Quantum Electrodynamics and Unified Synaptic Channel in the Identification of Consciousness

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Abstract
Through a careful revision of the bibliography of quantum electrodynamics (QED) and its application to the biochemical structure of the unified synaptic channel (USC), a model of consciousness identification is proposed. The model entails a channel running in loops all along the labyrinthic structure of the cerebral cortex and constituting an anatomical-histological structure on its own along which the flow of molecular (and ionic) particles as neurotransmitters determines a sort of constant low-noise effect.

Key Words: Quantum electrodynamics, Unified synaptic channel, consciousness, presynaptic membrane, postsynaptic membrane, global map, cerebral cortex

Introduction
The mysteries of Consciousness have gripped human imagination for over 5,000 years. At the dawn of the new millennium the international “debate over Consciousness” is largely being supported by two competing world-views: Dualism which splits the Universe into two fundamentally different mental and physical substances or properties; material Reductionism, which claims consciousness to be nothing more than a state or function of the brain.

Can consciousness be interpreted as a pile where both opinions are present? It is what we will try to demonstrate.

The aim of this paper is to show how the evolution of man is above all linked to the development of his own neurons, which during the millenniums acquire new information, increasing enormously in number and quality and assuming, so to speak, the features of the modern neurons.

We have also tried to combine classical physics with quantum physics in the emersion and identification of consciousness represented as a “whole”.

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Neuronal bases of consciousness and QED

In January 1993 the Brain’s decade started in Milan, following the 1990 USA declaration of the “International society of theoretical neurobiology” (SINT). S. Angeletti in his book “Brain in the hands” (Angeletti, 1995) reports: “Thought is quicker than light” but “Nihil est in intellectu quod prius non fuerit in sensu” (Cartesio-Gassendi) or “Tota humana notitia a sensibus surgit” (Abelardo).

Freud’s foresight that psychoanalytic therapy would have been in time substituted by a chemically-biologically-based therapy seems nowadays to be confirmed.

Recently, research reports that the first “schizophrenia gene” was discovered and localized on chromosome 22. The protein encoded by this gene has been designated as WKL1 and shares some features with ionic channel proteins. Such proteins are located in the cell membrane and assist transport of electric currents along neurons.

Preparata refers “… the first tenacious obstacle to the progress and to the humanization of medicine is, I believe, today’s paradigm of molecular biology (MB) deeply rooted on the view of the world that springs out of the atomistic revolution. The conviction that permeates MB, that the dynamic drama of condensed matter, both living and inanimate, has its origin in local electrostatic interactions leads to the equation “Form = Function”, according to which each mechanism of biological interaction is so highly selective due to the mutual recognition that the molecular participants owe to well defined spatial configuration”; he further states that “… a bridge between QED and Medicine” can be configured “in the interaction of very weak low-frequency magnetic fields with the ionic system of the cells” (Preparata, 2000).

M. Bizzarri refers that a “mental state” may be linked to an operating system that is comparable to the functional configuration of a computer (Bizzarri, 2000). These “states” may be interpreted in the light of QED, and the respective transition may be subject to a specific thermodynamic treatment.

Sermonti (Sermonti, 2000) refers that Monod (Monod, 1970) admits that much more information is required to spatially arrange the three-dimensional structure of a protein than to sequence its amino acids. He does not provide any suggestion about where such information might be located in the cell. The overall orientation of these coherent domains is called a “morphogenetic field”. He refers too that a biological membrane is in a state known as “Liquid crystal”. This consists of rod-shaped molecules having a positional as well as specific orientation order. The “liquid crystals” provide a good example of the dynamic “coherent regime of the matter field”.

It is useful here to report that Neher and Sackmann (Neher, 1992), Nobel in 1981, have studied the flow of a neuronal ionic channel with the patch-clamping technique, registering it as both accelerated and amplified, so as to show the pathway of molecules in both directions.

Güven Güzeldere (Güzeldere, 1999) in the introduction to “The nature of consciousness” recalls the 4W questions:

1. What are the media and mechanisms of consciousness?
2. Where is, if anywhere, the locus of consciousness? Can consciousness be localized in a specific organ or is it endemic to the whole of the nervous system?
3. Who can be said to be a conscious being?
4. Why consciousness at all and what is the role it plays in the general scheme of mental life and behavior of an organism?

Güzeldere at the end asks another question: “How does consciousness arise in or emerge from its underlying substance, structure and mechanism in the way it does?”

In 1690 Locke affirmed: “Consciousness is the perception of what passes in a man’s own mind” (Locke, 1959).

John R. Searle in “Mystery of consciousness” affirms that consciousness can be viewed as “lighting up” and “putting out” (Searle, 1997).

Having so “defined” consciousness, we must answer to the question: What does happen in the brain during such “lighting up and putting out” phases? The signals that arrive to the brain or better to the cerebral cortex through the centripetal pathway, joining the environment to the five sensorial centers, are transformed in consciousness events and form or create the global unified consciousness. But which is the explanation of this course of unification determining the constant synchronic presence of consciousness, i.e., the “I or Self”? How do the different signals that arrive to the cortex and pervade it contribute to the process of consciousness unification?

Searle states further on: “If I consciously seem to be conscious, then I am conscious” and this statement seems to agree with the opinion of D.J. Chalmers when he affirms that consciousness emerges from the functional organization of the brain (Chalmers, 1995). So Searle may indicate that the behavior of water molecules accounting for the liquid properties of water does not imply that the single molecules themselves should be “liquid”. In the same way, in our opinion, a single neuron, or a single ion accounted for by the QED theory, is not in itself conscious; on the contrary, the coherent field of ions coming from the enormous quantity of neurons and synapses may contribute to the emergence of consciousness. The same opinion is seemingly supported by F. Crick, Nobel in 1954, when he asserts: “You with your joys and your pains, your memories and ambitions, your personal identity and your free will, you are nothing but the result of the behavior of a myriad of nervous cells and their molecules.” (Crick, 1994)

Do we need a New Physics to understand the mind-consciousness?

Roger Penrose (Penrose, 1996), the well known physicist and mathematician from Oxford University, faces the problem of intelligence and comprehension emphasizing that “intelligence needs understanding and that understanding needs awareness”.

While awareness may be interpreted as the passive aspect of the consciousness phenomenon (low-noise effect along the unified synaptic channel - USC - according to our model (Bondì, 1998)), its active aspect could be the feeling of “Free Will”. The two aspects may be viewed as representing two faces of the same medal, and we can add that from the state of “low-noise-effect” (passive consciousness) it is possible to gradually achieve “free will”. This could be identified with the minor or greater opening of the USC. A recent research of Ramachandran and Hubbard (Ramachandran, 2001) refers how the different sensorial functions of the brain cortex merge, giving rise to the so-said “synesthesia”. This synesthetic fusion concerns close-by areas of the cortex (for colors, numbers and sounds definition). Such researches were carried through by employing positron emission tomography techniques (PET).
Is it possible for the conscious brain to operate according to “non computational laws?” Computational theories can be schematically traced back to the model of the Turing machine, corresponding to a mathematical computer. A. M. Turing affirmed that the brain works like a digital computer and that mind cannot be separated from matter (Turing, 1950).

On the contrary Gödel (Gödel, 1931) thought that mind is something beyond the brain. Kurt Gödel, still a young mathematician at the 1930 Königsberg meeting, expounded his famous Theorem showing how no coherent formal system of valid logical theorems can be sufficiently potent to demonstrate all true propositions of ordinary arithmetic. This means that given any system of mathematical theorems, there will always issue undeterminable propositions on the basis of such axioms, in the sense that they cannot be really demonstrated as being true or false. The results stemming from Gödel’s Theorem have been taken to demonstrate that human understanding - and intuition above all - cannot be reduced to any system of computational rules. By this statement we could be inclined to think or consider that our intelligence and/or “free will” involve some “Divine act”, inexplicable by science. Nevertheless Penrose confutes this thesis by considering that the algorithmic procedures are the result of hundreds of thousands of years of natural selection and/or of casual selection, which have determined the codification in the DNA of algorithmically “ingredients” as they were developed. It is possibly a question of “natural causality” more than of “natural selection”. The principle is the same. Only “Chance”, which is what is yet unknown pertaining to infinite events, would determine the direction of selection. The intrinsic force of each algorithm could itself be ruled by chance, interpreted as an equivalent to a “God unknown”.

A simple and intuitive example can be mentioned as follows. The hand of Primates is similar in its movements to the human one, including the opposition of the thumbs. However in the apes this movement is not as refined, quick and relevant as in man and this is due to anatomical differences. In fact while in Primates the two thumb flexor muscles are adherent and act at the same time, on the contrary in man there are two separate tendons and muscles, which allow for the precise and quick thumb movements we all know very well and which have made possible all our achievements. The fine operations performed with a stick, a club, a pencil or a painting brush or later with a pen or a screwdriver pertain only to humans. So the presence in the forearm of a thumb independent long-flexor is characteristic of the human species: no Primate in fact shows this individualized muscle (Testut, 1923). Is it possible to infer that stimuli from the hand have contributed to develop brain mass? Is it possible that the present technological results are due to the development of an independent hand muscle? Could such a hypothesis, outstretched as it may be, confirm the natural causality of the process of evolution?

The liberation of the hands from the locomotor function, having man learned to walk with two legs, would have been the first gigantic evolutive step. The thenar hypertrophy at the base of the thumb, together with the development of the independent thumb flexor muscle, resulted in true thumb opposition, thus making construction of the first tools possible for *homo habilis*. It is probable that in the course of time the continuous numerous messages sent from the hand to the brain may have resulted in the development of the area of Broca (the spoken language centre at the base of the third frontal left gyrus, thus contributing to the formation of consciousness.
According to J. Napier (Napier, 1962) this centre, adjacent to the motor area of the cortex, began to expand in the hominoids adopting the erect position, who thus became able to pronounce the first phonemes. Therefore it was through “hand specialization” that words and eventually the arousal of self-consciousness could have developed (Leroi-Gourhan, 1964).

On a higher level would it be reasonable to believe that “in the beginning” there was the Gesture and not the Word, or must we trust the Judaic-Christian mysticism, relying in the priority of the Word for the formation of the Universe? Once more must we choose between “Divine creation” with the ensuing autonomous development more or less remotely guided by the Divine Will, and Chance (an instance of the Big-Bang cosmologic approach) with the subsequent environmental evolution? Different terms possibly pointing to the same unknown entity at the centre of the mystery. In fact through Chance a cascade of events occurs and thus the total independence of future events is repeated over and over again.

In examining the brain and the consciousness phenomenon do we need to refer to classical physics or rather to quantum physics?

In 1928 P.A.M. Dirac published his quantum mechanical equation for the electron, thus “reducing” chemistry to physics. By this equation the QED Era began. (For a strange coincidence QED is also the acrostic for “Quod Erat Demonstrandum”, indicating the new line along which chemistry should have moved from then on, that is, towards physics).

As matters stand, following M. Gell-Mann (Gell-Mann, 1994), Nobel in 1969 for the discovery of quarks, the Quantum Universe is valid also for Biology. The Universe is made up of matter and matter is made up of particles. The quantum fields theory is based on four fundamental assumptions:

- The validity of the quantum mechanism.
- The validity of Einstein’s relativity principle.
- The local principle, for which the fundamental forces are due to local processes and not to remote forces.
- The principle of Indetermination of Heisenberg, for which the states of a particle do not have a well defined position; speed and position of a particle, cannot be simultaneously measured.

The QED theory is basically the electrons and photons theory; considering that the “electrons cloud” enveloping the atom measures about 10^-10 m. and comparing the nucleus to a foot-ball, the electrons would be one kilometer away. Matter is over all made by empty space. These elementary particles have no individuality; any electron is identical to any other one, and all the photons are reciprocally interchangeable. Nevertheless any particle can occupy only one among “infinite quantum states”.

Particles belong to two main classes (but there are more than 60 different particles): Electrons and Fermiums obeying to the “exclusion principle of Pauli”. This means that two particles of the same type cannot occupy the same state at the same time. Photons and Bosons obeying on the contrary to the principle of anti-exclusion, i.e., two particles of the same type show a marked preference for being in the same state at the same time. This is the property that makes possible the activity of the LASER (initials for Light Amplification by Stimulated Emission of Radiation) in which one photon stimulates the emission of other
photons and all have the same frequency and travel in the same direction, thus determining the laser beam.

The quantum of the electromagnetic field is the Photon, and the quantum of the gravitational field is the Boson (or so-said “Graviton”). Any fundamental force must be associated to one elementary particle, which is to the quantum of the relative field. It is said that the quantum “is the vehicle or the bearer of the corresponding force”.

Any mechanism at the basis of consciousness is likely to belong to the same scheme which supports and rules all of the known properties of the Universe. In modern physics Einstein’s formula \(E=mc^2\), linking mass with energy, may seem reasonable, since mass is a measure of matter and energy, though perhaps a vague concept, has been experimentally confirmed. Mind or consciousness thus can be referred to the brain cortical substance, impalpable as they may be — and as energy is. Consequently it seems likely that the consciousness-interneuronal-synaptic activity present in the USC (Unified synaptic channel) is the result of both classic computational physics and casual QED (quantum electrodynamics). The indeterministic QED is likely to be present in the ionic-molecular flow along the USC, rather than in the transmission along the motor and sensorial nervous pathways, which may be referred to the electric transmission through a conductor at 90 m/sec.

We are again confronted with a dualism: QED at the central level (interneuronal synaptic ionic-molecular flow in the USC), and classical physics at the peripheral level (conduction-transmission).

Some authors (Hameroff, 1982) suppose that the “Quantum indeterminateness” may be the way through which the mind/consciousness controls the physical brain. But where is the transition point between the classic level and the quantum level? It seems that single quantum states may be associated with the charging and discharging of entire sectors of neurons, pertaining to different sensorial centers. In this interplay it seems that some protein substances such as contractile actine (at the dendritic spines) and clatrine (at the microtubules) may be involved. The trimers of clatrine are similar to the carbon molecules known as fullerenes (the name comes from the geodetic domes designed by the American architect Buckminster Fuller). The “fullerenes” are similar in shape to a ball where each hexagon or pentagon offers a considerable surface of energetic exchange. These substances are present in the cytoskeleton and their concentration may be related to the storage of all ideas and concepts memorized during the development of the individual, as in an archive. Their interaction could account for the increase of the calculating speed of the \(1.5 \times 10^{11}\) neurons present in the brain cortex. So the unbelievable figures of basic operations per second may range in the brain from \(10^{14}\) to \(10^{27}\), such that cannot be reached by any present and perhaps any future computer.

We are still in the realm of computational physics, but if we consider that the content of microtubules should be constituted by water (liquid crystal according to G. Sermonti), it is reasonable to suppose that within such constituent, which is likely to be present also in the ionic-molecular flow along the USC, coherent quantum wave oscillations may take place. Quantum physics models could thus be brought to the microtubules and to the USC level, while computational classical physics models could be applied to the level of neuronal
output, where the transmission acquires the characteristics of a nervous current for peripheral conduction.

The model for the incoming signals could be a mixed one and the paradigmatic example may be represented by the optical-photonic-quantum signals reaching the retinal membrane and by the classic signals moving along the optical nerve pathway. Once again the signals become “quantized” in the occipital lobe that is in the neuronal microtubular-synaptic complex (USC). The same mixed alternative model should be present in the reception and transformation of the sensorial input coming from the external environment, such as: smells, tastes, tactile-thermic-painful sensations and acoustic signals. Moreover, how could it happen that in the synaptic space of 200 Ångström (1Å=10⁻⁴μ) the presynaptic and postsynaptic exchanges of messages, with their membrane reabsorptions and a constant presence of ionic-molecular liquid, may occur if not in a “quantum dimension”?

And how could “mental energy” - which is not a “simple” and so to speak “aseptic” form of energy, rather a “personified” form, related to the genetic and the environmental messages acquired during development - be accounted for by a classical physics model? Consequently it could be accepted that the QED working in the synaptic space (USC) constitutes the transmission vehicle of the global brain cortex (about 160,000 km long) (Figure 1).

Fig. 1 – Schematic design of a lateral section of the human brain, showing a continuous looped ribbon extended to the entire neocortex. On another, much higher, scale, the ribbon hints at the structure we called USC (the arrow indicates a space which would be 200 Å wide).

The extension of the USC is likely to produce the synchronic and synergic emergence of the consciousness in a quantum model based on a finely regulated mechanism
(comprehending the stages of exocytosis and active transport) of projection of sensorial inputs, which can be assembled in quantized sources and then processed along the USC. Such a channel runs in loops all along the labyrinthic structure of the cerebral cortex and constitutes an anatomical-histological structure on its own along which the flow of ionic-molecular neurotransmitters determines a sort of constant low-noise effect. The signals could then be brought back to the level of computational algorithmic transmission (the All or Nothing Law) towards the nervous conduction in the peripheral nervous system. The spike or nervous impulse moves at 90 m/sec by means of charged atoms or molecules moving through ionic channels with a back and forth movement through the cellular membrane that produces the definitive potential gradient.

J.C. Eccles, Nobel in 1963 (Eccles, 1973; 1989; 1992; 1994), gave the experimental demonstration of the intracellular electric registration of a stimulus-information of excitement-inhibition. Such a stimulus determines one exocytosis-emission, which has come to be considered as the basic neuronal unitary activity of the cerebral cortex. Every emission of 30-50 micro-vesicular releases several different neurotransmitters, which from the pre-synapse arrive to the post-synapse, there causing, via the above mentioned mechanism (all or nothing) a new electric state called “depolarization”, corresponding to an excitatory condition defined “Excitatory post-synaptic potential” (EPSP). Eccles’s later hypothesis defined as the Intelligence Quantum Theory could confirm the dualistic model of mixed transmission of the nervous impulse: QED in the central, internuncial synaptic level of the USC and classical physics at the level of the nervous peripheral system.

It is interesting to report that already in 1918 L. Testut and O. Jacob wrote in their Topographic Anatomy Treatise: “The intellectual faculty or intelligence would have no particular center, but they would result from the function of the whole cerebral cortex, i.e., from the functional association of all the cerebral neurons” (Testut, 1918).

Now we may ask ourselves: can the above mentioned mixed model explain in some way what is termed as free will, i.e., the capacity to choose among alternative possibilities? Can such choice be referred to the “QED indetermination”? Can this hypothesis seem realistic? In our model, as already reported (Figure 2), the USC structure may project quantum indetermination amplified in real time to the whole cerebral cortex, thus constituting a flow of neurotransmitter particles which can determine choice from chaos in an attempt to attain conscious order. In our opinion the mentioned multi-dimensional spatial development of the USC refers to the model of the molecules present in each synaptic fissure at any given instant, that is to say both the mediator and modulating molecules that follow their diffusion along the USC.
Fig. 2 – This electron microscope photography (115000X) was taken by Dr. John E. Heuser (Professor of Biophysics, Washington University School of Medicine). It shows the vesicles at the presynaptic terminal of an axon as they are opening towards the synaptic fissure for the exocytosis of mediator molecules, which will cross the 200 Å wide space and bond at the receptor sites on the postsynaptic membrane. (by courtesy of J.E. Heuser)

In more detail: we know that the ionic-molecular particles can bind to the appropriate receptors present on the post-synaptic membrane; that they can be reabsorbed by the presynaptic and glial membrane; or else that they could stream, at a very slow pace if compared with the speed of synaptic impulse transmission, along the USC and thus become connected with nearby synapses.

According to this model the molecules would thus gain an additional informative value; for their presence in the synaptic fissure they would become relevant apart from their bonding reabsorption since by the process of diffusion they would induce concentration changes in other portions of the cortex, thus affecting the underlying mosaic of neuronal activity and inhibition. We are inclined to think that the process or the result of the awareness of the “Self” could be more clearly understood, considering it as a change of molecules-particles concentrations along the structure of the USC. This would determine a subtly regulated transmission of all the pre-synaptic inputs so starting a synchronic and synergic low-level activity in the “whole” neuronal web.

The synapse (Figure 3) is crossed by neurotransmitters, among which the most common are GABA (gamma-amino-butyric acid) with inhibitory role, and glutamate with an excitatory role; their travel from the presynaptic membrane to the post- synaptic membrane accounts for the transmission and regulation of the nervous impulse across the synaptic space. Such a system does not rely solely upon the action of known neurotransmitters, rather it also involves other types of hormone-like substances, and particularly two gaseous molecules, NO and CO. These molecules, toxic at higher concentrations, together with the above mentioned unbound chemical mediators, are seemingly able to enhance or reduce the
efficiency of the classic type of transmission which therefore operates embedded in a pool of chemically active substances circulating in the synaptic space.

Fig. 3 – This electron microscope photography (65000X) was taken by Dr. John E. Heuser (Professor of Biophysics, Washington University School of Medicine) and Dr. Thomas S. Reese (American National Institute of Health). It shows the fissure separating presynaptic and postsynaptic membranes as it extends along the whole length of the presynaptic button and even further. Many vesicles containing mediator molecules are present, as well as mitochondria. (by courtesy of J.E. Heuser & T. S. Reese)

Such molecules, if considered by themselves, cannot account for the transmission of any other impulse in any other synapse, due to the fact that they would be no longer present in quantum concentration.

In this contest the emergence of the awareness of the “SELF” would thus appear to be based upon a mechanism of an extremely small and shortly lived (because they tend to be reabsorbed) parcels of neurotransmitters and other molecules, which according to their diffusion rate seem to sum up their effects to produce a constant flow of material, Consciousness resulting as a “Whole”.

In 1963 M. Gell-Mann identified and defined the QUARK. This word that really means “Sea-gull cry” was pronounced by a James Joyce character who, ordering at the pub, got mixed up and badly pronouncing, shouted: “Three Quarks for Muster Mark” instead of: “Three Quarts for Mister Mark”. Gell-Mann coined the word Quark = Quart for defining one proton or one neutron, as being composed by three quarks. The quarks have different flavors (u, d) and colors (red, green, blue), humorous ways to distinguish among their different states.
As the electro-magnetic force acting among the electrons is generated by virtual exchanges of photons, so quarks are linked by a force coming from the exchanges of other quanta, called “gluons” (from glue) because they glue the quarks. The gluons interact with the color in the same way as the photons interact with the electric charge. So the “Quantum-chromodynamics (QCD) theory”, defining the quantum theory through quarks and gluons, was launched in 1972.

Having accepted all this, we must now consider the fundamental theory of particles and the quantum state of the Universe (the fundamental time unit is about $10^{-44}$ sec). The quantum state of the not yet existing Universe could have caused its explosive dilatation, which seems to be still going on nowadays. This event produced the formation and evolution of the celestial objects like galaxies, stars and planets. Following such evolution leads to the discussion on the soundness of the “Anthropic principle” (Barrow, 1986). This principle affirms that the particular branch of history to which we belong has the necessary characteristics to allow for the existence of our planet and for the development of life over here, including the human one. The evolution of Earth, of the meteorological phenomena on its surface, of the prebiotic chemical reactions producing the emergence of life, have produced the formation over the ages of all paleo-anthropological findings. These give evidence to the course of biological evolution.

The “tree structure” of histories that branch out implies a casual choice at every ramification. Any history going on in the course of time, increases consequently the number of casual results. The concept of chance then takes on the characteristics of a kind of “divinity”, since we are unable to memorize an infinite number of data; Chance and Divinity seem then to be equivalent.

Anyway without the initial state of the Universe, and without the dynamic laws of quantum physics particles, the actual vision of our biological world would not occur. We would simply not be there to account for it.

**COGITO ERGO SUM or SUM ERGO COGITO?**

When taken together the well known aphorism of Descartes and its opposite may resemble a pun, but in a way these two sentences represent the whole human philosophy of evolution.

To opt for “Cogito ergo sum” means to believe in a spontaneous beginning and in a more or less Darwinian evolution; to opt for “Sum ergo cogito” means to accept a divine origin and subsequently developed events, more or less teleologically guided.

We have seen how “God” and “Chance” lead us, according to our opinion, to the same blind alley of the unknown.

One step toward a possible interpretation of the Universe was undoubtedly taken when the neuron was identified as the anatomic cellular nervous unit, leading to the recognition of the role played by synapses as interneuronal connections summing up to about one million of thousand millions in the cerebral cortex. It has been calculated that if we count one synapse per second, we would need 32 millions years to come to the end of the count.

To the matter vs. energy antinomy corresponds the biology vs. psychology one, to which numerous philosophers have brought their attention; it was only through the anatomical-histological-physiological study of brain, however, that it became possible to ascertain the correlation between brain substance and the mind.
Among the very numerous authors studying this argument, emerge the Nobel awarded Camillo Golgi and Ramon y Cajal (1906), Charles Scott Sherrington (1932) and E. Neher and B. Sackmann, who gave evidence to the fundamental histologic morphologies for the understanding of the mechanism underlying the formation of consciousness.

By means of embryological and topological studies it was understood that the combination activity of genes is what determines the characteristic hereditary form of a specific species. Considering however that the human genes and those of the chimpanzee (Pan troglodytes) result to be identical to the extent of up to 99% it is clear that the action of genes coding for proteins is not sufficient by itself to explain the morphological and biochemical diversity of cells and organs, as well as of somatic characteristics.

Here we think we ought to draw attention to the morphological molecules controlling cell adhesion and cell movements as described by G. M. Edelman, Nobel in 1972 (Edelman, 1993). Such proteins are characteristic of some regions of the embryo and have the aim to make the cells adhere: they are present also in many adult tissues and particularly in the cells of the central nervous system. They are divided into three families: CAM (Cell Adhesion Molecules), SAM (Substrate Adhesion Molecules) and the CJM (Cell Junction Molecules).

The expression of such molecules, which guide cell movements and forms, either in the embryonic stage or in the adult definitive forms, seems to be ruled by growth factors, perhaps coming from an original single growth factor (Brenci, 1994).

These growth factors pinpoint which CAM to activate and which to inactivate, thus differentiating the original tissues out of which subsequent cell and organ differentiation will derive. Such a process seems to be controlled by a particular gene - called the homeotic gene - which controls the final morphology of organs and species. The resemblance between man and chimpanzee would then have an accountable explanation and the differences would be due to the above mentioned regulator molecules.

Blaise Pascal once said: “The great prodigy of the evolutionary process is that man who considers himself”. The only creature of the Universe we know of, who is capable of questioning his own Weltanschauung.

Edelman draws a comparison between the immunological system, present only in the vertebrates and capable of recognizing the self from non-self at a molecular level, and the science of neurobiology, proposing that the latter should become the science of recognition, and that the adhesion molecules amongst neural cells should be the evolutive forerunners of the whole immunological system.

He fosters the theory of neuron groups selection (TSGN), whose key concepts may be thus summarized:

§ primary repertory: selection of neuronal populations in topological-biological competition subjected to the dynamics of the CAMs and SAMs;

§ secondary repertory: collection of active circuits with strengthened synapses. The two repertories can be brought together, developing further synapses and this can also happen in a developed brain;

§ re-entry: it connects psychology and physiology due to the formation of maps, with a correlation and interconnection system among maps of selective events.

Such a subdivision in numerous maps influencing each other, might realize a superior structure called “Global map”. This theory was simulated by Edelman and Tononi and alias
(Tononi, 2003) on a mainframe computer based on the TSGN algorithm in order to demonstrate that the perceptive registration may be realized on the basis of values of a global map. It has also been demonstrated that neuron groups of distinct maps oscillate at the same synchronic frequency of about 4Hz and this is consequent to synaptic connections.

We have briefly reported Edelman’s theory of the global map, because it seems to us that it may give evidence to our model of the USC developing like a labyrinth along the brain cortex of both hemispheres, thus making possible the synchronous and constant activity of the neurons and the selected transmission capacity of the synapses.

Perception, memory and learning are the three physiological functions through which emerges the consciousness of the self, increasing from the constant low-noise effect of a quiescent state to particular map interconnection systems correlating selective events. Such moments would necessarily have to correspond to ionic-molecular codifications that coherently are accounted for by the QED mechanism.

**When and how does consciousness disappear?**

1) **Physiological disappearance of consciousness**

During physiological sleep all the sensorial inputs stop, above all for lack of light and sound. Besides, the arterial-venous circulation pressure of the cerebral mass increases, and this is caused mainly by the horizontal position during sleep.

In this way the width of the USC decreases progressively (from the initial 200 Å), and the ionic-molecular particles flow is likely to be absorbed by the micro-tubular cytoskeleton system, determining the disappearance of consciousness, even though not completely. In fact a residual oscillating opening of the USC could cause the presence of oneiric activity.

2) **Pharmacologic disappearance of consciousness**

According to Hameroff (Hameroff, 1982) all the anesthetics (pentothal, barbitals, nitrogen prothoxide, ether, chloroform, halothane etc.) have the property of electric dipoles, leading to the attraction of molecules. Their hydrophobic activity would interrupt the action of microtubules, ejecting the watery liquor from the synaptic fissure, so that it collapses. The so-said “ionic particles liquor consciousness” would thus be ejected and reabsorbed by the above described substances (clatrine and fullerenes) that have a particular form, fit for the transmission and adsorption of the neurotransmitters. The inhibition of the cytoskeleton would cease as soon as the anesthetic substances introduced by way of hematic and/or gaseous circulation are eliminated. Following the introduction of suitable doses of oxygen and carbon dioxide the molecular attraction (electronic dipole) would cease. The activity of the cytoskeletal microtubules would once again be established and the USC would regain its normal width (200 Å), restoring the presence of the quantum wave of particles in the whole of the cerebral cortex. The patient thus awakes.

3) **Pathological disappearance of consciousness**

Intracranial effusions as edema/transudations/hemorrhages/hematomas, tumefactions or tumors are pathologies that by compression reduce the volume of the cerebral mass. This reduction of volume would determine the subsequent closure of the USC. In this way the pathological sleep or coma arises, exhibiting its various gradual ranges, just isomorphic to the larger or smaller fissure left in the USC.
These so described physiological, pharmacological and pathological moments through which consciousness disappears would confirm the global nature of consciousness which “lights up” and “turns off” when all the neuronal cytoskeletons and the USC loose their quantum/computational capacity.

Physiology, pharmacology, pathology thus help to understand the genesis, development and identity of self-consciousness.

Conclusions
In Plato’s *Phaedrus* (385 B.C.) Socrates reports that Thot, the Egyptian God of Science and Magic, recognizable by his ibis-like profile, showed to King Thamos his own creations, amongst which there was “writing”. The King spoke sententiously about this subject:

“*From your creation, capable men, there will come those having knowledge even without teachers… arrogant, conceited and unwise men.*”

It is always hard to be conclusive. However it is possible to affirm that self-consciousness is the result of information and experiences being superimposed along hundreds of thousands of years; *à la demande* they have been constantly and synchronically elaborated in the anatomical-histological structure which we called “Unified Synaptic Channel” (USC). In this channel, as visualized by us, all the incoming outer signals and/or information would flow, suitably processed by computational-quantum map centers. It is likely that in this channel illusions and realities could have developed, and psychological hierarchies, such as the Freudian visualization of the mind-consciousness relationship: superego, ego, es (inferior consciousness) and subconscious.

We began this paper giving evidence to the Dualism inevitably present in literature, which we later encountered more than once in our own dissertation: materialism or spiritualism? So formulated, the question seems to us not to be correctly posed.

In fact we think, together with other authors, that the dualism is to be referred rather to the classical physics vs. quantum physics approach. Through such a dualistic model accounting for the formation of consciousness would derive the acts and the decisions of free will. In its wonderful awareness free will is mysteriously tuned to the Divine-Chance oscillation that is to the spiritual-material dualism.

In the end, willing to introduce and promote as global a point of view as possible on the nature of the Universe, we are brought back to the consideration that Divine and Chance present man with the same unanswerable question, stemming from regions of not easily reached awareness. There remains a meeting point between the two thesis, as expressed through suffered reflection and profound meditation. Quantum physics may constitute the passage through which consciousness emerged at the dawning of time, through gesture and word, and evolved toward the brain/mind structure of contemporary man.
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