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Time and the dichotomy subjective/objective. An endo-physical point of view.

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Abstract. The process of collecting information from the observed phenomena occurs in the subjective time of all individuals who communicate to each other their own interpretations. Intercommunication between individuals constitutes a *loop of knowledge* by which single views are mediated toward constructing an “objective view”, agreed within the human society. During the last centuries this process of intercommunication has been made extremely efficient by Science but the generally adopted *exo*-physical perspective have often raised to the rank of absolute concepts the achieved objective views, stripping them of their evolving human nature and risking to rise expectations that cannot be satisfied. It is argued here that an endo-physical outlook fits better with the actual situation of humans imbedded in the world and heavily interacting with it. Within this framework, the dichotomy subjective-objective is conceptually overcome and the classical notion of “universal“ time may be seen as one of the results of the *loop of knowledge* occurring inside the human society. A general developmental scenario is also discussed in connection with the Eakins & Jaroszkiewicz’s “stage paradigm”, where classical spacetime and observers “emerge” in a universe running by quantum jumps.

1. Introduction.

Time and change are the most obvious evidences in the observed reality. The individual way we perceive change in the environment is very complex and irregular from person to person, with differences reaching limiting cases as in the altered states of consciousness. In the great majority of cases, however, the perceived time has an arrow from past to future that leads to unpredictability of the latter, thus accommodating a feeling of free will and the sense of “nowness”. In the classical equations of motion, however, time is reversible and no ‘now’ is evicted, which led Einstein to say that the subjective feeling of time is beyond the reach of scientific enquiry and that past, present and future are an illusion resulting from the limitations of our senses. This implies that also our free will would be at all illusive, at uncomfortable variance with our feelings.

Some changes have been introduced with the advent of Quantum Mechanics. The *Schrödinger* equation is time reversible like the equations of motion of the Newtonian mechanics, but here a form of irreversibility is included due to the probability of a potential state being realised after an observation. According to QM, in fact, the description of a phenomenon can only be made *after* a process of measurement, when just one particular state materializes out of several possibilities: this breaks the symmetry between past and future, the stronghold of classical physics as well as relativity theories. This character of QM has been interpreted by many as a demonstration that our free choices are responsible for the temporal symmetry breaking in a fixed and a-temporal block universe. This interpretation has been heavily contested by *Prigogine* [1] who believes in the necessity to update

physics by including an intrinsic irreversible time connected to the evolution of the universe toward always more complex structures and giving rise to the unpredictability of the future.

Not distant from *Prigogine, Jaroszkiewicz* [2] supports the scene that the classical concept of time “emerges” at a certain stage of an intrinsic spontaneous evolution of the universe, whereas *Barbour* [3] lets derive the human illusion of the flow of time from the presence in our consciousness of so-called *time capsules*, a collection of short-term inter-related images of the reality connected to each other by supposed cause-effect relationships. The concept of *time capsule* introduces in science an element of subjectivity, reaffirming the opinion of many scientists and philosophers about the necessity of a deep analysis of the behaviour of our consciousness in the processes of knowledge. From a considerably different standpoint, *Kozyrev* [4] gave rise to the rebirth of the *substantial* outlook by proposing the existence of a new physical entity, termed “time flow”, not identifiable with either matter, field, or space in their usual meaning.

But, illusion of our senses or intrinsic reality, there is still a lot of debate about what we actually mean with the term “time”. Is it a dimension, as in the Newtonian mechanics, in which physical processes occur independently of our subjective perceptions? Is it “something” substantial *à la Kozyrev*, flowing together with the observed events? Is it a process *à la Jaroszkiewicz*? Is it something else?

Levich [5] notes that all the substantial conceptions derived from *Kozyrev's* ideas, tend to the notion of an open rather than isolated world and interprets the revival of the substantial outlook as a response to the long-term predominance of relational paradigms. According to him, a basic task of all time researchers nowadays is to create an explicit model of the time flow, following a deep interdisciplinary research program which would certainly require the effort of several generations of researchers and could result in important changes of many current concepts of natural science. I agree with *Levich* that new scientific paradigms must be looked for with the aim of helping the development of the study of time, whatever consequences may derive on the study of natural science as a whole. The main feature of this new paradigms must be a natural reference for the time concept, including its intrinsic structure and variability, as first proposed by *Prigogine*.

Sanfey [6] and others identify the subjective experience of ‘now’ as the unique feature of our consciousness reflected in the objective descriptions of reality and argue that it might be identical to the so-called ‘hard problem’ of consciousness. I concur with *Sanfey* that an objective description of the empirical reality (including the supposed causal interconnections between perceived events) is not possible while ignoring human subjectivity. Failing to take into account the specific processes of knowledge followed by the human mind, may cause attributing properties to the external world that actually arise from our consciousness.

2. Internal times and cognition process in biological systems.

According to *Maturana and Varela* [7], living systems are cognitive, self-organising and self-producing (autopoietic) systems. Their transformations can be explained in terms of their internal organisation not in terms of external stimuli. The process of cognition, however, uses the external stimuli in order to allow the investigation of the environment and supply the internal process of awareness of the living system with all the material necessary for creating his own *space of consciousness* (term first used by *Metzinger*, [8]) where to allocate all the subjective experience. This space consists of “mental models” of various levels of complexity embedded in each other. The largest of these mental models active in the *space of consciousness* is the conscious *model of reality* which contains all the other conscious mental models and whose content is identical with the overall content of the *space of consciousness* [8,

9, 10].

With respect to their dynamics of states, living systems are autonomous and operationally closed systems. This means that their modifications can only be explained as a way to keep stable their organisation throughout the continuous interaction with the surrounding world. A living system can certainly be perturbed through the interactions of its components with the environment, but its response is fully determined by its own structure, regardless of what an external observer may say.

One of the elements of knowledge that looks very different between external and internal descriptions of the organization of a living system is the concept of time. If an observer wants to relate the internal time of an observed living system to the time of a physical clock or to his own internal time, he will meet extremely difficult obstacles because he will need the introduction of time scales with complex units, variable from one living system to another, almost impossible to determine. We know, in fact, that despite the efforts of more than a century of active psychological research, no relevant results are available on the attempts to relate the internal time of a living system with the universal clock time [11].

More generally from the point of view of an external observer, nothing can be said about the internal state of a living system, he can only examine its behaviour as seen from outside. From inside, however, the living system may observe its own process of cognition at each subsequent empirical state (the “now”, updated automatically in the course of time) where he is conscious about all kinds of sensory information received from outside. The organization of these states, leads to constructing his *model of reality*.

According to Pöppel et al. [12], processing of external stimuli in living systems appears to be temporally segmented by sequential processing units of a few tens ms duration. This is well correlated with the 50 bit/s limitation on processing of conscious information. It is in fact recognised that humans are unable to establish a temporal order to events that differ by less than about 20 milliseconds. Such successive time intervals may correspond to subsequent system states linked together by an integration mechanism. This integration can be conceived of as one of the fundamental mechanisms of mental activity because it provides discrete temporal segments within which pieces of cognition are represented.

Nikolaeva [9] follows Ruhнау [13] by assuming that two main temporal mechanisms characterize the process of cognition of the living system and tries, using this assumption, to deal with the binding problem of percepts and with the continuity of conscious experience: a high frequency mechanism (HFM) would provide elementary temporal windows where to implement spatial binding operations and a low frequency mechanism (LFM) would define intervals of integration for sequential information independently of content. Global perception would then be composed on a higher pre-semantic level.

3. The subjective feeling of time in humans.

The concept of time is definitely related to the subjective experience of the changing world and, as it is witnessed by the numerous historical and archeological findings, seems to have progressed along with the evolution of knowledge [14]. As we know from Chronobiology, nearly all living systems from unicellular organisms to humans show periodic variations of their functions or their structural characteristics: the *natural clocks* or *biological rhythms* on which is based the circadian time keeping. In the XVIII century Linnaeus, basing on the observation that plants and flowers opened and closed periodically in the course of a 24-hours cycle, supposed that they were governed by a sort of

horologium florum, an internal temporisation mechanism of all the vegetal world. Concerning humans, the thermoregulation of the circadian variations of the body temperature occurs in the hypothalamus which is thus supposed to be also the centre of a natural clock. This and the evidence of the ability of humans to judge intervals of time [15] are indications of a biologically based humans' sense of internal time.

This sense of time, however, besides being based on the biological internal clock, depends also on several individual's features as, for example, age, gender, personality, cognitive skill, knowledge and others, counting also the cultural traditions of the society he belongs to [16]. It is well known, for example, that the speed of the time flow is experienced differently by children and old people. It seems in particular that our organic processes slow down as we grow older [17], and therefore that the estimation of temporal duration depends on age.

According to *Vicario* [20], temporal perspective could be a unique feature of human consciousness, an important component of self-awareness playing a key role for coordinating all other mental functions. *Block & Zakay* [18] report that, as first suggested by *James* [19], the experience of duration in the prospective outlook, differs from that in the retrospective outlook (the recorded duration).

The most common feature of the individual subjective time is its "arrow" from a past which can only approximately be recalled into our memory, toward a future which can only be conjectured on the basis of the present moment, the "now", the only section of the subjective time for which we feel to have almost complete control. Together with this "normal" feature, the psychological literature is full of examples regarding the so called "altered states of consciousness" where the sense of time is heavily distorted due to several causes, like mental psychoses or drug taking, among others. Time distortion is generally interpreted as a manifestation of mental illness or brain injury [21] and the medical research in this field is mainly devoted to look for the mechanisms by which the brain manages to control temporal phenomena.

A vast literature is available about the numerous important results of the deep and effective psychological research done during the last century [22]. The most studied cases concern our ways to perceive time location and time duration since these are significantly influenced by the type and the intensity of the external stimuli. Concerning time location, it is reported [20] that two external stimuli, identical for intensity and duration but different for type (auditory or visual, high frequency or low frequency tone, located within filled or empty intervals) may be perceived differently, thus reversing in many cases the proposed order of stimuli. Concerning duration, its judgment depends on whether the external stimuli are presented in a prospective or a retrospective paradigm.

An usually debated issue is the notion of the "present moment", the "now", a unique feature of human consciousness, ignored in physics. In the framework of consciousness studies, tending to build a science of consciousness, arguments have been advanced for identifying the subjective experience of "now" with the so called "hard problem" of consciousness [6] and for considering the latter as arising from the presence of quantum effects in our brain. Actually, the basic frequency of the quantum processes described in the Orchestrated Objective Reduction (Orch OR) of the *Penrose-Hameroff* [23] model is right 50 Hz, a rate at which new conscious moments arise with always new organization of the internal spacetime geometry. According to this model, the unidirectional orderly flow of events might then be a function of our consciousness which, thus, "creates" the sense of the time flow [24].

4. The loop of knowledge.

To our eyes (and to our individual consciousnesses) the world appears as a collection of figures,

incessantly and certainly moving or changing in shape and properties and corresponding to distinct “objects” with their own space localization and characteristics, mutually exchanging matter and information, their unceasing and irreversible change being seemingly due to the existence of laws governing their behaviour. Each of us is directly involved in this continuous interaction with the rest of the changing world, interaction that needs to be put under strict control for purposes of survival and adaptation. We thus look for the rules governing the observed interactions and little by little we create within our *space of consciousness*, a reasonable representation of the world, a *model of reality*, linking causally all known phenomena on the basis of the countless relationships discovered.

A practical tool for providing a good internal *model of reality* is given by a set of “theories”, usually built by combining knowledge obtained from everyday observations into a general framework comprising also many other data and connections assumed to be true (by unconscious intuition or even by ideological, political or religious firm beliefs) because necessary for a complete and satisfactory overall view. In the following I will refer to the latter data as “*a priori* beliefs” for sake of simplicity.

Systematic updating of individual *models of reality* is generally done by filling in the gaps in knowledge by means of observations, experiments and indications from other individuals. There is no need to say that the choice of our investigations depends on the personal needs of the moment, needs that are different in different individuals and may be different even for the same individual in different physical and psychical situations. This is based on the fact that our primary need is to live a “better” life where the adjective “better” does not necessarily have a unique meaning for all of us and includes all the ways leading to a more stable and pleasant condition (health, economy, fame, power, pleasure, ...) with different priorities. It is therefore essential to keep in mind that what we “observe” and the way these observations are performed, together with the ensuing questions, depend on various parameters including the individual’s previous knowledge and beliefs, his modalities of perceiving the external stimuli (scale dimensions, sensory organs, the individual feeling of change,...), his present state (poor or rich, sad or happy after an event, in peace or in war, healthy or sick, etc...), his genetic bent (intellectual or practical, static or dynamic, shy or extroverted), physical constraints and all the infinite shades in between them. Due to this enormous variety of affecting data, all “single views” will show both large individual instabilities and large differences between each other, as regards their usefulness in satisfying the needs of the individual at any time [25].

These single or individual views are continuously subject to reciprocal confrontations within human societies and thereby they evolve toward a “common view.” If and when our individual situation changes (to the good side if our representation was correct, to the bad side if it was not, also in view of new interactions conveying new information and newly acquired knowledge), this view is modified by adding any new relationships discovered, derived from direct observation and/or from indications coming from other individuals who, in turn, communicate the links organically included in their own *models of reality*.

Newly acquired knowledge, however, is not always compatible with the models we have already in mind, this giving almost always rise to new queries requiring answers capable of eliminating any arisen contradictions within our *model of reality*. New observations and inquiries may provide the desired answers, but at the cost of modifying, sometimes drastically, our existing scenarios. In the long run, this results in a reduction of our *a priori* beliefs, with the advantage of achieving a more “objective” representation to use for controlling nature. The term “objective” here, has not to be intended as synonymous of “independently real” but only expresses the achieved consensus on its reality within society. It is worth noting at this purpose, that the path to an ever more universal common view is generally signposted by innovative ideas elaborated by strong individual personalities with great communication skills and strong *a priori* beliefs. These new ideas generate new theories for representing external reality, more “precise” languages of communication and updated ways to

performing new experiments. Quite often, however, new ideas more than accelerate the process toward a more universal common view, act as negative fluctuations producing dreadful conflicts with previously agreed views or biasing societies in “wrong” directions for long periods of time. Re-adjustments, anyway, always occur due to the anti-conformist role of “heretics” or, in more difficult cases, to revolutions and counter-revolutions.

As sketched above, subjective experience is primary, the belief on the presence of something “real” outside us is secondary and comes from the consensus of others’ subjective experiences. The starting point of the process toward increasing knowledge, is the individual subjective view which, after interaction and feedback with others’ individual views, is integrated into an always more “objective” view, characteristic of the culture of the human society where the interaction occurs. It follows that the two terms do not represent a dichotomy: the term “objective” has nothing but the same meaning of the term “subjective” when referred to a human society instead that to a single individual of that society.

The process toward a “common view” gradually reduces individual differences and the eventual expression of this confrontation is an evolving common language and investigation methodology, agreed within each society. Historically, at a certain stage, the continuous updating of this methodology gave rise to Science and Mathematics. Common views, analysed within corresponding scientific disciplines and coded whenever possible using mathematics, are referred to as “scientific theories.”

Nowadays the term “common views” would include all the current aspects of our representation of the world, including politics, moral, aesthetics, religion, science, etc... What is evident is the absence of a unique common view both in different societies and within each discipline. Concerning physics, we presently adopt several different definitions and theories for describing reality, each valid within certain application limits and almost always supported by some *a priori* beliefs and assumptions, generally different from one physicist to the next. As an example supporting this statement, a questionnaire distributed by *Jaroszkiewicz* in the run up to the Tatraska workshop of last May, evidenced strong differences in beliefs among the participating scientists.

5. Exo- and Endo-physical way of thinking.

The terms, exo- and endo-physics, were first introduced in a correspondence between *Finkelstein* and *Rössler*, and subsequently extensively discussed by several other authors (see, for example [26, 27]). A comprehensive analysis of the endo-physical way of thinking is given in [28], which also contains an exhaustive bibliography. The term “exo-physics” refers to the investigation of nature by observers who look at it from the “outside.” In exo-physics, the human observer is assumed to achieve such a level of abstraction that mutual interactions between him and the rest of the world can be neglected. In principle, he could reach the limit of a-temporality with a simultaneous vision of the past and the future of the entire universe and, consequently, attain a complete understanding of the laws of nature. Laplacian determinism can be considered to be a logical consequence of this assumption. Endo-physics is, on the other hand, a term coined in order to express the investigation of the world from the “inside,” which is the actual situation of man with respect to nature.

From the very beginning of its history, exo-physics was the adopted paradigm of science. The capability of human beings to conceptualise and classify every aspect of perceived reality has always been assumed as a reasonable sign that we can achieve in principle a very high level of abstraction and construct with our imagination any sort of theory, capable of explaining all natural phenomena. This attitude has produced great achievements in our knowledge, especially during the last few centuries but, on the other hand, it has also caused the tendency to forget that the individual subjective experience

remains the starting point and the foundation of science. It has become so automatic to relegate subjectivity to phenomenology that common views have often been raised to the rank of absolute laws (independent of the human consensus) ruling an intelligible, but as yet unknown, underlying reality.

Criticism of the exo-physical point of view is not a novelty. *Kant* in his *Critique of Pure Reason*, although not using the term exo-physics, strongly criticized the completely detached view and stated that “the cosmic viewpoint (sub specie eternitas) has to be reduced to a human viewpoint (sub specie homini).”

In more recent times, *Popper* [29] wrote that “the laplacian daemon must predict the system from within the system itself not from without it (because) no predictor can predict the results of his own predictions, based on the notion of information and velocity of information. The scientist cannot be considered any longer a disembodied spirit outside the world.”

Still more recently, *Kampis* [30] observed that a “detached viewpoint provides a better and more global view but is in contrast with the man’s role as an observer of a world with which he interacts heavily. There is the danger that, beyond certain limits, scientific theories be meaningless from a human viewpoint.”

Looking at the process of increasing knowledge through a loop *subjective-objective-subjective*, closely connected with the features of our consciousness and with our physical and intellectual needs, is characteristic of the endo-physical paradigm, where the capability of humans to achieve complete detachment from their interacting environment is excluded.

From an exo-physical point of view, nothing would authorize us to believe *to be subject to laws when searching for the laws that rule the universe*. Because of our feeling of having free will, we tend to believe that we have achieved such a level of detachment from nature as to make us almost independent from such laws. From the point of view of endo-physics, however, the observer and the rules which he obeys in the observation of nature are central elements in the development of any theory aiming at taking into account the interaction man-nature. We then need to include these items in the discussion, so to render logically explicit the mutual interaction between man searching for laws of nature and nature itself to which man belongs.

6. Objective measure of changes and the arrow of time.

It seems obvious to observe that, in the course of the evolution of human societies, a consistent effort has been done toward agreeing on an “objective” way to measure the observed changes for establishing a commonly accepted temporal reference. From most remote epochs, it was approached the problem to find a typical and reproducible duration, a “universal” clock. Astronomical phenomena, like moon and sun’s movements, provided soon such a tool for their great precision in predictions. Some fragments of a deer’s bones with incised 28 subsequent notches, found at Les Eyzies (Dordogne) by *Marshack* at the beginning of 1960, show that already 10000 years ago (even before the establishment of the first sedentary civilizations) humans used the moon’s observation to measure time. At Babylonian time (about 4500 years ago), the *Saros* cycle of priest-astronomers, used mathematical calculations based on the movement of celestial bodies able to predict much in advance the eclipses of the sun and the moon. With the evolution of the human society and the increasing knowledge and technology, the reference clock became always more precise and commonly agreed, until the nowadays use of the atom’s radioactive decay.

It is known that cyclic phenomena are not only based on gravitational processes or on the

electromagnetic radiation of atoms. There are in nature other kinds of clocks for measuring the observed changes, coming from various differently organized systems (mostly biological, geological or social; some important examples can be found in Smith [31]) which generally differ both in the periodicity of their cycle and in the uniformity of their courses. The much greater precision of clocks based on gravitational or electromagnetic processes, however, favoured an easier objectification of the measurements.

With the use of a commonly agreed clock, humans made a decisive step toward the construction of a well organized higher level organism, the human society. Still one of the most important elements of our subjective feelings concerning time, its “arrow” and the related sense of nowness, remained confined in the field of phenomenology and were left out of the search of scope for an objective agreement. *Saniga's* algebraic geometrical model [32, 33] pursues for the first time the aim at objectifying subjective arrow of time and provides us with possible clues about how the psychological and physical aspects of time can be interconnected. His model accounts both for our “normal” perception of time, but also for a number of “anomalous” experiences in the so-called “altered” states of consciousness, which certainly represent a profound departure from the consensus reality of our “normal” state of consciousness. After *Saniga's* studies, these states may well be considered as possible modalities of perception of yet scientifically uncharted aspects of reality and yet unexplored attributes of the human brain evidencing these aspects. The model may be of great utility in preparing the road to include irreversible time (perhaps the most important aspect of the way our consciousness works) in the set of coded laws of nature [34].

7. The Eakins & Jaroszkiewicz's Quantum Universe.

The E&J view of the running universe [35, 36] provides an interesting and attractive explanation of the evolution of the universe, linking the observed evolution of human knowledge, including all those separate aspects described by the current physical theories, into the general framework provided by the endo-physical paradigm. In this view, the universe is a self-contained quantum automaton organizing its own observations without the necessity of the presence of semi-classical observers standing outside it or its parts. It jumps serially from one “stage” to the next, each subsequent “stage” consisting of a new quantum state, a new information content and a new set of rules governing the stage and determining the next self-test. Each quantum state ψ is an element of a vast *Hilbert* space H and can, in general, be either entangled or separable. If a state is separable, then it is the product of some factor states, which lie in different factor subspaces of H .

Cosmologically speaking, the E&J universe started from a pure state, a state of chaos completely entangled with no classical structures such as observers, space and time. Only after an enormous number of jumps, the rules and information content at some critical stage “ i ” were such that the completely entangled state ψ_i jumped into a new state ψ_{i+1} , separable into two or more states, thus giving rise to a mixed state, product of two or more factors. In this view, the Big Bang is not seen as a singularity and may represent one of the many points in which separate expanding universes may arise from an increase of factors states. From then on, the state of the universe became more and more factored, this giving eventually rise, at high-level evolutionary stages, to the emergence of reasonable stable patterns like the classical space and time. It might be a far-reaching interpretation of the E&J view (I take it under my own responsibility) to consider also the spontaneous emergence of semi-classical observers with a sense of free will, aware of themselves and looking for the rules governing the universe itself.

All the jumps which produce stages with updated information content I are called “q-ticks”, which are

then the discrete markers of the change and define time as the ongoing jumping process. In the case where the change of stage is not accompanied by a simultaneous change of the information content, the self-test is to all purposes a *null* test, at least for some of the factors of the previous stage [37]. These factors will be contained both in the previous and in the subsequent stages thus appearing as unchanged during the jump with no information being extracted in the jumping process. As an example of the independence of q-ticks in the jumping processes of separate parts of the universe, we may refer to the state reduction connected with the radioactive decay of an atom which have remained frozen while innumerable other quantum jumps have extracted information from the rest of the universe. It follows that q-ticks in separate parts of the universe are not necessarily linked with each other and so are the related jumping processes leading to always new stages. This is in agreement with Smolin's view [38] that time is a natural consequence of a world with many highly organized structures, whose different evolution can be used as reference clocks in each "local" context.

It is my interpretation of the model that, in the same way as for the information content, there may be jumps characterized by resulting in the same rules for some of the state factors. Here, any increase in complexity arising from the corresponding changes of state would probably give rise to apparently more complex rules, reducible to the set of the fundamental rules typical of that stage (epistemological emergence ?). On the other side, when also the rules would change from one stage to the other, the concept of reduction cannot be applied, the new rules could be uncorrelated with the old ones and we would observe an "ontological emergence". In general, if a "rule of rules" would exist in such a QU, it would have a probabilistic form. This kind of "probabilistic determinism" could have also far-reaching implications like the sense of free will in the emerged semi-classical observers, quite more satisfying than the old Laplacian mechanistic determinism.

Looking at the current stage of our universe from the E&J standpoint, it seems to be one which is highly factorised with a stable classical space and time, which accounts for its almost perfect classical nature. We see, however, also a residuum of quantum processes confirming the correctness of quantum principles (including the violations of Bell-type inequalities) and there is still evidence of some entanglement, as first demonstrated by Einstein with the EPR paradox [39].

In the E&J Quantum Universe, only one stage is "real" in the conventional sense. Relative to this stage, we can only talk of stages which were real and whose rules lead to it or of potential future stages not yet occurred [37]. It is stimulating to think at the possible relationship of this concept of "real" stage with the concept of subjective "now" in the case of classical stages where sentient beings have the concept of space and time and look for the set of rules governing their stage. Each of these sentient beings, in the course of innumerable many jumps with unchanging rules, elaborates his own *model of reality* in close communication with others.

It is not explicitly expressed in the E&J stages paradigm what factors are important in choosing the self tests to perform at each subsequent jump; it might be the universe itself, through some kind of *rule of the rules*, which essentially determines these choices. Conventional quantum mechanics is somehow mixed up with exo-physical perspective when solves this aspect by simply saying that we have free will in doing our observations. As it was stressed above, there may always be found a number of implicit reasons for us to choose what to observe and how to perform our observations, (and, not least, how to interpret these observations within our consciousness).

8. Conclusive considerations.

The problem of understanding the nature of time seems intimately related to understanding the way

how our consciousness works. We have direct experience of the world during a small portion of time, the “now”, and our consciousness is able to recognize a unidirectional flow of events causally connected from before the now (the past) to after the now (the future). The nature of consciousness has long been debated and essentially two opposite kinds of explanations have been proposed.

Panpsychism and its variations consider consciousness as a fundamental components of the universe, which our brain is able to detect and to organize. Roughly speaking, Whitehead’s philosophy can be considered as representative of this stream of thought. He viewed the universe as a process consisting of events and, in order to account for consciousness, he transformed Leibniz’s monads into “actual occasions of experience” occurring in a “basic field of proto-conscious experience” [40].

Dualism, based on the Cartesian separation between *res cogitans* and *res extensa* and on the *exo*-physical perspective, maintains that consciousness lies beyond science and relegates subjectivity to the domain of phenomenology. Dualism is often connected with *vitalism* where biology is considered immune from many physical laws, especially the second law of thermodynamics.

No one of these two opposite views satisfy the need to follow a line of reasoning based, as much as possible, on empirical data without the necessity to resort to non-demonstrable *ad hoc* assumptions. Between them, it is possible to look at consciousness as a *emergent* property appearing at a critical threshold of complexity along the evolution of the brain. The paper attempts at building a general theoretical scenario with the aim to link the behaviour of both inert matter and living systems interacting to each other. A possible approach is given by the use of the endo-physical paradigm where any description and explanation of the world is done by taking seriously into account the feed backing interaction observer-observed. Within this approach, the starting point can only be the subjective experiences of us, humans, who construct our individual *mental models of reality* with the aim at fully understanding and controlling the world where we live. These individual mental models are then confronted with each other within human societies giving rise to “objective common views” which, in turn, are influenced by individual views in a “loop” of increasing knowledge where the objective *model of reality* becomes always more precise in collectively representing the world’s behaviour.

If the start of the loop of knowledge is necessarily the individual subjective experience, the start of the overall process bringing humans to construct their (individual and social) models of reality lies much beyond them and may be related to the way the universe has evolved giving rise to the observed organization of matter and, finally, to the presence of living systems, aware of themselves and endowed with consciousness. A cosmological model of evolution well suited to this purpose is the Eakins & Jaroszkiewicz Quantum Universe. Besides being fully compatible with the endo-physical point of view, this model has the form of a general *rule of the rules* governing the global self-evolution of the universe towards various organized forms and where, in some cases, semi-classical observers may emerge as the result of increasing complexity. In such a scenario, the reduction from higher to lower rank rules is epistemologically possible only on a probabilistic basis, thus providing a “*probabilistic determinism* view” which leaves consistent room for the human sense of free will, in contrast with the Laplacian mechanistic determinism where free will is not allowed.

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