selection of a box and its opening

The set of all possible outputs, that is, of all the possible sequences of N binary digits, is nothing else than the set of the first 2^N integers. So we take 2^N opaque sealed boxes, labelled by these integer numbers. In some of these boxes, selected by means of a random numbers generator, we place small plants. The apparatus is equipped with an actuation device (Figure 7) which can be connected or disconnected from the line. The characteristic of this device is that if it is connected, the output of a given sequence (e.g. 10110) involves the opening, for a predetermined time, of the corresponding box (the one numbered 10110, see Figure 8). If the open box is one of those that contain within them a plant, this latter will be exposed to the Sun and enjoy a healthy period of photosynthesis. This benefit to the biosphere will be absent if the open box is one of those that do not contain a plant.

The additional assumption of what we talked about at the beginning, stimulated by the discussion on the evolution of the previous section, is as follows. Let us assume that cosmic archetypes exist, structured in such a way to promote the growth and evolution of living systems on the planet Earth. If this hypothesis is correct, then we must be prepared for a disconcerting possibility, namely that *when the device is connected, the successions of micro-events associated with the opening of boxes containing a plant are favored*.

As unusual, this statement is experimentally testable. In fact, if f is the frequency of the event "in the selected box there is a plant", measured when the device is disconnected, and f' is the same frequency, measured when the device is connected, it is to see if f and f' differ in a statistically significant manner. This check is certainly possible to do, because the distribution of the random variable "number of selections

that match boxes containing a plant" is a binomial, tending to a Gaussian when the experiment is repeated many times. The statistical significance of the difference between f and f' can then be verified with established statistical procedures (Student's t test).

Suppose to have performed this experiment, and found a statistically significant difference between the values of f and f' . This difference shows that an acausal link exist between the micro-events of interaction of stellar photons with detectors and events like "in the selected box there is or isn't a plant"!

There are at least two interesting aspects of this experiment. The first is that the numbering of the boxes can be implemented *after* the interaction of photons with the mirror. This variant requires delay lines downstream of the photodetectors and very fast switching electronics. It corresponds to the making of a "delayed choice" in an EPR type experiment, with the in-flight reorientation of analyzers. If the difference between f and f' remains the same even with this arrangement, this is to mean that the acausal connection with which we have to do is *transtemporal*.

The second interesting aspect is that the quantity $H = \log_2(f'/f)$ represents an information entered in the physical world without any energetic or entropic cost. This can easily be realized if we think that all exchanges of energy and entropy of the selector+device system remain exactly the same whether the selected box contains a plant or not. The entry in the physical world of this free information represents an *innovation*, the creation of something that is not pure effect of the past: it would be the mark of a truly creative power of nature.

Of course, the idea of this class of experiments rests on the need of having to isolate the source of micro-events from the biosystem, in order to have control over the process. In nature, micro events occur *within* the biosystem, and this latter *feeds back* on the source, so that the control of the process is difficult or impossible.

5. Levels of reality and psychosomatic connection

As is well known, the generic elementary event in the physical world – that is, the R process – can be represented as a projector of a suitable algebra. On the other hand, the connection between projectors (for example of Clifford algebras) and propositions of formal languages is well established (Conte 2010, 2010a); microphysics is thus led back to the context of semiotics (Beil and Ketner 2003).

Using the notation suggested by De Beauregard (De Beauregard 1989) [$| q \rangle =$ creation of qualia q ; $\langle q | =$ destruction of qualia q], the projector which represents the destruction of the physical quality q and its subsequent re-creation takes the form $| q \rangle \langle q |$ ($| q \rangle \langle q |$ which is very similar - even graphically- to the operator $| q \rangle \langle q |$ of Dirac representation. This operator destroys the "state" q and recreates it. The similarity becomes correspondence if we assume, on the basis of a philosophy *of the process*, that at the micro-phenomenic level the "object" to which the qualities summarized in the "state" q are attributed disappears and only these qualities survive. The reality then becomes the expression of the change consisting of the incessant creation and destruction of qualities. In agreement with this, the R process is the elementary

transformation $|q\rangle\langle q|$ whose translation in quantum formalism leads in a natural way to the Dirac representation.

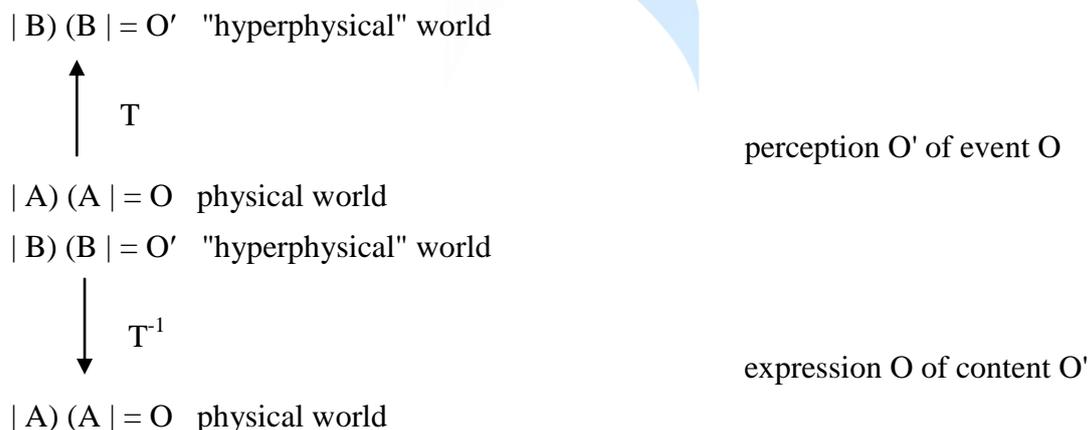
From the point of view of hylozoism the notation $|q\rangle\langle q|$ indicates the existence of an universal agent (a "first matter") with characteristics of a cosmic subjectivity. This agent projects the quality (i.e. the "physical state") q in the physical world and reabsorbs it; in other words, it creates the quality q as an effect of an internal projection and then perceives it as an object. The space-time-matter, that is, the physical world, is a reality emerging from this process of projection/perception.

It is also possible that in addition to the plane of physical reality others levels of existence also exist, i.e. other algebras associated with different sets of qualities, and then to other types of experience of such "universal subject". This would explain in a natural way, *inter alia*, the phenomena of the psyche and their connection with the physical phenomena (e.g. perception and voluntary action).

To understand the argument, consider a hypothetical world having only two levels of reality. One will be the physical plane of reality, the other will be a plane of reality that we will call generically "hyperphysical" (and that can be identified, for example, with one of the levels of the psyche). A generic micro-event O on the physical level will consists of the destruction (refolding in the primary physical unity) and creation (unfolding on the physical plane) of a physical "qualia" A . A generic micro-event O' on the hyperphysical level will consists of the destruction (refolding in the primary unity related to that level) and creation (unfolding on that hyperphysical level) of a hyperphysical qualia B .

The events O, O' may be connected in two ways: either through an operator $T: O \rightarrow O'$ which transmutes the qualia A in qualia B , or through an operator $T^{-1}: O' \rightarrow O$ which transmutes the qualia B in qualia A . The first transmutation is equivalent to the evocation, on the hyperphysical level, of the *representation* of an elementary event of the physical plane, namely the *perception* of that event. The second transmutation is equivalent to the burst, in the physical plane of reality, of the representation of an event of the hyperphysical level, namely its *physical realization* (e.g. the execution of a voluntary action). These transmutations are possible if one admits that primary unities (the physical and the hyperphysical) are mere differentiations of a single primary unity.

This concept is summarized in the following mirror, using the notation suggested by De Beauregard:



In this definition of psychophysical connection, or more generally, the synchronic connection between different levels, the possible existence of a center of self-consciousness on the hyperphysical level (for example, the “*I*” on the mental level) does not play any role. This fact can be present or not, but it is secondary.

The concept of archetype as a pattern of synchronic connection between physical micro-events must then be generalized to include also the synchronic connection between elementary events of different levels of reality. The essence of an entity ultimately consists of the structure of the set of its internal transmutations; this structure is the *archetype* of that entity.

It is perfectly possible to have transmutations that put in correspondence, rather than individual physical and hyperphysical micro-events, *sets* of physical micro-events and *sets* of hyperphysical micro-events. Hyperphysical qualia would therefore be evoked by special *clusters* of physical micro-events, i.e. the succession of particular physical states of a particular physical system. This would explain, for example, why to have a “mind” one needs of a brain structured in a certain way, and because different brains evoke different qualia (that is, the subjective nature of the experience). However, the mental plane exists *independently* from the brain. *It would be equally fundamental than the physical world.*

The psychosomatic connection thus becomes a particular aspect of the representation of the cosmic *process* through an algebra product, in which the “transmutations” appear as special operations of parallel product between projectors of different sub-algebras.

6. From the “quantum providence” to entelechies

We started with an idea of the archetype as a sort of “providential” link that can help the plants used in the experiment illustrated in section 4. We then extended the idea to identify the configuration of a systematic process: the connection between psyche and soma (or, more generally, between different levels of reality). Two clarifications are necessary at this point.

First, in an attempt to develop an experiment that proves the reality of the archetype initially intended in terms of “quantum providence” we have had to postulate a “final cause”: the support to the growth of the biosphere. However, if the acausal synchronic connection assumed in this article is real a living system is not only a complex of diachronic processes; these will be intertwined with synchronic relationships. Therefore the stabilization of the system can take advantage of these additional possibilities of connection, in addition to the known diachronic mechanisms (minimization of energy, etc). The “final causality” can therefore be reduced to an *efficient* causality in which the synchronic, vertical, transtemporal dimension is added to the well known diachronic dynamics. The plant synchronically fits to the cosmos in order to stabilize its state (homeostasis), just as it does in the diachronic dimension (Jarva 2014). Only with the involvement of hyperphysical planes on which there are nuclei of self-reflexive consciousness and voluntary action we will have a genuine final (intentional) causality.

Secondly, it should be borne in mind that, as it is well known, a living system remains in a more ordered state than its environment due to its release of entropy. If it is assumed that the information archetypically acquired is compensated with this release, the archetypal action can become, from occasional, systematic in full compliance with the 2nd law of thermodynamics. This consideration justifies the generalization, made in the previous section, of the concept of archetype in relation to the plurality of levels of reality.

In this case, if the hyperphysical plane introduced in the previous section is the mental level, the archetype corresponds roughly to the Driesch notion of "psychoïd". If the hyperphysical plane is identified in some sort of an "etheric" field in the sense, for example, of the "etheric body" of the esoteric traditions then the archetype corresponds roughly to what Driesch called "entelechy" (Szkutnik 2014).

At present, the fresco brushed on these pages start to get some feedback. Researchers are beginning to question whether a percolation of quantum indeterminism to macrostates of a biological system is possible; an interesting review of the experimental situation and the philosophical implications can be found in (Stamos 2001).

McFadden has proposed quantum effects (quantum Zeno paradox) as an explanation for some adaptive mutations in *E. Coli* (McFadden and Al-Khalili 1999). A discussion of evo-devo based on this key can be found in his book (McFadden 2001). Although it is still too early to talk about percolation of non-locality at the macroscopic level in biology, it is at least comforting that research workers begin to consider quantum leaps as the real crux of the relation between quantum and biosphere.

Acknowledgements

The idea that *quantum randomness* - contained within the limits set by the uncertainty principle, and then in accordance with the known laws of physics - could convey meaning within biosystems was clearly spelled out by the physician, traveler and Italian patriot Beppino Disertori during the difficult years of World War II. This work is dedicated to his memory, and the cosmic vision he proposed; it has much in common with that advocated today by the BCA.

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