PHYSICS, CONSCIOUSNESS AND TRANSCENDENCE

The physics of Roger Penrose and David Bohm as regards a scientific explanation of the human mind open to reality

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ABSTRACT: The works of David Bohm and Roger Penrose *per se* represent a major contribution to the study of physics and consciousness. It is not an easy task to engage in rigorous analysis of one of the most profound philosophical-scientific problems; namely explaining the nature of consciousness. This article explores the global vision that emerges from Bohm and Penrose's approach to physics and consciousness. It focuses on examining the way in which their respective physical-metaphysical proposals can be bound together in a general model, thus shedding more light on the phenomenological characteristics of consciousness. The philosophical consequences of this model are closer in many respects to the experience of transcendence as described in religious works. What emerges is a unitary image of man in the cosmos that harmonises notions of mind and matter, open to a transcendent connection between the conscious subject and reality.

KEY WORDS: mind, determinism, emergentism, intuition, holism, microtubules, quantum gravity.

Física, conciencia y transcendencia

RESUMEN: Las obras de David Bohm y Roger Penrose representan *per se* dos contribuciones de orden mayor al estudio de la física y la conciencia. No es una tarea fácil abordar con rigor científico uno de los más profundos problemas científico-filosóficos; a saber, la naturaleza de la conciencia. Este artículo explora la visión global que emerge desde el acercamiento de Bohm y Penrose a la física de la conciencia. Se centra en el examen de la forma en que sus respectivas propuestas físico-metafísicas pueden converger conjuntamente en un modelo general, que pueda explicar mejor las características fenomenológicas de la conciencia. Las consecuencias filosóficas de este modelo están en muchos aspectos más cercanas a la experiencia de transcendencia tal como es descrita en las obras religiosas. Lo que emerge es una imagen unitaria del hombre en el cosmos que armoniza una idea de mente y materia, abierta a una conexión transcendente entre el sujeto consciente y la realidad.

PALABRAS CLAVE: mente, determinismo, emergentismo, intuición, holismo, microtúbulos, gravedad cuántica.

Consciousness is a phenomenon and a problem. The phenomenon of consciousness indisputably refers to man as a subject open, from both a psychic and physical point of view, to reality. Equally, consciousness is a problem as we are unable to explain this psychic, experiential and subjective phenomenon in relation to the biophysical, experimental and objective environment in which it is manifested. This is the so-called psychophysical problem of the mind-consciousness. There is currently no clear solution to the problem of consciousness; a conundrum that dates back to the origins of the history of philosophy, despite attempts by eminent thinkers such as Aristotle, Descar-

tes, Kant, Hegel and Husserl. At the beginning of the twenty-first century consciousness remains an enigma. From classical dualism of body-soul and positive-materialist reductionism we now move towards a new paradigm that, without becoming engulfed in an attempt to explain reality from fundamental material bases, seeks to provide a scientific understanding of psychism within a evolutionary and unitary framework in which structures, the morphology and function of which are irreducible to the material properties of other physical regimes, emerge, that is say emergentism.

As the physical properties of the quantum regime cannot be understood through Classical-Mechanist epistemology, we maintain in this article that the phenomenon of consciousness has proven a problem in the history of thought as the emergent properties of the quantum regime of matter have been long relegated to the margins. Roger Penrose and David Bohm are pioneers in the discussion of the physical problem of consciousness. Their illuminating contributions open out ingenious avenues of thought from which to approach the problem of consciousness by adopting an epistemology that closely resembles emergentism in their in-depth exploration of pyschophysical, global, unitary and coherent reality. This article ends with a consideration of the transcendent dimension of man, in the light of the Bohm-Penrose physical model of consciousness, which lends support to a rational interpretation of religious phenomenon.

1. The physical dimension of the phenomenon of consciousness

In contrast to a physical particle or a biophysical structure, consciousness is more resistant to objectiveness and the rigours of experimentation. We cannot measure its mass, length or charge as if it were an electron. When we study a cell we can verify its weight and surface area, and even analyse the charge of the respective ions involved in an osmotic process; but it is more interesting to examine the functionality of its membrane, of its endoplasmatic structures or the genetic material stored in its nucleus. The continual formation of the membrane, the collective dynamics of the cytoplasm or the nuclear changes during cellular division constitute biological processes governed by physical-chemical changes, the functionality of which is more important than mere quantitative data on its principal physical dimensions. At this level of sophistication of matter purely physical properties are less important than the function performed by the total matter organised in the cell. Even though physics has shown us that a cell is composed of electrons and quarks, scientific study of the same is approached from new material structures which, at a cellular level, are considered to be fundamental. The biophysical properties of these structures differ qualitatively from the physical attributes of the elemental particles and their functionality cannot be explained by corpuscular mechanicism in a strict sense. Matter has organised itself, reaching a level of cooperation that permits biophysical functionality.

The physical study of matter makes way for biophysical analysis in biological structures. Historically, consciousness has been seen as a problem as a scientific approach to the phenomenon has not been discovered. We cannot take a sample of consciousness, dye it and examine it using a microscope or on a microscope slide. Nor can we give a full account of it by examining its constituent physical particles in detail. Faced with these seemingly insurmountable difficulties, dualists have opted to consider the nature of consciousness as a soul that is essentially distinct from matter thereby initiating a strand of thought parallel to that of material scientific thought. Such contributions can be evaluated from the standpoint of rationality, logic and internal coherence but they can never be assessed scientifically, as they have positioned themselves in an epistemology outside scientific praxis. Science can provide alternative explanations but it cannot refute dualist affirmations, as they are based on a spiritual principle that is orthogonal to material empiricism.

A scientific approach to the study of consciousness does not necessarily require a physical reduction *ab initio* of consciousness to particles and fundamental interactions, as physical science per se understands that the fundamental element depends on the energy level involved. Consciousness is manifested at a psychic level, in which the collective dynamics of a group of biophysical systems capable of functioning psychically is the most important element. Breaking down this psychic architecture in biophysical systems and then into physical constituents does not provide us with any clues about the nature and functioning of consciousness. The dualists would argue that a reductionist dissection of this kind neglects the fundamental psychic principle. In order words such approach would fail to discover the matter of consciousness. In the same way that life cannot be broken down to amino acids as vital elements, consciousness cannot be reduced to a basic material element of consciousness. Scientific research into consciousness requires accepting the emergent nature of the properties of matter. Physical matter is capable of organising itself until the properties of the living matter emerge and, at a higher cooperation level, produce the emergent psychic properties manifest in higher animals. Matter produces consciousness as a result of global cooperation, which cannot be explained from an exacerbated corpuscular atomism. Indeed, it would not be a scientific option if these emergent properties of matter were not supported by phenomenological approaches.

The phenomenon of consciousness is manifested in living beings endowed with a complex psychic system, stemming from the biophysical development of matter. Conscious states are produced by a psychic subject with a living material body, which is sufficiently well organised and evolved to feel, perceive and interpret reality. In other words, a material organism that feels the energetic pressure of the physical environment. Focusing on this physical side of the phenomenology of consciousness implies testing the rational hypotheses followed in order to explain what is observed, pursuant to scientific laws, and proposing an explanatory model based on existing scientific theories. For this purpose, we describe below the physical phenomenology of consciousness outlined by Bohm and Penrose, highlighting several psychophysical correlations guiding physical

research into animal psychism within an emergentist scientific paradigm. We conclude discussion of this first point by formulating a phenomenological hypothesis on the structural and functional unity of consciousness.

1.1. *Physical phenomenology of consciousness in Roger Penrose*

Any scientific explanation of a fact of nature such as consciousness requires a detailed observation of its phenomenology, that is, the sum total of its inherent characteristics. Thoroughgoing knowledge of phenomenology of the consciousness is needed in order to identify the best course of action to take in order to build a model to explain such a commonplace and enigmatic phenomenon. The richer the phenomenological content of the consciousness is, the more fertile the scientific *explicandum* will be and, as a result, the higher the probability will be of achieving a general *explicans* free of epistemological bias (stemming from prioritising certain phenomenological points over others). It is therefore advisable to outline the phenomenology of the consciousness as perceived by a range of scientists from the fields such as psychology, epistemology and neuroscience. Without losing sight of the phenomenological nuances of these sciences, in this article we have elected to focus on the physical phenomenology of consciousness; physics being the paradigmatic science par excellence, as by concentrating on the physical dimension of consciousness it is possible to evaluate the reasonableness of scientific research that does not involve reductionism as an alternative to dualism.

The works of Roger Penrose, physicist-mathematician from the University of Oxford who worked with Steven Hawking on black holes and quantum gravity, address the physical phenomenology of consciousness on a number of occasions [1]. Throughout his works [2], amid arguments against reductionists and dualists, or intercalated in the exposition of his physical model of the mind, we find characteristics that define the phenomenon of the mind precisely as Penrose sees it himself. Attributes of the physical nature of the mind abound in this phenomenology. Hence Penrose's approach to physical phenomenology is of interest here, especially given the eminence of the author and the importance of his publications.

The main phenomenological feature of consciousness highlighted by Penrose is the psychophysical connectivity of the mind, closely linked to matter. Consciousness is shown as a phenomenon exclusive to psychic subjects endowed with an evolved living material structure. There is no phenomenological evidence to alert us to the presence of a consciousness other than the psychobiophysical structures that produce it. Consciousness emerges from matter and there is no phenomenological consciousness without matter. But it does not follow that all material reality is conscious. It is evident from the way in which matter is manifested in the world that most matter is nonliving matter without psychic activity. When we consider the phenomenon of consciousness, a psychobiological

[1] Cf. R. Penrose, *The Emperor's New Mind* (Oxford, Oxford University Press, 1989).
[2] Cf. R. Penrose, *Shadows of the Mind* (Oxford, Oxford University Press, 1994).

unity can be observed that defines a second phenomenological feature. Consciousness manifests itself as the product of the psychic and biophysical cooperation of specific biological structures grouped together in a unitary psychic architecture governed by physical processes. There is no consciousness without a nervous system, there is no brain without neurones, there are no neurones without biological structures and there are no functional biostructures without physical processes. Consciousness appears as a unitary psychobiophysical phenomenon in which it is not possible to separate clearly psychic elements from biological or physical ones. This psychobiophysical unity leads us to the third phenomenological feature, which is highlighted through the high degree of correspondence between the psychobiophysical structures of consciousness and physical changes in the environment. By interacting with the physical environment the psychobiophysical being becomes a psychic subject that feels conscious of being an individual in a physical environment through the biophysical body. The psychobiophysical subject perceives consciousness as a highly ordered state, integral to his biophysical psychism, which enables him to go beyond stimulus-response behaviourism, following less predictable behavioural patterns of a more unitary and personalised nature.

These three phenomenological features together form the pyschobiophysical structural unit of the conscious subject; notions shared in large part by David Bohm, another eminent physicist whose ideas we outline next. It is worth noting that Bohm's approach here is less specific than Penrose's as he stresses the indeterminist, non-computability of consciousness. The conscious thought of psychobiological subjects possesses higher qualities distinguishing it from the computable processes of a computer. Although the psychobiophysical subject issues a range of regular automatised responses in order to survive in the environment (automatisms), the richness of conscious behaviour manifests other phenomenological qualities that cannot be reduced to computable processes and do not require specific responses for survival purposes such as affiliation with beauty and truth (intuitionisms). Penrose refers to ethical judgements, aesthetic activity or the search for the meaning of existence. He particularly stresses those blissful moments when the mathematician finds a way of advancing his reasoning effectively, intuitively, incapable of anticipating the advent of the same. During such instants the past and the future overlap in a prolonged present, thus enabling us to experience coherence and unity.

1.2. *Physical phenomenology of consciousness in David Bohm*

Following a different and complementary line to the phenomenology of Penrose, David Bohm underlines the holistic nature (experiential, spatial and temporal) of consciousness, departing from a psychobiophysical foundation, resulting from the natural evolutionary development of primal matter affected by physical and psychic activity. Bohm, an influential American physicist, chose to address this issue and managed to tackle the problem of physical determinism handed down by Albert Einstein with greater success. Bohm ended his days

working on the physical nature of consciousness at *Birkbeck College* (University of London)[3]. His phenomenological analysis centres on the holistic dimension of consciousness.

Conscious perceptions are characterised by the unity between the observer-subject and the object observed. By experiencing his own body the conscious subject perceives his own psychocorporal unity. He perceives a single organic whole not unconnected parts of his body. The fourth phenomenological feature of this article explores how the conscious subject perceives his body as a non-located sum of sensations, which are synthesised holistically in self-perception. Perception of self entails the creation of a psychic identity or self-consciousness, which opens out to the outer world. Movement through our environment is not perceived as being remote controlled, but as an organic identity that moves through the environment in a relatively autonomous way.

In line with Penrose, as self-perception is consolidated, the individual perceives his body with greater precision and is capable of better directing his will through the environment; thereby reaffirming himself as a conscious individual and the possibility of anticipating in the mind actions that might occur later emerges. The fifth phenomenological feature involves the free action of the conscious individual, capable of anticipating future actions, thinking them over and taking the decision at will. The sixth and seventh phenomenological features concern the conscious subject's holistic experience of space and time. Holistic experience of space is a highly significant remote perception, which consolidates the indeterminism of the conscious individual and the freedom of his operations referred to above in the fifth phenomenological feature. The conscious individual, who perceives the space holistically, is predisposed to accent his temporal sensibility. He is a free individual, capable of performing indeterminate actions to break the shackles of a conditioned present and free himself to the possibility of distinguishing the past from the future, in a phenomenological present in which it is possible to anticipate events. Ordinary, spatial and temporal perceptions are all always mediated by the subject's consciousness. However, we acknowledge the existence of perceptions independent of the epistemological mediation of the subject; these are direct perceptions: what Penrose calls intuition and Bohm refers to as insight, and these make up the eighth phenomenological attribute of consciousness.

The last five characteristics of phenomenological consciousness describe the functional aspects of consciousness. Bohm places special emphasis on the eighth, which he refers to as insight: the holistic experience of reality in which the conscious individual passively receives its true meaning. Man is the psychic individual most predisposed to experience direct perception or insight, thereby becoming a fully cogniscent being, open to knowledge of reality. Just as consciousness knows mediate reality as a psychobiophysical structural unit similar to the environment, the mind opens directly to an understanding of the

[3] Cf. D. Bohm, *The Undivided Universe* (London, Routledge, 1993).

absolute in its transcendent dimension. This higher level of consciousness, cognitive conscious psychism, is an extension of the material biophysical body that becomes conscious of the global meaning of totality and experiences the coherence and internal unity of the cosmos. Subject and object are bound together in an eternal moment bestowing order, clarity and full openness on the mind. In Bohm's terms the individual's mind (conscious, free and observant) is bound with the cosmic mind thus conferring meaning and freedom on the whole. Despite the fact that such phenomenological experiences of harmony and unity are less everyday than other simpler conscious perceptions, they are still psychological verifications ascribed to several different effects, including mystical, psychopathological, psychotropic effects. Nonetheless, they are experiences lived by the conscious psychic subject, which must be explained scientifically.

1.3. *The structural and functional unit of consciousness*

The first three phenomenological aspects of consciousness that describe the psychobiophysical morphological characteristics of the conscious being correspond to the most primitive states of natural evolution. Living beings as simple an amoeba possess a psychobiophysical structuring that is essential to enable it to adjust its responses to environmental stimuli. As the configuration of the nervous system advances, more intense levels of consciousness are displayed, characterised by a holistic perception of the environment, which enhances the survival of the individual enabling it to distance itself from the stimulus-response adjustments of lower animals. For instance a dog possesses a psychobiophysical architecture that is sufficiently developed to enable it to take decisions at will, which are difficult to explain within a strictly behaviourist framework. Here we are referring to the five functional aspects of consciousness. In man the sophisticated psychobiophysical structures widely unfold their psychic potential and predispose the conscious subject to seeing reality fully: both physically and cognitively. Notwithstanding, consciousness is verified as a phenomenon of the material reality that activates in one way or another its functional potential: physical and psychic. In sum, the phenomenon of consciousness manifests itself as a structural and functional unit the goal of which is to perceive reality (physically and psychically), in other words, as the emergent product of psychobiophysical cooperation aiming at full understanding of the whole.

2. The physical problem of consciousness

Phenomenologically speaking, consciousness is the emergent product of a psychobiophysical process in matter. The conscious psychic subject has greater capacity to perceive space holistically, foresee events and choose freely. The harmony between its psychism and the physical world is so great that its perceives intuitions that are key to survival. All these psychophysical relations comprise

the psychic *explicandum* to be explained by science. Driven by the set of psychophysical phenomena of consciousness, physics needs to investigate heuristic proposals that explain conscious psychism. Bohm and Penrose have worked on such proposals based on analysis of the principal physics theories. Each author has focused on an internal problem in physics to initiate propedeutically speculative proposals that explain consciousness physically, that is, an *explicans* that renders the phenomenology of the mind understandable in a scientific framework. In both cases the research concludes that there is something in physical theory per se that needs and, in turn, is projected towards the phenomenon of the mind.

2.1. *The psychic-physical problem according to Roger Penrose*

Penrose's formal approach to the problem of consciousness can be understood based on the phenomenological description he provides, centring on indeterminist aspects of the way in which it functions. Conscious thought, particularly non-analytical mathematical reasoning, reveals behaviour by the consciousness that it is difficult to understand from a strictly determinist position. In relation to the phenomenological issue of the non-computability of consciousness, Penrose poses the internal problems of physics, calling into question the completeness of the science. He stresses the impossibility of constructing a complete physics theory of the physical universe unless elements that explain conscious psychism are included. He highlights three internal problems in physics: *i)* the temporal symmetry of physical theories vs. the asymmetric perception of phenomenological time, *ii)* the absence of a formal explanation of the classical-quantum transition vs. the information that the conscious observer acquires after a measurement of the quantum system, *iii)* General Relativity vs. Quantum Mechanics and its relation with consciousness as a phenomenon between the macrocosm and the microcosm. Penrose's brilliant idea lies in disclosing that the central problem of physics coincides fully with the problem of consciousness and, as a corollary, an explanation of consciousness requires a complete physical theory that integrates non-computable processes. We analyse below each of the psychophysical problems reviewed.

i) *Temporal symmetry vs. asymmetric perception.* The passing of time is a profoundly human conscious experience. Man perceives the temporal flow from past to future: he perceives how he grows older, he recalls past events and projects future events etc. In sum, he orders his life according to a temporal arrow that differentiates asymmetrically the inaccessible past from a future that he cannot remember. This phenomenological experience of time is not covered by the physical theory of time, namely, Relativity.

Since 1905 when Einstein presented the relativity of time measurements by observers in relative movement, nobody has managed to explain the physics of time better. The theory of Relativity, the prevalent theory of time, is a physical-geometric construction that maintains a causal relation between events, without differentiating the past from the future. Relativity determines the evolution of

a system based on environmental conditions. Akin to all local theory, its equations pre-dict the future evolution of the Universe and retro-dict the past based on explicit environmental conditions. No distinction is drawn between the past and the future because there is no temporal flow. Everything is in a vast space of phases that describes every possible physical condition of matter, that is, the combination of all physical events. This phase space is a structure that lacks dynamism. It does not grow or alter. It is always the same, without a temporal arrow. So, how can consciousness of time be explained in a geometric structure without temporal flow? Consciousness requires a physical support for the asymmetric experience of time.

ii) *Classical-quantum transition and the conscious observer.* Alongside Relativity, the Quantum Field Theory is one of the mainstays of modern physics. Relativity is the theory of time and gravity whereas Quantum Theory describes the other physical interactions that govern the microcosm: electromagnetism, strong and weak nuclear force. Despite the descriptive force of these two theories they are incompatible and there appears to be no way of uniting them. At present, no theory of gravity exists that integrates quantum effects: gravity and quantum theories are still irreconcilable. This is a lacuna on the border between classical gravity and quantum theories; that is to say, no quantum gravity theory has been developed yet to explain how the classical-quantum transition occurs between the indetermination of quantum field systems and classical realization of ordinary conscious experience.

In phenomenological terms, consciousness is manifest in living beings with an appropriate psychism, which are part of the physical world halfway up the scale between the quantum microcosm and macrocosm dominated by gravitatory interaction. Psychic experience is found in animals with an evolved nervous system governed by a brain, capable of perceiving the physical pressure of the environment and of producing mental images in psychophysical correspondence. This psychophysical connectivity is displayed in the correlations between psychic states and physical states. Psychic conditions have repercussions on the biophysical conditions, a state of stress causes stomach pains, and vice versa, tooth ache conditions the state of mind. This phenomenological evidence leads to the existence of interdependency between psychic and physical elements.

The study of the mind should not be separated from the study of physics. The problem of the mind involves explaining why physics does not explain the mental reality if it is manifested as an intrinsic property of the physical world. Determinist laws of Classical Mechanics describe the physical regime of ordinary experience. Newtonian mechanics, which is so powerful in determining the future behaviour of gravitatory systems, has not borne fruit in its attempt to solve the problem of the mind. Its determinist epistemology collides headlong with the phenomenological indeterminism characteristic of conscious experience. As there is psychophysical evidence, neither classical nor quantum deterministic physics, cannot reach a scientific resolution of the problem so Penrose adopts a heuristic view that permits a new approach. The indetermination of the classical-quantum transition, the

source of much discussion in quantum physics, could be of interest when it comes to understanding how the consciousness emerges from reality after the process of information analysis of the environment through the senses. If this is not the case, what alternatives do we have? Consciousness requires us to reconcile the indeterminism experienced by the psychic subject and the epistemological determinism of physical theories.

iii) *Microcosm, macrocosm and the phenomenon of consciousness.* The human mind is capable of understanding the space-time structure, the foundation of all material reality, of representing macroscopic physical objects (planets, galaxies, the Cosmos etc.) and understanding the smallest structures of the microcosm (electrons, neutrinos, quarks etc.). Physics explains both the large-scale dynamics of the Universe (General Relativity) and the interactions between basic particles (Quantum Field Theory), supported by a high level of experimental evidence. Existing physical models are excellent at describing both macroscopic and microscopic states but we lack a convincing physical explanation for the psychic process that produces them in the human mind.

Man is halfway between the microcosm and the macrocosm. In phenomenological terms, consciousness is manifested in the psychic activity of biological nervous systems coordinated by the brain. There is no evidence of conscious beings without this psychobiophysical structure. The body does not appear to be a mere recipient capable of storing a psychic entity like the soul as described by the dualist school of thought. Nor can it be broken down into functional, simple components without this being to the detriment of its richness and organic unity. In contrast, experience reveals a unitary mind-body organism with interrelated physical and psychic faculties. The psychic conditions of the individual have an impact on his biophysical states (somatization) and vice versa: toothache conditions state of mind. This phenomenological evidence leads to the existence of interdependence between psychic and physical faculties. Consciousness emerges from the physical world. Therefore rather than separate the study of the mind from the study of physics, it should be integrated in the scientific *explicandum*.

Consciousness is the borderline between the microcosm and the macrocosm. The conscious being is a material psychic subject who lives in a natural environment halfway between the cosmic and the microscopic. On a large scale, the macroscopic universe appears to be dominated by collective, regular and predictable dynamics. In contrast, on a small scale, the microscopic universe is also dominated by collective dynamics, albeit less regular and more unpredictable. The conscious subject lives on the border. As a corollary we can see consciousness as a specific reality of a sector of nature in which the properties of the micro and macrocosms play an important role.

Indeed Penrose has raised these ideas in his book *The Large, The Small and the Human Mind*. The intense connectivity between psychic and the physical faculties, combined with the absence of a physical theory to describe the universe in a unified manner, lead Penrose to suspect that the problem of the mind (a

phenomenon halfway between large and small elements) and the problem of physics (a science with two irreconcilable pillars) are simply part of the same basic problem: the physical explanation of the mind on the threshold of the micro and the macrocosm. Penrose starts the aforementioned study with the hope of resolving the psychophysical problem from a complete theory of gravity that unitarily explains the universe: macroscopic or microscopic, physical or psychic. This theory would necessarily solve both problems. The difficulties in developing quantum gravity, a physical theory with temporal asymmetry or a physical explanation of the mind halfway between the large and the small, are inherent in approaching the same basic problem sectorially. The problems of physics and the problem of the mind constitute the same basic question, requiring advances in physics and neuroscience in order for them to achieve fruitful qualitative development.

2.2. *The psychic-physical problem according to David Bohm*

In broad terms David Bohm agrees with the psychophysical problems posed by Penrose in relation to the problem of consciousness: temporal experience, conscious perception and the consciousness as a phenomenon on the threshold of the macroscopic and the microscopic. While Penrose lays the stress on the formal problems of physics in contrast to the phenomenon of the conscious, Bohm concentrates on the underlying physical/metaphysical questions [4]. Bohm is also fully aware of the confrontation between Relativity and Quantum theory in the spaces where their application as experimental physical theories is put under strain. He highlights the head-on collision between relativist theory, which represents a continuous, local and causal space-time order and quantum theory, which establishes a discontinuous, non-local threshold without a causal explanation. While Relativity establishes a leapless space-time fabric in which each object is influenced exclusively by causes that act locally as disturbance at below the speed of light speeds, Quantum Theory lacks a well-defined substrate that allows for the existence of quantum leaps and remote instantaneous interactions that break with the relativist localness. This purely physical problem is translated into a psychophysical problem linking technical issues of physics with the psychic experience of the conscious subject. The following psychophysical problem can be traced in the works of Bohm [5].

i) *Conscious perception and relativist space-time.* The sum total of perceptions of reality does not lead to the existence of blocks of matter, which are individually separated and independent; rather to a profound reality that is unique and continuous, in which a variety of individual objects emerge, ordered in their totality. In his book *The Special Theory of Relativity* [6], Bohm includes an

[4] Cf. D. Bohm, *Wholeness and the Implicate Order* (London, Routledge, 1980).
[5] Cf. L. Nichol (ed.), *The Essential David Bohm* (London, Routledge, 2002).
[6] Cf. D. Bohm, *The Special Theory of Relativity* (London, Routledge, 1965).

appendix on physics and perception highlighting some of the conclusions of one of the greatest psychologists of the twentieth century, Jean Piaget, drawn from his studies on child psychology. Piaget contends that the structure of the knowledge of a child differs greatly from the outcome of his later development in adult life. An infant experiences and perceives in a virtually undifferentiated whole. Initially the child simply possesses a series of reflexes that enable him to distinguish certain smells, movements and pleasurable objects, which are essential to his survival. Gradually the infant learns to follow objects with his eyes and recognise the invariant shape thereof during movement. Through movement of objects and handling of objects he discovers the basic properties of space in which each body occupies a place, which can be modified as a result of movements in different directions. Finally, the child is capable of representing the absent object by evoking an image in his memory.

As he reaches maturity, man interprets his actions based on the mental suppositions of his childhood, consolidated through his experience over time and constantly corroborated intersubjectively through language, experience and concepts. The adult has empowered to such an extent a particular way of perceiving the physical world that he interprets it quickly according to these mental reflexes without intelligence intervening. Objects from the physical world are represented according to the individual perspective and knowledge of the observer. In general, objects are ordered following a three-dimensional Euclidean geometry. Einstein's theory generalizes Newtonian space-time concepts and therefore limits the supposed universality of the system of *evident* perceptions in accordance with the three dimensional Euclidean geometry of space adopted by Newton. Relativist space-time geometry differs substantially from the standard geometry of perception in which the objects of reality are ordered in Euclidean way.

Furthermore, there is a difference between the simultaneous observer-observable nature of perception and the relativist laws of space-time. When we look at the sky on a starry night we do no see a unique present of stars simultaneous to the observer. The image perceived corresponds to the star of the observer's past which generated particles of light received through the retina in future time for the star. The sensation of absolutely universal present of the observer is contrary to the relativist suppositions on simultaneity. This simultaneity is the consequence of the imperceptible time that light takes in communicating two regions of ordinary life. The validity of the common sense of the experience of absolute space and time is the consequence of the negligible time light takes during an everyday process. The conscious idea of a singular temporal order that permits us to order events in time in absolute terms and generate concepts of past, present and future can only emerge under this physical low-speed regime where life occurs. As soon as one leaves this domain of validity empirical security disappears.

ii) *The experience of free will and physical determinism.* A strictly determinist universe is far from compatible with the idea of free will perceived by conscious beings. The mechanicist determinism of classical physics, either in its microscopic-

individual or macroscopic-statistical version, is a long way from being able to explain phenomenological characteristics of consciousness such as intuition, the ethical dimension or free will. The psychic experience of control over the body, of governing it at will through the environment, and the sensation of being able to decide by taking part in the natural dynamics of physical phenomena, contrasts with the determinism prevalent in physical theories. The unitary evolution of a quantum state and the dynamics of a relativist event are both strongly conditioned by laws that predict in a determinant way a state or future event based on the previous environmental conditions.

Bohm reviews the evolution of Newton's mechanics by centring on the problem of determinism [7]. Departing from the most deterministic Newtonian mechanics proposed by Newton, Laplace and D´Alambert, Bohm shows how in an evolutionary sense physical theories do not concern themselves with determining the conditions of speed and the position of the systems of many bodies, and focus instead on statistical questions of wholeness, which suffice to describe thermodynamic phenomena accurately. We refer to nineteenth century Statistical Mechanics, in which determining the microscopic features was seen as critical while ensuring that the rigour or accuracy of the statistic predictions was maintained. The notion of statistical fluctuation did not sit well in a classical epistemological framework, as there was not a corresponding objective material entity. However, said thermodynamic fluctuations do exist in other physical contexts and can be predicted statistically with a high level of experimental accuracy. If this is so, as experiments have proven, it shows that the observable macroscopic physical properties emerge from the action of the totality of the physical constituents, regardless of the exact position and speed of each individual particle in the system. The global dynamics are therefore more important than individual ones. And hence the physical observables are products emergent from an interaction of the whole in which the importance of the dominion of the strictly corpuscular is diluted.

The canonical epistemology of quantum theory invalidates any reference to causal laws that might predict well-determined results. Heisenberg's Principle of Indetermination blocks the classical dream of being able to predict the future of a physical system based its environmental conditions. It is not possible to measure simultaneously with complete accuracy the position and speed of its constituents. As a result it is necessary to disregard the classical concept of trajectory in favour of the idea of quantum leaps. A quantum leap, the realization of a state of quantum indetermination over a classical state, creates an opening in physical indeterminism, which is more compatible with the psychic sensation of freedom.

Physical indeterminism and the sensation of freedom depended on the quantum fluctuations that realize classical states from quantum dynamism. The epistemology of the Copenhagen School eschewed an interpretation of the causes

[7] Cf. D. Bohm, *Causality and Chance in Modern Physics* (London, Routledge, 1957).

of quantum indeterminism, maintaining an instrumental concept of the quantum leap. It was Bohm, in line with De Broglie's proposals [8], that put forward a causal, physical-metaphysical explanation of the dynamic activity of the quantum void. Both propose that matter evolves by virtue of its own energy driven by *active information* transmitted via a quantum pilot wave. The matter has the capacity to move (energy), controlled by means of potential energy which informs it how it should activate itself. His 1952 interpretation [9] on the hidden variables that regulate these processes mistakenly categorised Bohm as a determinist of the Einstein school. Bohm, who accepts the validity of the Uncertainty Principle, states that the result of an individual physical process is unpredictable —in line with Bohr and the positivists—, but he argues that a (physical-metaphysical) causal explanation of the processes that produce the classical realization of a quantum system is plausible.

Bohm assumes the existence of subquantum variables that cause quantum disturbance. Rather than coming from pure physics this hypothesis serves as causal-ontological complement from which to gain a better understanding of quantum phenomena. In this sense, the Heisenberg Principle is considered the expression of the minimal degree of indetermination that is accessible in the quantum order, but this level could be reduced (not eliminated) in a non-manifest subquantum order, in other words, a metaphysical one. Bohm seeks to analyse which aspects this subquantum dimension should possess in order to explain the characteristics of the quantum world. This ontological concept is coherent with the sensation of free will, as is the proposal of pure quantum fluctuations. Notwithstanding Bohm's idea on active information that directs the matter that floats in a quantum chaos at will seems much more plausible as regards accounting for freedom of choice.

iii) *Stability of conscious experience and dynamism of the quantum content.* The Planck scale, in which quantum and relativist laws are expected to fail, presupposes the existence of a single flowing motion in which quantum disturbance is so high that it is impossible to conceive Einstein's gentle space continuum. Instead it suggests that a new quantum space-time order would emerge with a highly intensive flowing activity that would lead to the constant formation and destruction of microstructures. This quantum space-time would behaviour as a swarm of matter where space-time twists and turns in angular shapes that in fold in on one another.

In phenomenological terms, states of consciousness appear as a holistic experience. Conscious perception is not seen as an active point enclosed in the brain but as the outcome of the organic coordination of the corporal whole. The stability of consciousness in particular, which offers a stable, coherent and

[8] Cf. P. R. Holland, *The quantum theory of motion: an account of the Broglie-Bohm causal interpretation of quantum mechanics* (Cambridge, Cambridge University Press, 1993).

[9] Cf. D. Bohm, «A suggested interpretation of the quantum theory in terms of hidden variables», *Physical Review*, 85 (1952), 166-180.

unitary image of reality, and of the observable physical world in general, contrast sharply with the dynamic nature of the energetic quantum content as described in physics. How does classical stability emerge from such a chaotic quantum order? How is the stability of the conscious perception possible in underlying quantum dynamism?

This question led Bohm to explore in greater depth the study of the physical/metaphysical properties of subquantum ontology. According to Bohm the essential foundation of nature is its unceasing activity. Every motion and everything is created through motion: matter, life and psychism (sensations, perceptions, thoughts etc.). Nothing of a material nature can exist outside this creative activity called holomovement: the movement of the whole. As a consequence, life and psychism are not explained through abstractions of the whole. The multiple explicit manifestations of matter simply represent the different outcomes of unfolding a single implicate order that is infinitely connected. In Bohm's holistic framework, the implicate order, which is essentially dynamic, is a metaphysical substratum that enables us to explain coherently the psychophysical unity based on the movement of the whole. The physical world remains in direct relation with the movement of the underlying universal order. Physical objects are structures arising in the implicate order, which are *dissolved* again in the same. In this holistic framework, things are merely abstractions of an indivisible whole; the essence of which is movement. If consciousness emerges from this whole as the total sum of physical phenomena, then it must draw on the quantum ontology that sustains reality and submit itself to processes of classical realization that stabilise perceptions, in accordance with the stability of the macroscopic physical order.

2.3. *Ontological and formal perspectives of the psychophysical problem*

Up to this point we have emphasized the psychophysical, phenomenological and formal correspondences between consciousness and the physical world. Consciousness appears as a phenomenon affected by physical determining factors, moreover, the internal problem of the unity and coherence of modern physics reflects in many ways the physical problem of consciousness. For this reason authors such as Penrose have sought to link the questions surrounding physics and psychism in a single psychophysical problem of consciousness by analysing the formal aspects of the incompatibilities of physics with the formal characteristics of the phenomenon of consciousness. In pursuit of this goal, Penrose seeks a complete theory of quantum gravity that necessarily integrates the physical mechanisms of consciousness in order to be able to formulate a unitary and coherent image of the physical and psychic universe as a whole. The implementation of quantum rudiments in the biophysical being that produces states of consciousness, represents an intellectual enterprise that intrinsically links psychophysical matter and quantum gravity with the Big Bang. To some extent, Penrose's worldview anticipates the material psychophysical unity that Bohm would explore in greater depth, at the risk of crossing from one side to the other of the diffuse physical-metaphysical border.

In his in-depth exploration of the problem of consciousness, Bohm stresses fully the ontological nature of matter in order to be able to understand psychobiophysical reality. In Bohm's thinking, the problem of consciousness can be summed up to a large extent as a search for the causes that activate physically and psychically the psychophysical potential energy of matter. The underlying ontology is an incessant energetic activity with quantum properties, as endorsed by fundamental physical results and theories. This underlying metaphysical order is called the implicate order (enfolded), in contrast to the total sum of physical phenomena that constitutes the explicate order (unfolded). Bohm aims to explain the interrelation between the physical and psychic phenomena of the explicate order, based on the ontological mind-matter unity of the implicate order. The unfolding of this enfolded psychophysical wholeness is produced globally in time to the holistic movement or holomovement as Bohm calls it. Seeking to explain the causes of physical and psychic phenomena, as well as their mutual psychophysical relationship, is an intellectual endeavour that intrudes on metaphysical ground, armed with scientific data and theories. This ontological venture, of a clearly holistic nature, complements the formal proposal made by Penrose in order to understand the phenomenon of consciousness in relation to the physical properties of material nature.

3. Physical explanation of consciousness

Given the phenomenologies of Bohm and Penrose's consciousness, as well as their respective studies of the internal problem of physics related to consciousness, in this section we proceed to explain their respective explanatory models. Penrose drew up his model in collaboration with the American anaestheisist Stuart Hameroff[10]. It involves the implementation of physical concepts in biological and neurological systems that in coordination could explain consciousness as the product of special psychobiophysical architecture[11]. We will refer to this as the Penrose-Hameroff model. In addition, we will outline the physical/metaphysical contributions made by Bohm. These are intuitive ideas, of a marked holistic nature, which shed light on the common nature of physical and psychic processes. Although Bohm did not construct as detailed an explicit model as Penrose's, his ideas are particularly interesting and complementary to those of Penrose-Hameroff. Hence we end by highlighting some of the key complementary ideas in a joint model that it is better equipped to comprehend the total sum of phenomenological characteristics of consciousness, namely the Bohm-Penrose-Hameroff (BPH) model. The BPH model is a heuristic interpretation of consciousness, which draws

[10] Cf. S. R. Hameroff and R. Penrose, «Orchestrated Reduction of Quantum Coherence in Brain Microtubules: A Model for Consciousness», in S. R. Hameroff, A. W. Kasniak and A. C. Scott (eds.), *Toward a science of consciousness I*, 507-542, Massachusetts, MIT Press, 1996.

[11] S. R. Hameroff, *Ultimate Computing. Biomolecular Consciousness and NanoTechnology*, Tucson, Personal edition, 2003.

on the observations and physical theories in Bohm and Penrose-Hameroff's contributions and brings us closer to reaching an understanding of the mysterious nature of psychophysical matter.

3.1. *The Penrose-Hameroff model*

From a mathematical point of view, Penrose's motivation behind constructing a physical-mathematical model of consciousness stems from the existence of non-computable mathematical structures, which could serve as a formal structure to explain the non-computational behaviour of the mind. His model is closely related to the quantum space-time geometry based on a fundamental physical-mathematical postulate, that is, the nullity of the Weyl tensor in the Big Bang. The peculiar geometry of the Big Bang, the nullity of the Weyl tensor, permits us to link the theory that describes space-time dynamics (General Relativity) with the Second Law of Thermodynamics and explain both the high level of order of the primitive physical universe and its temporally asymmetric nature.

From the Big Bang to the present day all physical processes have been evolving towards more disordered states, thus enabling us to define a temporal arrow that distinguishes objectively between today and yesterday. Penrose relates this temporal asymmetry of physical evolution with an aspect of quantum theory that lacks physical foundation: the temporally asymmetric reality of the non-unitary reduction of the quantum state. The irreversible transition of the quantum regime to the classical one involves a decrease in the entropy or disorder of the physical system, caused by a sufficiently intense fluctuation in space-time geometry. This gravitatory disturbance leads to an increase in the entropy that offsets the decrease produced in the quantum-classical transition and generates a global increase of the total entropy of the system, in accordance with the Second Law. Thus, Penrose constructs a quantum-gravity theory of a thermodynamic nature, which explains objectively the reduction of the quantum state as a physical distinction of *before* and *after*. In sum, it provides a physical explanation of the conscious temporality of physical events, based on a model depending on non-computable quantum/gravitatory fluctuations.

Penrose aims to explain consciousness as the evolutionary outcome of the physical geometry prior to the physical universe. After verifying the total sum of phenomenological characteristics of consciousness, belonging to the structural block, he seeks biophysical structures capable of producing coherent quantum states. He enters the new field of quantum neurology in which formal elements are integrated to provide a better explanation of the functional indeterminism of consciousness. Departing from a Fröhlich's study of states of quantum coherence and particularly the work by Hameroff [12] on the analysis of neuronal microtubules and associated proteins (MAPs), Penrose develops a neurological quantum model of consciousness.

[12] Cf. J. Tuszynski (ed.), *The emerging physics of consciousness* (Springer-Verlag, Berlin, Heildelberg, 2006).

Microtubules are self-assembling hollow crystalline cylinders, 25 nanometers in diameter on the outside and 14 nanometers on the inside, found in the cytoplasm of nearly all animal and vegetable cells. Each microtubule is a polymer of globular proteins known as tubulins, 8 nanometers long and four nanometers wide and deep. Each tubulin has two conformational states, being able to jump from one state to another with ATP energy. Microtubules are hollow cylindrical structures well isolated from the noisy thermal environment of the brain. The structure, dimensions and sophisticated isolation of the microtubules make them the principle biological element of the Penrose-Hameroff model of consciousness. These characteristics permit the formation of collective quantum states among the tubulins. During the pre-conscious state, the quantum connection of the tubulins permits a quantum processing of sensorial information, governed by unitary laws of Quantum Mechanics. This stage is dominated by macroscopic quantum coherence phenomena that connect the microtubule tubulins, or even microtubules, cytoskeletons or different regions of the brain. During this pre-conscious phase the MAPs (microtubule-associated proteins that bind their internal action with the cellular environment) locate themselves in strategic position so as not to interrupt the coherent quantum dynamics of the processing. Each MAP will occupy a node of the wave function until objective quantum reduction occurs, caused by gravitatory disturbance of these proteins.

The functional indeterminism of consciousness is explained based on the movement of the MAPs which, when displaced from the wave function nodes, disturb the system in a gravitatory sense inducing a quick transition of decoherence in the microtubules, until the realization of the conscious classical state. Out of all the possible quantum biophysical states during the processing phase, the psychobiophysical system becomes the only conscious classical state, which coincides with the start of a new quantum processing of information, followed by a different conscious state. The reduction process of the state of quantum superposition of the tubulins that produces the conscious state is directly related to the non-local nature of the energy in General Relativity. The gravitatory energy disturbance that initiates the collapse of quantum processing in a conscious state after the MAPs move is not localised; it is phenomenon that, like a gravitatory wave, that is delocalised throughout space favouring the appearance of non-local interactions. This gravitatory distance breaks the temporal physical symmetry; it produces an objective reduction in the quantum state and generates a temporal arrow related to entropy and the information that can be obtained from a system, mirroring what must have happened in the process of formation and creation of physical structures after the Big Bang [13].

In synthesis, according to the Penrose-Hameroff model, consciousness is the biophysical product of quantum cooperation between microtubules, which connect distinct regions of the brain in a quantum way. The isolation of the

[13] Cf. R. Penrose, «Gravity and state vector reduction», in R. Penrose and C. J. Isham (eds.), *Quantum Concepts in Space and Time*, New York, Oxford University Press.

microtubules means that the physical information from the environment can be processed until the realization of a neuronal engram correlated with phenomenological psychic experience. This quantum-classical transition between the preconscious and conscious state is mediated by the MAPs, which originate an objective reduction orchestrated from gravitational disturbance. The brain therefore operates in a quantum and unconscious way most of the time until the MAPs induce a process of decoherence when quantum uncertainty has been resolved. Then the brain can produce a psychic image of the reality it perceives physically.

3.2. *Bohm's physical/metaphysical proposals*

Interest in Bohm's interpretation of the phenomenon of consciousness is growing as more and more scholars become aware of the ontological problem between space-time relativist physics and quantum physics. The physical phenomena of quantum coherence and non-local action provide such unity to the physical universe that they spurred Bohm in his search for a metaphysical ontology to explain the surprising coherence of the physical order, as well as to generalise the laws proposed by the physics in favour of a single holistic physical/metaphysical connection. His work has focused on searching for an ontological structure that causes psychophysical phenomena stemming from a coordinated global movement: the holomovement that generates an unfolded phenomenical order. In this holistic ontological structure, mind and matter form an indivisible part of a single metaphysical reality of implicate orders with various degrees of consciousness.

Bohm explains consciousness as another intrinsic property of this ontological content that shows its psychophysical potential energy by unfolding in the holomovement [14]. Consciousness cannot be separated from the movement of matter. It is another element of the universal dynamics of mind-matter. Mind-matter of the psychophysical universe has been interlinked with the temporal dimension of the explicate order, but its ontological nature is essentially atemporal. Beyond the ordinary perception caused by the energy of the explicate order, the psychic-material subject can transcend the temporality of the world and become conscious of the universal wholeness after experiencing a direct perception or insight caused by the action of the cosmic mind on psychism. The psychic material subject is therefore open to envisaging the integral unity of existence and discovering its real psychic identity in the transition of the determinist thought mode to the intuitive consciousness mode.

Bohm introduces the concepts of super-potential energy and quantum potential energy as physical-metaphysical links that concentrate energy to synthesize particles from the implicate energy content and guide them thereby

[14] Cf. M. BÉJAR, «Conciencia, creatividad y libertad: sobre la naturaleza creativa libre de la conciencia en la correspondencia entre David Bohm y Charles Biederman», *Pensamiento* (in press).

permitting their association in macroparticles. Each particle is therefore the explicate outcome of the joint action on a universal content of energy of quantum potential energies. The quantum super-potential energy operates on the cosmic sea of energy to generate a multidimensional implicate order that unfolds to form a temporal phenomenical order of particles with three dimensions (strictly spatial). The quantum potential energy's action on these synthesised particles from the implicate order explains the oscillating, field and potentially unitary nature of the physical order: waves, fields, macro particles etc.

Consciousness is the emergent product after the quantum binding between multiple neurones from different parts of the brain. The conscious experience is a qualitatively novel phenomenon that emerges when the brain operates holistically as if it were a single macro neuron [15]. In this special quantum state the brain is governed by the quantum potential energy, which maintains quantum coherence. In Bohm's terms the brain would behave like the implicate order: dynamic, coherent and unitary. In this way, the brain could be affected by the implicate cosmic order and would experience (beyond space-time) the action of the cosmic mind, namely, insight. The quantum super-potential energy would serve to undo the quantum coherence of the brain, making it operate classically and producing the state of consciousness. In synthesis, Bohm's model is best described as metaphysics of the physical nature of consciousness which concerns itself with applying the ontology of the cosmos to the individual mind. In our view, these holistic intuitions are more fruitful in collaboration with the biophysical structures of the Penrose-Hameroff model, constituting the so-called Bohm-Penrose-Hameroff (BPH) model.

3.3. *The Bohm-Penrose-Hameroff model*

The biophysical explanation of consciousness in the Penrose-Hameroff model is based on the coherence wave in the microtubules' tubulins. This model can be enriched by the physical/metaphysical ontology of Bohm, better suited to explaining the holistic functional aspects of consciousness.

If the coherence wave in the microtubules is represented as a pair of coordinated axes, the x-axis represents time and the y-axis the level of internal quantum coherence or Bohm's quantum potential energy. At any given time, say zero time, the tubulins are in a classical state forming individual entities: a classical system of multiple tubulins in classical interaction described by null quantum potential energy. As time passes, a quantum interaction begins to take place, supported by psychism in the implicate order, defined by a finite value of the quantum potential energy. In a few tenths of a second, the quantum potential energy has intensified to such an extent that the physical states of the tubulins begin to acquire quantum properties, in other words, coherence superposition states emerge.

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[15] Cf. D. Bohm and B. J. Hiley, *The undivided universe* (London, Routledge, 1993).

As these individual quantum states are consolidated, the growing intensity of the quantum potential energy leads to the interlinking of the tubulins' quantum states, which lose their identity to become a coherent microsystem capable of processing in a quantum way the physical information gathered by the senses. In less than half a second, the psychism reaches the highest degree of coherence accessible biophysically and saturates: quantum potential energy is maintained more or less constant. In this phase, psychism resembles the implicate order. It is a mind-matter system with maximum internal coherence, limited by the constraints of the biophysical matter itself. In other words, the quantum potential energy saturates at a finite limit because the matter it is composed of is in degenerate state in comparison to primordial matter, unaffected by entropy, from the Big Bang. Thus the holistic intuitions of Bohm and Penrose's geometric proposals are connected in the Big Bang.

Unless another action mediates, the system would maintain its internal coherence until the thermal chaos of the environment causes quantum decoherence. Hence the chance ordinary quantum reduction of the phenomena belonging to the physical world would occur. The action of the super quantum potential energy prevents this thermal reduction and permits the orchestrated gravitatory reduction. As the levels of quantum potential energy are saturated in the psychobiophysical system, the super-quantum potential energy regulates the displacement of the MAPs prior to the formation of the conscious state. The active information from the super-quantum potential energy causes the MAPs to move, resulting from the energy from the biophysical system, towards positions that modify the internal gravitatory energy. The resulting increase of gravitatory energy, above the elemental quantum of gravity, initiates the induced decoherence phase that concludes with the formation of the conscious state. As a consequence, psychism (Bohm's individual mind) is connected to the temporal reality of a world subject to constant change thus favouring a generalised increase of entropy. The information produced by the psychic subject on perceiving consciously a specific external reality, from the wide variety of virtual quantum realities that exist during the quantum process of sensorial information, represents a decrease in the entropy, offset by the increase in the gravitatory entropy in the quantum-gravitatory collapse orchestrated by the MAPs. This serves to explain the temporal experience of the psychic subject, which distinguishes the memory of the past from the unpredictable nature of the future.

The psychic changes caused in the brain by these perceptions during a more or less atemporal phase need temporal consciousness in order to be consolidated as conscious experiences that are capable of modifying conduct or action. Conscious experience, as we observe it, requires psychism to remain interlinked with time. The temporal connection of the psyche reproduces the large-scale primordial binding of the explained cosmic order, after the development of a disturbance in the implicate order, consolidated by the super-quantum potential energy. The functioning of psychism, constituted over time in an evolutionary way, is regulated by the same guidelines that have existed since the Big Bang.

Just as the explained order of the psychophysical phenomena reached relative independence from the implicate orders, consciousness needs to be partly disconnected from the coherent integrity of underlying orders. The action of the super-quantum potential energy is essential to cut short the coherent processing of the brain and cause a state of individual and temporal knowledge that we call consciousness. If the quantum-classical transition were random, temporal continuity of the conscious subject would not be possible. Consciousness, therefore, would not exist, only independent instants of pseudo-consciousness, that is, spasms of consciousness, which are far from conscious experience. In conclusion, the temporal binding of psychism is an essential element in order to understand the conscious phenomenon constituted by individual subjects, the essence of which persists over time.

The information encoded in the energy of the environment by the super-quantum potential energy generates an implicate order structure in the psychism of conscious beings. The action of this energy over the psychobiophysical body starts the formation of a coherent quantum state among diverse microtubules located in different cells distributed throughout the organism. This holistic structure of microtubules functions as a resonator of the information received from the environment. The active information from the environment, which indicates how the field energy from the environment should be structured and guided, passes directly to the global structure of the microtubules, which form conformational states in line with said information; in other words, they are organised according to the information received by the super-quantum potential energy. The conscious image therefore comes directly from external reality in the psychism and is felt holistically. The immediate outside world imposes itself on the microtubules as a whole and these in turn copy the information received integrating it in the global structure of microtubules integrated throughout the body. Consequently, the conscious perception of reality acquires holographic properties. A spatially ordered and continuous conscious image is formed, in which objects display mutual coherence.

In the BPH model, the microtubules are biophysical resonators of the quantum information. The resonance modes are limited in a microtubule; the combination options between the vibration modes of all the microtubules of the body are sufficiently broad to cover the extensive phenomenological register of conscious states. Penrose's model does not explain why a specific quantum interconnection pattern is produced in the tubulins, although it does explore how a coherent pattern is reduced by the action of the MAPs. In our proposal, the MAPs must also play an important role in constituting a specific conscious state. In one way or another, the MAPs should modify their position in line with the active information received from the environment. The microtubules start to look for possible states of mutual coherence, compatible with the relative position of the MAPs, which are positioned in the wave nodes during the quantum processing phase. Out of all the patterns from this reduced group of possible quantum psychic states, the ones that reach the highest degree of

coherence would be resolved, in order words, those that resonate with greatest intensity, in line with the main characteristics of the conscious state: unity and coherence.

Thus, for instance, in visual perception, the super quantum potential energy that operates in the electromagnetic field establishes the relative position of the MAPs from certain microtubules, which begins to generate compatible states of quantum macro-coherence. The resulting quantum coherence wave, constituted by microtubules distributed throughout the body, reaches a maximum level of coherence and saturates: psychism cannot generate a more coherent quantum state due to its psychobiophysical limitations, and it initiates the decoherence phase induced by the MAPs until it forms the classical conscious state. Psychism is ordered according the quantum information received from the environment. It organises itself to receive directly the encoded information in the light received from the wholeness of the physical environment and consequently produces a conscious holographic image.

If ordinary conscious perceptions *per se* are sufficiently complex to merit lengthy explanations in existing models, insights add extra speculative content. However, they also have a place in the BPH model. They can be explained in the BPH models as direct input from the informational reality at ordering levels well above standard levels, which spurs psychism to seek a wave with a high degree of quantum coherence. In the intuition or insight the action of the external energetic-informative block is so intense that the marred psychic control forces pre-established by thought become negligible. As a consequence, psychism does not saturate as easily. The previous schemes of thought remain dysfunctional and psychism is forced to seek psychic coherence faced with the intensely coherent reality that imposes itself. The MAPs, still constrained by biophysical limitations, are freed from psychic impositions and perform their function with greater faithfulness to external reality.

To a large extent, Bohm's conscious direct perception requires energy of maximum order whose light constructs the conscious reflex image in psychism. The action of the cosmic mind over psychism would operate directly on the microtubules, independently from the MAPs, and transmit their coherence directly on the microtubules binding them in a non-local connection. The non-local connection system of microtubules would represent the explained reality closest to the implicate dimension of maximum coherence. In the final analysis, the decoherence of the MAPs must take place in order for the subject to be conscious of the cosmic experience. The MAPs, then, represent the essential psychic element that grants individuality to the conscious subject and differentiates it from the rest of the whole. Without the objective reduction orchestrated by the MAPs the subject would be subsumed in the cosmic mind and reduced to a quantum cellular automaton of ordinary perception. Consciousness, therefore, represents the holistic, unitary and coherent image, which emerges after the quantum processing of the direct dump of external information on psychism.

4. Conclusion

The epistemological and metaphysical analysis of the BPH model enables us to be aware of the ontological nature and meaning of the psychobiophysical reality. The joint BPH model, characterised by an evolutionary-emergentist line of the psychophysical material reality, offers us an ontological and functional perspective of coherent consciousness with scientific phenomenology. The metaphysics of the BPH model provides us with a more profound vision of the human being as a participatory element of existence.

Consciousness is the main evolutionary element that provides unity to the whole of creation. It is the clear result of an original cosmic consciousness capable of recognising in its individual nature the very essence of the cosmos. Just as we call the sum of psychobiophysical events that occur in a primordial explained order the existential phenomenological cycle, we can say that conscious individual knowledge of the cosmic consciousness is the conscious act that closes a higher existential cycle from the explicate order to the energetic content of the implicate orders: the existential hypercycle as personal conscious knowledge of the cosmic essence of each psychic subject. The emergence of consciousness marks a point of inflection in the development of the universe, as it enables us to understand the holistic unity of the evolution of the psychobiophysical universe and therefore become relatively independent from structural evolutionary dynamics.

The ontological nature of consciousness is similar to that of other material processes observed in the universe. The BPH model proposes a formation process for consciousness based on the physical cooperation of the psychic architecture of a living being. The conscious subject possesses matter that is capable of manifesting physical and psychic activity. Physical, biological and psychic evolution has produced a psychobiophysical being in which the psychophysical echoes of a fundamental ontological reality resonate. The universe becomes conscious and reveals itself as an active part of a unitary psychobiophysical process. This is a creative universe (it produces conscious beings) and a revelatory one (it unfolds the potential of matter), where structures emerge that are ontologically akin to their fundamental essence. This essence unfolds and originates the universe of matter, life and consciousness. Man, emergent in this psychobiophysical universe, is capable of understanding and transcending this through the experience of insight.

The ontological identification of man with the cosmos, as well as his ability to transcend it thanks to the direct intervention of the cosmic mind, offers a metaphysical perspective, stemming from a philosophical physical reflection and scientific interest in understanding the phenomenon of consciousness. Man is linked to the material essence of the cosmos by virtue of his psychobiophysical constitution. At the point of maximum resonance with the cosmos he can reach a direct perception of the wholeness of reality and bestow meaning on his existence. This is the most intense rebinding with creation, the maximum tuning

with the cosmic mind, the closest to identification with the essential cosmic content that creates, unfolds and rebinds. The image offered to us by a scientific-philosophical reflection of an emergentist nature, shows consciousness as a window wide open to the essential content of reality. For man the universe is a conscious physical system, in which he is capable of questioning its raison d'être and playing an active role in rebinding himself with the essence thereof.

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