

## Borges, the Quantum Theory and Parallel Universes

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**Abstract:** The “Whole” proto-theory and the “Tuner” metaphor, using the least phrasing and technical formulation as possible in order to draw the almost shocking relativist and quantum concepts near an educated population, yet, without a particular physical- mathematical background. The “Whole” is the basic permanent, omni-potential and may be one-dimensional continuous nature, where there is no proper time arrow. [The Journal of American Science. 2006;2(1):1-30].

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### Introduction

It took me almost four years to complete this essay, triggered after re-reading Borges’s story “El jardín de los senderos que bifurcan”, (The Garden of the Bifurcating Paths), at the end of my career as an engineer.

This has not been Borges’s fault, but rather my intention of shaping, in an orderly way, a series of thoughts and existential considerations that have been building up in the mind of someone, as it is my case, who has been permanently dealing, as a professional, with so different subjects that range from chemistry to physics and mathematics, passing through human behavioral sciences, compelled, perhaps, by the ultimate goal of a chemistry engineer who has become an accidents-prevention and environmental sanitation specialist.

Through years of research, teaching and practical application of this knowledge, there appeared ideas and concepts that seem to contradict common sense or our purest ideas, especially on cosmology.

As things continuously change and due to the rhythm information moves through the web, this objective seems a never-ending story, and it becomes worse when trying to keep it up.

As you will see throughout this essay, this material does not have the purpose of a literary analysis of the fantasies of our great author; much has been written about it and undoubtedly much more will be written. I only try to give my opinion about the cosmological character of this story, which can be found as part of “Fictions”, and expose also a metaphor which can be helpful for the better dissemination and understanding of theories such as the quantum or relativity ones, so new and hardly fought by common sense.

I do not qualify reasoning as “metaphysical” or “philosophical” although these words would perfectly fit in this context, agreeing with the feeling of discomfort the use of these meritorious and solemn terms sometimes provoke, according to Borges, when

his objective was intellectual and aesthetic in his case, while mine is only of intellectual dissemination.

I do not agree with those who think that Borges’s ideas among others, about convergent, divergent and parallel times that “*cover every possibility and even then they are only a partial, incomplete, though not fake vision of the universe*” (Borges, 1941) are only the product of fortuity or a hypothetical accident (Alberto G. Rojo

[www.lehman.cuny.edu/ciberletras/v1n1/crit\\_06.htm](http://www.lehman.cuny.edu/ciberletras/v1n1/crit_06.htm)). I do think that he refers to the story, as he did in some other ones, in an unequivocal, cunning way when he says it is a detective story.

Borges knew what he was writing about, in the 4th decade of the 20th century, when he mentioned that Albert (Einstein?!) very busy with his infinite times and paths that would end with the (nuclear?) bombing attack to an homonymic English city in those years, portent of nazi intentions in a Germany, that was already widespread and notorious as the press reported, was already at the gateway of mastering the atom.

Of course I do not refer to a scientist’s physical-mathematical knowledge, but rather to the understanding of an informed and enlightened poet who read about Einstein’s relativity, Heisenberg’s uncertainty principle, Schrödinger’s experiences and other relevant thinkers whose ideas illuminated the 20th century daybreak.

Only a genius’s mind could glimpse the infinite realities that the quantum theory proposes, in the depths of a matter that becomes weird and elusive as we try to penetrate the boundaries of what is very small or unbelievably big..., the anguish of our ignorance coupled with the infiniteness of extremes.

After his long European experience and having read, in his mother tongue, among other books, most of the fantastic literature giants (he liked that name for what technicians today consider, almost mistakenly, “science fiction”) - such us: H. P. Lovecraft, Olaf Stapleton, H. G. Well, among many others, not to mention the unending list that probably starts with the

ancient Greek classics and develops continually up to his contemporaries, both western and eastern - the polyglot Borges formed and set motion in 1941 to the germ of the *meme*, that would give birth, in turn, to the *parallel universes* and would catch today many important investigators' attention.

More than a decade had to pass by before science would be interested in dealing with these ideas and give them a physical mathematical support, with Hugs Everett's doctorate thesis (known as Many World Interpretation o M.W.I. by its acronym in English) in 1957, who eventually gave up scientific research and even his life, disappointed as he was because of the scant interest he arose and his colleagues' skepticism.

Now, it is really exciting and amazing to see that scientists like Stephen Hawking, Martin Rees, David Deutsch, Francis Crick and hundreds of others who, in spite of the scandal that these quantum conceptions produce, are sharing some of these opinions and working on the development of new concepts, which thousands of technologists are striving to concrete in new "realities" that amaze us day after day.

At their time it was Bruno, Spinoza, Galileo and other thinkers the ones who challenged the established Dogma with their revolutionary ideas about round worlds drifting in space that was not the axle of any celestial privilege and paid with their freedom, health and even life for the right to expose them to the big public. But others followed them until they convinced us that we are barely part of a minor planetary system that spins - maybe inconsequentially - in an obscure branch of an ordinary galaxy.

Many tyrants obstinately, systematically and recurrently insisted on keeping these hateful thoughts in silence, as they humiliated and denigrated ancient sacred ideas; but all bloodshed in the cause was useless as futile it is to try to cover the sun with a hand. This is how things are, and this is how our beliefs and knowledge develop, sometimes happily, sometime regretfully.

And what about computers' calculation speed? Such devices did not exist at the time we were in high school, when we dirtied our fingers with stencil copies that today are easily obtained through photocopies. And, where is the proud expression that stated that a machine could never possibly defeat a champion at chess?

Scarcely more than one hundred years ago, humanity barely launched into the sky on fragile grotesque systems, while today we negotiate international agreements in the new frontier proposed by the space station.

We could go on mentioning an endless list of new realities that became concrete thanks to technology; "realities" that seemed mere fantasies or aberrant ideas about the nature of things. Holograms, fractals, tunnel-effect microscopes, scanners, magnetic resonance,

nanotechnology, etc, etc are only some of the new concepts and devices -"realities" at last today- which are at hand everyday to improve our life quality.

In this essay it is not my intention to spend time on the description of this list that shows human intelligence evolution. Instead, conducted by the fabulous writer and also lying on the shoulders of the geniuses that inspired him, I do intend to expose to the reader's consideration a simple argument about the quantum mechanism that nature employs to shape what we define as "reality" in order to reach, with the help of two metaphors (or more precisely, a pro-theory and an easily-understood metaphor): the "Whole" and the "Tuner", a new version of the subject-object relationship, that would let us understand better the world around us, to set up the possibility of "multiple realities" and overcome old antinomies, of the Materialism Vs Idealism and Dualism vs. Monism kind, which have confronted rational thinking for a longer time than we would have desired.

Words like quantum mechanics, decoherence, antimatter, emerging properties, teletransportation, etc., etc., intimidate us unjustifiably by their complexity, for the lack of a clear and simple explanation that would allow a conceptual approach to them and, although some of these revolutionary ideas are nearly centennial, most of the population does not grab their incredible entailments, neither are there attempts to make these concepts easier and understandable

May be two, among many, of the most incredible conclusions at which the quantum theory arrives are: on the first place, the revolutionary idea that the outer world "reality" - the environment that surround us - that we feel, watch or measure in everyday life, does not depend exclusively on itself; it is always and lastly related, directly or indirectly, to interactions with our brain—the tuner—and, on the second place, these interactions can give way to multiple experiences or versions of that everyday "reality", thus making what is known as the multiple worlds interpretation theory (MWI).

From this new focus or point of view posed by the Quantum Theory, the old and venerable human pretension to know the "essence" or the "being" of things or the thing in "itself" is simply a chimera, because for something to "be", "exist" or incorporate in our "reality" it is necessary that that thing or its constituting elements interact - demonstrate themselves - directly or indirectly with our senses. This condition is not fulfilled in any of the mentioned expressions as these refer specifically and emphatically to the interior or characteristic of the thing, conforming in all cases one of the many traps or paradoxes expected by our form of expression. That is to say, that we only know the direct or indirect interactions of things with our

brain through the different senses and functions of our body.

From this point there arose the difficulties faced by those who wanted to define reality's intimate nature, since whatever the method used to detect it, it is always about interactions, that depend not only on the interacting local elements but also on the context in which they do it and on the particularities of the observation method and subject's judgment.

In other words, for something to "exist", that is to say, for an object or thing to be, an interaction with another element or thing that would act as a subject and vice versa is necessary; if not, we would be facing what we define as nothingness, nothing.

It is just the Quantum Theory, with its uncertainty principle, its probability waves equation, the wave function collapse, and so on, the intellectual tool that lets us speculate with the possibility that there may exist different "realities" in nature—the whole—that reveal themselves only according to the characteristics of the interactions between the object from the environment and the subject (in this case our brain or tuner); all this, if we only speak about the recently known interaction levels.

Summarizing, my intention is to leave at hand of any person who asks himself/herself about his/her role in this open adventure life offers, another explanation of the brain's function, in particular the human brain which I think it is similar to a tuner, using this didactic metaphor with clear arguments linked to well-known elements, and also coherent and compatible with the ideas that great author gave us from the intellectual joy of his prose and poetry in line with the last advances of human knowledge.

Without neglecting other explanations, I think human brain functioning resembles—only as a parabola or an explanatory metaphor—the functioning of a radio or TV tuner, that instead of producing sounds or images, in this case it produces ideas, abstractions and consciousness knowledge and awareness, thus using this resemblance in the same way as the metaphoric term "Big Bang" could express so successfully our universe's primigenial explosion (although it is only a mere approximation).

The idea or metaphor of thinking about the brain as a machine is not new as it is consciously or unconsciously used by the immense majority of scientific people who deal with neurosciences and medicine in general. What may have a feature of novelty is the idea of assimilating brain functioning to a tuner function and I have only found one similar reference in the case of the already centennial Swiss chemist, Dr. Albert Hofmann, inventor of the unfairly treated lysergic acid diethylamide (LSD), who in his book: "Interior Word, Outer World", pages 33 through 44 (Humanics New Age; 1989) he refers to the brain as

acting like a tuner of reality, that produces consciousness and awareness.

Paraphrasing the legal lexicon, I could say that I will try to justify each concept used, by those explanations that constitute the "factual evidence", "proofs" or "traces" agreed upon by most present scientists. Moreover, it is not less important to add that these opinions concur on the fact that our present scientific knowledge is far from being a certainty in absolute terms and that it will surely be modified, enlarged and may be improved in the times to come.

Memes, purest ideas and concepts like time and space, so intimate and natural to our reasoning and daily experience, have suffered the assault of new theories and little is left of the primary common sense certainty, as a result of the dimensionality (macro- daily situation) in which our existence normally goes through and to which we have got used to, but not submitted.

Thus, we find that even relatively new explanations of the atom's structure, like a mini planetary system, or about the origin and fate of the universe, such as the "Big Bang" and the "Big Crunch", are now being dramatically questioned, proposing unsuspected consequences. I firmly believe and assert in this essay, that it will be very difficult for science to give us all the answers about the nature of things, "reality" and our relationship with it, but I hope evolution will take us that way.

In this concise summary of "Borges, The Quantum Theory and Parallel Universes" essay, I want to highlight the explaining basement for both, the "Whole" proto-theory and the "Tuner" metaphor, using the least phrasing and technical formulation as possible in order to draw the almost shocking relativist and quantum concepts near an educated population, yet, without a particular physical- mathematical background.

The Whole and the Tuner  
(A tale about us and "reality")  
Eternity beats

In cosmology – the science or a group of sciences that study the general laws that govern the physical world of our universe considered as a unity-, when scientists refer to the origin of the universe using the illustrative and well-known "Big Bang" metaphor, in what is nowadays accepted as the "Standard Model" explanatory of reality and its structure, they generally use the following argument that reads like this:

*"...going back in time farther than this singularity, when and where time or space did not exist at all. From this nothingness space- time emerged, and with it, everything else emerged,..."*, etc., etc.,

Most explanations suggest that there was nothing before the Big Bang or "Great Explosion", neither time nor space, and that these dimensions are created in that

initial moment sprung from that nothing. Following is how Peter W. Atkins, among others, explains it. He is a well-known chemistry-physics professor in Oxford, member of Lincoln College Council and author of the best-seller *The Creation* (1) who in chapter 5 (page 117, Biblioteca Científica Salvat, Ed. Salvat Editores S. A.) says:

“Let us go back in time now, farther than the moment of creation, when and where time or space did not exist at all. From this nothingness space-time emerged, and with it, everything else appeared.

*In time, knowledge also emerged; and the universe, which at the beginning did not exist, became conscious.*

*Now, in the time before time there is nothing but extreme simplicity. In fact, there is nothing; but, in order to understand the nature of this nothingness, the mind needs some type of support. This means that, at least for the time being, we have to think of something. So, and no more, for the time being, we will think of almost nothing.*

*We will try to think, not of space-time in itself, but of space-time before being such. Although I can not say exactly what this means, I will try to point out how we can start to face it. The important thing to have in mind is that it is possible to think about a structureless space-time and that, after some consideration, it is possible to shape a mental image of that geometrically shapeless state.*

*Let us imagine that the entities that are about to be structured in space-time, and later, in elements and elephants, are like shapeless powder. Now, at the time we are considering, there is no space-time, only powder from which space-time will take shape. The lack of space-time and the lack of geometry only means that one can not say that this point is near or far from the other one; one can not even say that this thing comes before or after the other thing. In these circumstances, there is an absolute amorphous state. Later, we will have to sweep away even dust; but this, like every simplicity, will take care of itself....”*

Other important thinkers, as well as Atkins, consider the beginning of the known universe from a singular event that everybody knows as the “Big Bang”, before which time and space did not exist, as if everything had started from zero in that supposed beginning of all history.

From my point of view, that flash known as “Big Bang” is just – no more no less - that point or space-time singularity back to which we can project, with some rationality, the past (in fact, back to the moment 10<sup>-43</sup> exposed to the minus 43 seconds, which corresponds, approximately to the 10 septillionth part of a second, Planck’s time) after that beginning, the application of our present knowledge about natural laws, the behavior and movement of matter and energy observed in the universe, especially in face of the stars

expansion confirmed by the astronomer Hubble in 1929 and the coherent evolutionary process recorded in all the different manifestations of the universe, from the primigenium magma or plasma, through atoms and molecules to monkeys, fleas, men and the galaxies.

Nowadays, there is a precarious, relative and, surely transitory, general agreement among scientists as regards the “Big Bang” being the limit moment or situation or space-time singularity before which nothing can be scientifically stated; nor about time not even space, which is something completely different from accepting that before the Big Bang nothing existed or that our universe emerged from nothingness, like an unexpected miracle.

Scientists used to believe that the supernovas or the black holes were weird events in the universe and they even doubted about their existence; nowadays, we know that they happen everywhere in the cosmos. Likewise, there are many scientific speculations that consider numerous “Big Bangs” in every size that happen regularly in the relative infinitude of space, as Sean Carroll, a physics teacher in Chicago University, and the graduate Jennifer Chen assert, generating new and particular universes shaped from gravitational crises in the core of the frightening black holes through, maybe, the up-to-the-moment unknown and mysterious warm holes.

Also and from different disciplines, other authors agree with these brand new criteria. In his book “The infinite in the palm of the hand” Mathew Richard, a Buddhist monk of French origin with a scientific background in biology, together with Trinh Xuan Thuan, a Vietnamese astrophysics, tell us in their book, (Editorial Urano; 2001; pag.37):

*“...The idea of the “beginning” is, no doubt, an essential worry of all religions and of science. The Big Bang theory, according to which the universe was created approximately fifteen thousand million years ago, together with time and space, is the best explanation of the visible world. Buddhism tackles this problem in a very different way: it asks itself if a “beginning” is really necessary and asks about the reality of what could have gained existence in such a way.*

*Is the physics’ Big Bang a primordial explosion or the beginning of a certain cycle in a succession without opening or end of an incalculable number of universes?*

*Do our habitual concepts let us understand the ideas of origin and absence of origin? Doesn’t this idea reflect our tendency to consider all phenomena as things, i.e., to consider them things blessed with an intrinsic reality? ...”*

Following the order of this reasoning, and according to what I have said, I believe that we can define “nothing, nothingness” as the lack or absolute absence of elements that can interact directly or

indirectly with sensitive elements of our intellect (our brain, the tuner) in a certain and limited space-time region.

Of course, this is always something transitory and full of potentialities.

So, and beyond a possible religious interpretation, when we speak of nothing as a possible situation prior to the “Big Ban”, we are evidently in the presence of a simple declaration of ignorance or a mistake, a wrong explanation, and we would have to think of a new conception of what nothing is as I propose above, as by definition, “nothing” contains nothing, nor time, nor space, not even any type of powder .

Even quantum fluctuations require something that fluctuates, whether real or virtual particles, beyond any word play.

Reasonably, and just to use what most of us consider the best method human beings have to interpret things from “reality” through statements based on logic and checked by experience empiric data, there seems to be only three possible states or situations previous to the moment of the hypothetical origin of this our known universe, or this particular “Big Bang”:

- The futile and contradictory nothingness, which we have already discarded with enough logical arguments as the generator of any “reality”;

- that there exists only something, which seems incomplete; I do not find a logical supporting argument, unless we take as valid the metaphor of the “Tuner” described below;

- Finally, the alternative of the “Whole” is left, for everything we can or we cannot even imagine nowadays; it seems not to have logical contradictions and it is justified within the framework of the “Tuner” metaphor , which completes and accompanies it from the perspective of human consciousness or awareness.

On my part, and within the framework of the explanatory coherence I pretend to support, I find it more logical, feasible, easy, reasonable and useful, to believe that our universe emerged as part or something (a cycle?) of a “Whole”- original, previous and permanent, made of the totality of the basic elements of nature and which , for the time being, lies greatly, “*beyond*” our present sensitivity and possibility of understanding, although not far from a certain amount of based argumentation.

From these particularities, new (though not necessarily unique or unedited) and different relationships—interactions—among some components of this permanent “Whole”, there emerged and emerge, in each space time singularity known as “Big Bang”, different elements with unlike characteristics that developed and develop in organisms of growing complexity, which perceive time and space, as for example, we in this our universe.

What do I refer to? What is this “Whole” made of? Why do I say that perceived “reality” is only one part of this permanent “Whole”? I will try an explanation:

Development of the theory of the “Whole” and the “Tuner” metaphor

First of all, and after overcoming the basic Cartesian doubt and the ecstasy produced by the fact of being aware and proving that there exists “something” instead of “nothing”, I understand that even with language restrictions and limitations, we have to define certain elements in order to tackle coherently the data that experience gives us to answer questions such as:

What is that that “exists”? What is “reality” made of?

Most of us will surely agree on the fact that saying that reality is what it is or that things are what they are is a sovereign tautology that does not help us at all in the task of understanding nature, taking the latter as everything that surrounds us, even ourselves and the mutual relationships, according to the experiences that life poses.

Probably most people will also agree that every thing, element or individual has a nature of its own, particular, unique and distinct; that is to say, Perón was J.D. Perón, the Argentine president of the early fifties, Julius Caesar was the antique roman emperor in 50’s BC, J.F. Kennedy was the American president who was murdered in Dallas, Texas, on 22 November 1963, Adolf Hitler was the German dictator who began the World War II, Chita was Edgar Rice Bourroghs’s Tarzan’s monkey, and Rin Tin-Tin was the most generous and intelligent dog that we remember on TV. Likewise, each one of their numerous homonym’s or not of these characters, each atom, object, particle or individual that belongs to the known universe had, has or will have its own unique and particular identity or entity in time and space.

Well,... according to the Quantum Theory, all this may not be entirely true (or at least, it may constitute a partial version of the infinite nature of things). Let us see:

According to Bohr and Heisseberg’s *complementary principle*, also known as the duality wave/particle paradox, the subatomic elements which constitute the whole “reality” or known matter/energy, may be or behave: as a particle or as a wave. Moreover, according to the “*uncertainty principle*” (Heisseberg), these multifaceted freaks may be found at any point in space/time, not being able to establish simultaneously their precise position and movement.

Accepting the validity of these principles (as apparently science does), and considering that each element from “reality” is in the last instance the result of a subject/object interaction and vice versa, we inexorably have to admit that such element considered punctual in traditional space/time, accepts now (in the

light of the mentioned quantum principles), and also as a complement, a multiple interpretation, when taking the particle as a wave, and under that consideration, it will be a multi-interaction.

If at this point of the argument you are beginning to distrust this reasoning, neither feel bad about it nor think you are the only skeptical person: even Albert Einstein had always rejected these assumptions (“God does not play dice”, he used to say) and he tried to rebuff them till the day he died..... unsuccessfully.

The Quantum Theory is the most successful and inclusive one of physical science reasoning and in it and by it, it is argued that there may not be only one “reality”; there may exist potentially infinite “realities” and identities, as many as there are elements, either object-subject or subject-objects which interact among each other.

Borges poetically expresses these doubts about the entity and identity of things, the impossible time return and its relationship with the being’s multiple consciousness, and he regrets about it in his essay: “New Time Refutation”, written in 1946 and included in “Other Inquisitions” (1952):

“And yet, and yet... To deny time progression, to deny the I, to deny the astronomical universe, are apparent miseries and a secret relief.

*Our destiny (different from Swedenborg’s hell and Tibetan mythology’s inferno) is not horrifying for being unreal; it is horrifying because it is irreversible and made of iron.*

*Time is the substance which I’m made of.*

*Time is a river which carries me away, but I’m the river;*

*It’s a tiger that breaks me into pieces, but I’m the tiger;*

*It’s a fire that consumes me, but I’m the fire.*

*The world, unfortunately, is real;*

*I, am, unfortunately Borges”...*

Also in “El jardín de los senderos que bifurcan” (The Garden of the Bifurcating Paths), through its characters, Borges tells us of his suspicions about the potential multiplicity of “reality”:

*“...In every fiction, every time a man faces different alternatives, he chooses one and discards the other ones; in the almost inextricable Ts’ui Pên’s, he decides – simultaneously - in favor of all of them. In this way, he creates diverse futures, various times, which also multiply and bifurcate. Here lies the novel’s contradictions. Fang, let us say, has a secret; an unknown man knocks at his door; Fang decides to kill him. Naturally, there are various possible outcomes: Fang can kill the intruder, this one can kill Fang, both of them can survive, both of them can die, etc. In Ts’ui Pên’s story, all the outcomes happen....”*

With no delay I should state that in my opinion, there exists a basic permanent nature made up of

something like a kind of a non differentiated element/wave or primordial dimension. Such is the case of the “one-dimensional resonators or oscillators of which the last physic-mathematical speculations speak about (see Crotti’s [HYPERLINK http://www.geocities.com/macpetrol/Waves\\_and\\_Particles.html](http://www.geocities.com/macpetrol/Waves_and_Particles.html), among other Internet pages or sites, by Engineering M. Crotti, or may be the membranes of the hard working but prolific “M Theory” by Edward Witten, awarded the Fields Medal in 1990—equivalent to a Nobel Prize, in mathematics – and other renown thinkers that do not use to spend time foolishly). From this point or by it, through different types of interactions between each other, different phenomena, elements or dimensions give way, that in turn, when they evolve - new interactions at each level - they give place to the development (here I was tempted to add the word “final”, but I think it is exaggeratedly anthropic) of new characteristics, among which are those individuals - like us - who have self-conscious properties, among other ones.

I call the “Whole” to that basic permanent, omnipotent and may be one-dimensional continuous nature, where there is no proper time arrow, what the prominent American physicist Richard Phillip Feynman (1918-1988) called “the sum of all stories”.

We know by our own experience that there exists at least one universe – ours - which was formed in that singularity we know as “Big Bang” and which developed, among other emergencies, up to one of these types of phenomena with consciousness, awareness, and knowledge of one part of the “Whole” that we identify as human beings, homo Sapiens Sapiens, man, in the last instance, us, the “tuners” of the “Whole”, which make up, among other things, something we define as “reality”.

The “reality” we know, perceive and accept as such, the physical universe “reality”, is experienced and recognized through various ways: we see something with our eyes; we hear something with our ears; we smell something with our nose; we touch something with our hands or the contact or graze of our skin. Afterwards, when these different signals or interactions with the outer world are processed somewhere and somehow by our brain, we decide that there is something, that we know or feel about “something”; summing up, we shape a “reality”.

There is no scientific evidence about any other kind of interaction between our brain and the world that surrounds us; it has not been seriously verified, no matter how hard it has been searched for, the existence of any type of extra sensorial communication, telepathy or similar esoterism, that if they existed, they would also be interactions.

That is to say, scientifically speaking, it is only through our senses that we interact with some of the

elements of the outer world or environment, thus generating certain signals that are transmitted to our brain. Nevertheless, the only way to know or be conscious of those “things” or outer object is through the subsequent neural (or mental, if you prefer) processing of the signals in our brain/tuner.

It is worth remembering and stressing that although our senses receive different types of signals from the environment, such as light waves in our eyes, sound waves or air vibrations in our ears, vapors, gases or air suspensions in our nose, liquid solutions in our mouth and tongue or contacts of our skin with different bodies and surfaces, etc., etc., no part, “particle” or wave from these bodies, substances, objects, or external elements reach the brain directly in order to be interpreted, it is only a matter of interactions.

Thus, sounds, smells, tastes, colors, etc. etc. such as, and how, they are perceived, do not exist in the world outside us, they are perceptions and feelings that turn concrete and are recognized as such in our interior, in our consciousness, when waves/particles (air pressure waves, matter and/or energy radiations, different atoms and molecules, etc., etc.) of this world or outer environment interact with the corresponding nervous terminals of our senses. As stated more spiritually but with the same reasoning by the already mentioned and well known Swiss chemist from Sandoz Laboratories, Dr Albert Hoffman (almost accidental discoverer of LSD and explorer of what today is known as “consciousness altered states”): “... *We always have an external prompting, maybe chemical if we eat something, and this chemistry in my body produces an impulse that reaches my brain and in turn my mind says: “sweet, sweet...”*. Thus, all this connection between the material and the spiritual worlds takes place in our brain, in the different systems centers of the brain. Up to this point we can follow up the energetic waves that come from outside... but here starts the spiritual world because, for example, the sound does not exist in the outside world, there, only air vibrations exist, sound as perceived by us is spiritual, as tastes and images...”

The nervous terminals in our senses are the ones in charge of picking up (as an antennae tuner would) and transmitting (as a tuner’s conductors would) the codified signals with the corresponding information from the object (the something or part of the external Whole) to different areas of the brain. This is done as electro-biochemical processes called nervous impulses (synapses, chemical potentials, electro-chemicals, neurotransmitters, etc), which are pretty well known processes, essentially based on electromagnetic interactions, somehow similar to electric currents in tuners’ wires. Lastly, in a third stage these interactions are processed inside the brain where they are transformed into consciousness, awareness and

eventually, different actions like efferent manifestations, in a similar way, though far more complex, in which the invisible and electromagnetic waves in the “ether” turn into determined and precise air-pressure waves (radio sounds) or other kind of codified and visible luminance radiations (TV images) in the different types of tuners.

But nothing, absolutely anything from the outer world with respect to us, not waves nor particles, gets into or is processed or interacts *directly* with our brain or mind; it is just a matter of transmitting and processing specific codified electro-biochemical signals; these being very well-known signals, product of the interactions of our sensitive system (the tuner) with the outer world or environment (the something or part of the “Whole”), ... again, only interactions.

The knowledge of the first two stages of this process has reached to such an extent that nowadays cybernetics subjugates us with the possibilities of “virtual reality” that has little or nothing to do with concrete objects of our environment: They are simply artificial signals that imitate and substitute the natural process in those stages. Also, in some medical centers, cochlear implants are regular surgeries, where a bunch of electrodes are directly connected to the brain in order to produce “hearing” in certain types of deafness and similar efforts are being done to produce artificial sight or, in the efferent sense, to be able to move objects with the brain through electrical circuits directly connected to the brain or by a wireless connection between the brain and a robot, once the motion signals from the individual’s mind are codified.

Although, so far, nobody can tell for sure in what specific place in our brain/tuner such phenomena of the third stage we know as consciousness, knowledge and awareness take place, neither do we know the mechanisms which explain them, there is a general agreement—particularly based on the neurosciences field—that they are new ways or neuronal tracks that are created with every experience and recorded as we repeat them together with or as complement to the pre-existent connections in the brain/tuner of every species, according to their genetic pattern.

The researcher Dr. Fernando Cárdenas Parra, from the Psychobiology Department of San Pablo University, Brazil, asserts in his more than relevant Internet articles “Mental Representation and Awareness”:

“Anatomy and physiology of brain representation

*Million elements are grasped at every instant thanks to sensitivity systems, which acting out as filters, let in only an infinitesimal part of the outer world, that part which, along the evolutionary history of life on this planet became of crucial relevance for self-preservation of organisms.*

*Apart from not being related to the totality of the real world, this reflex of the different characteristics of matter, is decoded by the sensitive receptors in nervous*

signals and as such is kept inside the biological system. Notwithstanding, later in time, it may be turned into “outputs” of movement, endocrine, exocrine, cognizant or verbal nature. When tracing the anatomophysiology of the different sensorial paths, a process of disintegration of the perceptual units into their minimum components is reached.

Initially, environmental information excites a group of receptors, which, in their connection with the “first end” (or more appropriately the initiations) of the nervous terminals decode that information into nervous activity in the shape of a local modification of the Na<sup>+</sup> and K<sup>+</sup> trans-membrane ionic cumulus. This modification moves through the axon at a speed ranging from 20 to 120 m/sec., ending at the other end of the nerve-cell with the relief of transmitting substances, which, in turn, act as a new stimulus for the nerve cells or other cells on which they make contact. This process, in the case of sensorial systems (except for the olfactory system) comes up to a series of neural aggregates or nucleus called altogether thalamus, with such a precise organization that it is possible to determine somatic, visual or auditory representation maps in the ventral, posterolateral, lateral geniculate and medial geniculate nucleuses, respectively. Such maps of the body, retina or cochlea are kept in the brain cortex with identical precision, once the impulses are transmitted from the thalamus.

Obviously, the information does not maintain a unique path in series, that is to say, the nervous impulses originated in certain receptors, apart from being transmitted to the brain cortex, are sent to other locations, (amygdala, hippocampus, superior and inferior colliculus, reticular formation, etc). This process shows an architectonical parallel organization, simultaneous with a series one, based on the principles of convergence and divergence of synaptic connectivity, thus conforming information processing nets or meshes. The recurrent activation of the same connection nodes establishes a process which is an unprecedented evolutionary gain, pillar for the development of animal biological systems: memory; initially by a simple electro-chemical facilitation for the work of certain synaptic connections (short-term memory), and lately, as a generator of new synaptic contacts, that is, physical modification of the structure itself (long-term or permanent memory)”...

And, among other considerations, he recommends taking the following with care:

“...Partial conclusions

Evidently, awareness in spite of being a brain process, can not be located specifically in any restricted area; thus, it corresponds more to a temporal work of the anatomic circuits excited externalyl and intrinsically; “...anatomy as a space and physiology as temporal dynamics” (Jaramillo, D., in printers)

One of the most shocking points that arise from all this makes reference to the fact that the physiological change produced to the system’s inside by the stimulation received is least (in activity rhythms, pulse patterns or evoked potential trains in certain neuronal populations both thalamic and cortical). This means that there is a back stage (the system’s spontaneous activity) on which the received information makes a little alteration. At least three important consequences can emerge from this statement:

a) minimum variations of the spontaneous activity lead to quite different subjective perceptions, with which the potential variability of different subjective situations is infinite, as it is the potential variability of different physiological states.

b) the subjective experience as such already exists in the system’s inside and the external sensorial information would only “polish” this experience, highlighting some traits and toning down others.

c) the difference between the subjective awareness experienced by organisms would only depend on the relative differentiation of their anatomo-physiological organization; however, the similarity of subjective states of awareness is immense, due to the genetic similarities of the organisms pertaining to the same species (same-species-organisms’ design). That means that our subjective worlds are much more alike than we wished, from this, we can share consensus or achieve empathy (assuming as taking the place of another person)

Relating the data obtained by Mountcastle, V. and Edelman, G. as regards the functional organization of the brain cortex in cortical columns or modules, with the concepts dealt with, it is possible to introduce certain ideas through which we can put together the experimentally and clinically found events and in turn find greater coherence in the conclusions mentioned in the previous paragraph...”

Therefore, I assert that the “reality” we know today may not be all that exists. There may be other elements of the “Whole” (for our present: year 2005 A.C.) that have not interacted with our senses yet, may be because they have not been needed by our evolutionary branch so far, and thus have not been incorporated into our present knowledge and speculations. For example, a possible candidate to emerge shortly, although only partially and only valid for our universe, is something which has been strongly outlined among astronomers, physicists and cosmologists in the last years: the enigma “dark matter and/or energy”, which some estimations place in approximately 20-25 times the addition of all known matter and energy (baryonic) as factor and necessary value so that certain numbers of the so called “Standard Model” “fit”.

I also state that man recognises only part of the “Whole”, because it is obvious and evident that day by

day new things are incorporated to his “reality”, to his consciousness his awareness and general knowledge, in an evolutionary process that – almost - nobody can deny nowadays, in spite of the doubts about its origin.

About this conceited permanent increase in our capability to understand the nature of “tuning” the “Whole”, a curious, enigmatic or paradoxical consideration - among others - can be summarized in a remark that is contradictory at first sight:

It would seem that the more we know about the “Whole”, the bigger is our ignorance; or in other words: for every answer to a question, many new questions arise; or another extreme form of saying the same: as the field of our knowledge broadens, unfortunately the horizon of our ignorance becomes larger..., from this point my doubt about what we can boast about.

Using an expression that belongs to our football slang or jargon, we could say, “evolution is permanently moving the goal away”, and this is really scary.

In order to better understand how human consciousness, awareness and knowledge work, I appeal to a well-known literary image, a metaphor, and I propose the model or parabola of the “tuner”, as an explanation about how a human being’s body, especially its senses, brain and intellect, interacts with the “Whole”, generating consciousness, knowledge, awareness, and, eventually, efferent actions.

At this point of development of this reasoning, and taking into account the confusion in most known languages with respect to the meaning of the words consciousness, awareness, self-consciousness, etc., etc., to the sole effect of using them in this summary of the essay “Borges, Teoría...”, it may be worth making clear the terminology used:

1) When I use the word consciousness, I am referring to the capacity, that in greater or lesser degree, all living beings have to grasp the environment or outer world around them and to act accordingly. For example to escape or defend themselves from hazards and dangers, get the necessary sustenance, etc., etc..

Instead, when I use the word awareness, I want to refer to the capacity that almost exclusively - and thus can be expressed - in greater or lesser degree, human beings mentally developed and sane have in their interaction with the environment when they are awake and attentive.

Of course in both cases, consciousness and awareness, it is possible to consider different degrees of attention, concentration and other circumstances that can blur the limits of the definition given, but, almost undoubtedly - at least in the neurosciences consideration – it is always about “properties emerging” from the interaction of every individual’s CNS, particularly its brain, with the surrounding world, generating in first instance a certain type of mental representation and also different types of eventual

internal “abstractions” conformed or produced by the consequent neuronal activity.

Apparently there is a specific neural processing that it is supposed to be produced redundant and comparatively only in men’s extended frontal lobules, the responsible for the emergence of awareness, qualia and other manifestations exclusive of human beings.

Most of the work being done on this subject, can be visualised or appreciated in any Internet search engine (browser). For example if we look for “Awareness vs. Consciousness “ or Self-Awareness vs. Consciousness in Google we can find more than one million four hundred thousand (1,400,000) (“variopintas”) entries in English and approximately six hundred and fifty (650) entries if we prefer the Spanish language for: “Conciencia vs. Consciencia”, with (also “variopintos”) articles referred to this subject.

In those articles we can see that both, in English and in Spanish, these two words: “awareness or consciousness” in English and “conciencia o consciencia” in Spanish, are practically synonyms and that it is necessary to undergo a deep and wise lucubration to establish subtle but, for some analyses, major differences of interpretation, as for example to consider or not mental representation in one case, qualias, self-awareness or self-consciousness in others, etc. etc.

In my case, by this means, I try to clearly establish a difference that dictionaries in both languages do not show or reflect and that the undeniable evolution process has established between brain/mind/human tuner functioning and the corresponding functioning of the rest of the living beings.

As it can be seen, the limitations sometimes imposed by language can be overcome if we previously agree upon, delimit and state clearly the phraseology to be used; something that seem to be easy at first, but that in practice esotericism and certain cases of recalcitrant fundamentalisms, are in charge of denying.

There are still those who emphatically reject the evolution process or Darwinism, among other reasons, because they have not yet found the perfect “lost link”, when really there are thousands of fossils and other elements found from our ancestors, such as tools, ornaments, etc. that duly dated and classified, render non contrastable proofs of an almost routine evolution process, as the saying: “there is no worse blind that the one who does not want to see”.

#### **On the other hand:**

2) We believe and say that there “exist” different types of things, but in a first instance we could classify everything into two big groups:

a - concrete things: they can be detected directly (or also indirectly through instruments) by our senses and they have locations and dimensions that can be defined

in time and space; for example: water, an apple, fire, a stone, air, the sun, planets, a tree, radiations, a book, animals, atoms, etc.

b - abstract or ideal things: produced by cerebral or mental activity; for example, fashion, God, beauty, truth, good and evil, the devil, angels, desire, love, numbers, time and space, the soul, ideas, that is to say memes, general concepts and processes that have no defined space-time dimensions.

There is much more that could be added about the nature and characteristics of things, both concrete and abstract; at least, we can say the following:

- Back to the beginning of times, and still today, the amount of things that “exist” has been constantly increasing, the concrete ones - only since the appearance of awareness - as well as the abstract ones.

-Until recently, concrete things seemed to have certain degree of independence from the observer; this is still valid for macroscopic objects, but the situation changes dramatically since we have had access to the quantum or subatomic or microscopic level; instead, abstract things keep a kind of “personal touch” within their subjectivity, which every individual defines on his own.

-All concrete things may be conceptualized and symbolized, thus turning into abstract ones, but not all abstract things can have their corresponding concrete ones.

-We should also say that both types of things are bound to a permanent change of “status” and attributes; in this way, atoms, electrons, etc., were only abstractions or speculations in scientists’ mind/brain/tuners, while nowadays science and technology allow to manipulate such objects both in time and space, with the same or more precision than Maradona mastering a football. Likewise, but in the opposite direction, those same concrete elements until a few years ago, now vanish in a mass of indeterminations and uncertainties when their intimate structure at the light of the scarce believable principles of the quantum theory are to be explained.

This process is what we call cognizant evolution and although we do not know every detail yet, we believe that it follows some intelligible rules. For example, quarks, electrons, positrons, radiations, pulsars and galaxies that are real and concrete things today, at least for the science man, surely did not belong to any human being’s “reality” or “existence” in the Middle Ages, not even in the most esoteric fantasies at those times, still less in Paleolithic times. Nevertheless, we know now that these concrete things were there as they are today, they belonged to them and accompanied them like silent, indifferent and unknown venture-mates, in the same way as today we can have no idea about other things that surround us or that are our constituents but that they will “exist” or become real in the year, let’s

say, 3050, supposing that there will still be conscience and awareness to detect them.

Repeating this reasoning, one could argue that the above mentioned elements are just mere and new combinations of the existent and known matter, but this is not so. What was that known matter that already “existed” for our ancestors?

As far as we know, the ancient Greek thought the world was made up of elementary and indivisible particles that Democritus called atoms, these proceeding from four basic types of matter: water, earth, fire and air and from which combination they gave place to all the other objects of the “reality”. Later on, in the course of the 17th, 18th and 19th centuries, there appeared the approximately one hundred chemical elements that integrate the periodic table today. Different radiations also interrupted in the 19th Century and it was on the past century that the antimatter was incorporated to everyday “reality”, just to mention some of the last elements that “emerged” to humanity’s knowledge, consciousness and awareness.

Something similar occurred, and still happens, with abstract things, ideas or memes: they have also increased in number, developed, at last, they have also evolved and evolve, at phylogenic as well as at ontogenetic level in every individual

Undoubtedly the frontier –if there is such a thing— that separates concrete from abstract things is blurred, elusive and voluble for human beings. Nobody questions today that a chip or a computer are things that belong to the concrete “reality”, but some time ago, they were only mere abstractions or scientific speculations. It is only due to our need to categorize things for a better understanding and grasping through language, that is the tool that we, human beings, use to understand among each others, thus dividing natural from artificial things as if they were different, but it is also possible to consider them as a simple - or complex if you prefer - evolutionary continuum.

So we see there is a close relationship between what “exists” and our awareness, as bishop G. Berkeley used to say far in the 18th. Century: “to be is to perceive”..., which is not at all the same to say that we perceive” everything” that exists.

Let me make clear what my agreements and discrepancies are with respect to this idealist position. In his Treaty on Human Knowledge Principles, G. Berkeley says:

*“There are some truths that lie so near the mind and are so obvious for it, that a man only needs to open his eyes to see them. From these, there is one which is utmost important, namely: that everything in the sky and on the earth, or, in one word, all those bodies that make the powerful structure of the world lack an independent substance from the mind, and their being consists of being perceived or known; consequently, as long as they*

*are not perceived by me or do not exist in my mind, or in any created spirit's, either they will not have any existence at all or if they do, they will have to survive in some eternal spirit's mind. Attributing any part of those things an independent existence from a spirit, would be completely unintelligible and would entail the absurdity of an abstraction".*

**Or also as Borges says:**

Curios about shade  
And frightened by the threat of daybreak  
I revived the tremendous conjecture  
By Schopenhauer and Berkeley  
That declares that the world  
Is an activity of our minds,  
A dream of our souls

With no base, or purpose, or volume" J. L. BORGES, "Fervor de Buenos Aires", (1923)

I agree with the bishop in that we say or define that something "exists" to everything that is perceived directly or indirectly by our senses, transmitted by our CNS and processed by our brain (tuner).

I disagree with him when he denies any kind of "existence" to everything which is not perceived (direct or indirectly) by our senses; it is surely another type of "existence", which we could very well define as potential or as everything that has not yet interacted (directly or indirectly) with our brain/tuner .

To support my disagreement, I propose to analyse what nowadays is accepted as the detailed description of the phenomenon called "perception", responsible for the conformation of what we know as "reality", at the light of the last scientific knowledge which, of course, the Irish bishop did not have on those days:

Perception is the interaction between the outer world and our brain/mind through different senses that make up the structure of our Central Nervous System (CNS).

Different stages can be identified in the perception process:

1 - Arrival, contact or interaction of the external signal (electromagnetic radiation, variable pressure wave, chemical substance, etc.) with the corresponding nervous terminals of the CNS;

2 - Generation/ transduction and transmission by electromagnetic interactions of the corresponding electro-biochemical codified signal by means of the CNS neuronal system(s) which operate in each case (synapses, neurotransmitters, etc.);

3 - De-codification and interpretation of the signal received in the different brain information-processing centers.

Although the details described in the first two stages of the perceptive process are very well studied and understood, it is the third stage - where human

knowledge, consciousness awareness are believed to reside- the one that presents the greater proportion of doubts for present neurobiological science .

This is considered neurosciences' hard problem: Which, how and where is the process that generates the sense of "I", of our personality and individuality, the site and essence of self-knowledge and awareness produced?

I dare think of neural mechanisms being similar to those that generate other kinds of elemental feelings/sensations such as pain, pleasure, anger, fear in animals consciousness, which evolution has taken to process in a more complex way and redundantly in the case of hominids, specifically in the new areas of human brain, as the frontal lobules, neocortex, etc, generating new sensations and unrest which did not affect our animal ancestors as for example: intellectual values (as regards this, I recommend reading Lewis Mumford's The Machine's Myth or Elkhonon Goldberg's "The Executive Brain" or Johnjoe Mc Fadden's Quantum Evolution)

Different research on the study of certain pathologies and brain strokes or injuries (accidents) which alter the normal functioning of the information-processing areas, such is the case of different kinds of agnosias - aphasia, amnesia, etc. - has allowed to establish in certain individuals, that in spite of receiving clear signals from the outer world that conform the first stage in perception, as well as operating the sensitive/transmitter/ transducer process described in the second stage correctly, a deficiency in the third and critical stage of human interpretation produces the subject's unconsciousness and ignorance of the variables affected. That is to say, that "reality" disappears from his mind; that "reality" does not "exist" for him; he will not recognize it in front of his wide open eyes and it is likely that he will even mock those who think otherwise. (See The Man Who Mistook His Wife for a Hat by Oliver Sacks; Editorial Gerald Duckworth & Co.; London; 1985).

I deeply believe that something similar happens naturally in the rest of the animal species: as they lack the redundant processing of the third stage, which is exclusive of human beings, all of them have - in a lesser or grater degree according to their sensitivity - a similar image, an equivalent consciousness of the surrounding reality, that is to say a similar - and even better and more complete in some cases - interaction experience between their senses and the outer environment, but none of them can process that information in their respective brains to produce awareness properly. That is to say, they know, but they do not know they do; or in other words, they are conscious of and in that "reality" but they are not aware of it; they lack a brain mechanism with the size - proportionally speaking - and complexity of our brain cortex, neocortex or frontal

lobules, that asks or compares redundantly the other neural functions.

In the same way as our children, adolescents and certain senile or sick personalities, they also have the same “reality” we have (the sound and well culturally and intellectually developed adults, with all the exceptions this conception may imply) in front them, but they lack the necessary intellectual capacity to interpret it in our way; we could say, comparatively, that they undergo different types of associative agnosia.

We could also state that while the adult, healthy human being knows that he/she knows, for the time being, that human being ignores how he/she knows it.

I keep inside a cruel suspicion that could also be called secret illusion: Which and how many natural and innate agnosias of the human species may there be?

On the one hand, I feel anguished to know or at least suspect, about the existence of other worlds, universes or dimensions - the infinite configurations of the Whole—that I can not perceive directly because of that innate hypothetical incapacity. But, on the other hand, those fears are limited and my hope encouraged because I know or infer that we can reach them and their different “realities”, maybe indirectly – not through the direct interaction with our senses – in some cases for the better others not so much, through the evolution of our intelligence, creativity, imagination, and, why not, the creasiest fantasy, that led to the artistic expressions of Rembrandt, Mozart, Verdi, Picasso, Proust, Borges, the genialities or scientific intuitions of a Leonardo Da Vinci, Newton, Maxwell, Planck, Julio Verne, Einstein, etc. but also to the foolishness of a Hitler in Germany or a Pol Pot in Cambodia, just to mention some deplorable events in the past century.

According to some authors we are dreaming machines, infinite story makers, creators of myths, gods and religions; from the freedom of our fantastic imagination to the technological wonders only limited by our scientific knowledge; all of them new interactions, capable of creating new “realities”—from art, faith, science, etc. —which exceed the perceptive “reality”.

This mindset drives me to think that, in the last instance, the “WHOLE” exists, as the sum of the universe we perceive today and of what it is – may be just for the moment - *beyond* our senses and knowledge.

This means that there “exists” a growing “reality” that we identify directly or indirectly by the interaction of our senses with the outer world as part of or something of a “Whole”, which is fundamental, continuous, basic and permanent of which we grasp partial aspects as a “tuner” does, though our body, mainly the CNS and the brain, where a complex and so far not very well known neural mechanism finally

produces what is known as consciousness, knowledge, awareness, and eventual efferent actions.

It is evident that everyday, with no hints of exceptions in the known story, we are constantly broadening that “reality” by interacting, in some way tuning, with some of the other elements of the “Whole”, that lie beyond the immediate perception.

Those who believe that there is nothing beyond our senses and knowledge, should have in mind the following:

- In the same way as a given “tuner” is not capable of processing every different wave that reaches it, our senses do not “grasp” all the range of phenomena they are supposed to; for example, our sight only detects a very small fraction of electromagnetic waves; our ears are incapable of hearing infra or ultra sounds not at reach of our sensitivity, etc. This shows that a big part of “reality” is out of reach of our direct perception.

- With the development of neurosciences certain pathologies and accidents can be detected, where neural systems are injured, producing what in medicine is known as agnosia, aphasias, amnesias and other similar disorders which cause “loss” of reality. Thus, it is admissible to assume the possibility of other potential interactions unknown for the time being.

In order to better grasp this concept of the mentioned interaction between the “Whole” and our body in the production of knowledge, consciousness, awareness and efferent actions, I propose the “tuner” metaphor that I will explain later and moreover, I believe that this new activity - what is mental, the abstract thinking with self-knowledge - had a start in our known universe with the brain development—the tuner—and the appearance in it of those early redundant functions, some million years ago in the primates, modern men’s ancestors.

How things and ideas developed up to the quantum mechanics

All concrete things are made up of what at first were thought to be indivisible elemental particles, something like matter balls, identifiable in time and space, as for example, Democrito’s atoms.

It was not until the beginning of the last century that Rutherford, Bohr and other researchers proposed a new atom model according to which it was no longer an indivisible ball as the Greek thinker originally thought, but it had a central massive nucleus with positive charge around which smaller and lighter particles with negative charge, the electrons, revolved at different distances from each other.

This miniature solar-system like scheme worked very well as an explanation of the atom according to the classic or Newtonian mechanics principles, we could add, almost keeping with common sense; but, unfortunately, some complain all this scheme began to crack almost simultaneously with the new relativist

concepts and it collapsed with the amazing and hard to believe Quantum Theory. This theory proposed the almost utter disappearance of matter continuity, displacing it by the discrete properties of elementary “particles” (tiny subatomic elements) that included probability waves and other similar, more diffuse and less precisely located – in time and space - lively things. That is to say, the nucleus itself was no longer a small solid and indivisible ball but was in turn made up of “particles” or smaller wave-packets: protons and neutrons that were neither indivisible as the other smaller and less defined or concrete entities in turn integrated them.

Let us put it clearly: the universe, concrete things, kept being externally the same that have always been to our senses, but now these interacted (generally indirectly, through devices and instruments and sophisticated devices such as particle accelerators/colliders in the case of subatomic or super-radio-telescopes for big cosmic bodies) and our brain also processed other levels of the external “reality”. We had penetrated in a world of dimensions or magnitudes so different to everyday experience, where it was logical to expect things and behaviors different from the ones we were used to.

Let us remember that good man or indigenous if you prefer, who belonged to a country or tribe who believed they were the only ones in the world and that by a strange accident they found themselves immersed in another planet, country and culture unknown by them, how do you think they might have felt?... at least, confused and bewildered.

I think this is the situation of the Homo Sapiens Sapiens and some of his nearest ancestors: a continuous amazement and bewilderment before new things; but, as soon as the first doubts and fears were over, their growing intellectual background came into play and the inertia of evolution continues its way.

Those who believe in Darwinian or natural evolution, think this is a good, though precarious explanation - the only one available at present - of the long run since our “Big Bang”. We also think that awareness as well as abstract knowledge are unedited emerging elements, product of the activity of a new and bigger brain, let us say the last evolution development, in the same way other emerging properties were, as life, intelligence, homeostatic equilibrium, consciousness, etc., in the known history of nature.

This was how, thanks to the relativities of what is immensely big, we lost deep concepts as absolute times, the flat earth, simultaneousness (see M. Crotti) and there appeared other exiting concepts as curved spaces, black holes, quasars, galaxies and similar spatial wonders our forefathers did not even dream of and which propose us trips to new universes or dimensions through exotic worm holes.

In the other end, in what is immensely small, the shocking Quantum Theory eliminated some years later, the image of the electron as a planet revolving around its star, and it replaced it by a cloud of juxtaposed (entangled) probabilities that could be placed almost anywhere in the universe, giving place, among other weird things, to the possibility of meeting infinite parallel universes (David Deutsch, in: “The Fabric of Reality”, PenguinBooks, London, 1997), as we will see later.

Eventually, ...again, the anguish of our ignorance joined in the infiniteness of extremes.

A similar evolution phenomenon may be considered for abstract things, but in this case, the amount of present knowledge about the intimate nature of these kinds of things is even more limited.

### **Paradigm changes that the new “reality” proposes**

The duality wave/particle as fundamental constituent of what is concrete is nowadays accepted, almost without blushing, as the same subatomic element can manifest itself in discernible particles or waves, according to the mechanism or device used to observe it, as it happens in the well known experiments on optical interferences of grids.

What happened? Maybe “Reality” has changed? Yes and no.

What happens is that, when we change the observation scale, as science went into the subatomic world, we face new things or “realities”, which although they have always been there, behaving in the same way, they were inaccessible to our ancestors’ brains – or “tuners”— to their consciousness, awareness and knowledge; therefore, those things did not “exist”, did not take part in any “reality”.

Nowadays, we can assume that those “particles” that interact among concrete things of the outer world and our senses are the quarks, electrons, muons, and other fundamental products which lie on the borderline of what are the smallest ones, according to the latest science communications. On my part, I prefer to suspect that other still smaller incredible creatures lie, as Russian dolls, in the deep inside and *beyond* the “reality”, that is known today, such as other constituents of the “Whole”, with which we have not interacted yet, either under a consciousness or an awareness fashion, and that will surely come to light as we develop our “tuners”, rendering new and not even today imaginable amazements.

I would like to point out that when I refer to the word “particle” these inverted commas are justified because in the quantum scale (subatomic), what we know as concrete matter or “reality”: electrons, quarks, etc. lose or transform their characteristics before us, appearing like waves also, depending on the use of devices, either to detect or to measure them, thus losing

their space/time specificity and their location is best expressed in those cases as a probability function or wave equation (Schrödinger).

Moreover, from theoretical developments by Einstein, Plank and others, it was demonstrated that matter and energy (everything we know) were different manifestations of the same elemental thing.

Following this, luminescence radiation waves can be interpreted as “particles”: the photon or wave packets or quantum, according to the work of scientists such as Plank, Heisemberg, Schrödinger, Dirac, among others. Also, a “particle” as an electron may be described as a kind of wave, which loses or changes its specific characteristics, according to the approach method used.

For the first time in history — apart from G Berkeley’s and his followers’ idealism— it is being admitted that the “reality” which is observed and measured, may be made of or defined by the object as well as by the subject...and that is, in the last instance, an interaction.

All this has been proved and checked by innumerable lab experiences and technological applications that take part in our everyday life and made a deep change in the object-subject relationship mandatory, at least in the subatomic level, taking to the surface of our knowledge the fact that the observer, the subject, can determine a specific “reality” among maybe infinite “realities” or possible alternatives of the “existence” of the object.

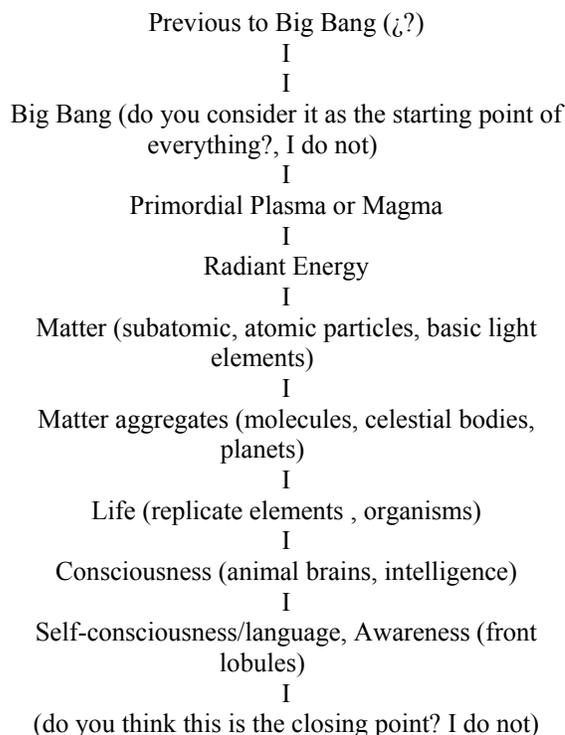
This has been almost ironically immortalized by the well-known experience of Schrodinger’s cat. In it, the Austrian physicist described a hypothetical experiment where a macroscopic element—a cat enclosed in a box with a poison which was occasionally activated by a radioactive source —could be considered to lie in a “limbo” of infinite states of “existence” between life and death, including both of them, until a spectator defined one of the infinite and possible versions of it with his act of observing.

About interactions in the quantum level and “emerging properties”

Leaving what is immensely big as it is not point of this essay, I will concentrate on developing the concept that links what is extremely small as a conceptually fit element to make up the “Whole” as the sum of what “exists” in nature and which we can reach gradually and progressively through the evolution process, according to the development of our “tuner” or awareness. Let us make clear, once more, that what is big and small, time and space are abstractions or subjectivities extremely useful for our existence, products of our brain activity but which interrelationship and intimate nature are, for the time being, away from our reach or understanding.

In the known universe, every concrete thing and its “particles” or constituents manifests itself through its

interactions through any/some of the four elemental forces: electromagnetic, gravity and the two types of nuclear forces (strong and weak) with other concrete things and their “particles” or constituents, either when the elements of the outer world interact between each other, as it has been occurring from the “Big Bang” up to date, and also when these elements interact directly or indirectly with our senses, following an evolutionary scheme which we can simplify in the following graph:



Although we do not always stop to think of it, practically everything that makes up our “reality” is, in the first instance, product of these interactions, forces or relationships among elementary “particles” from nature, from concrete things such as water, an apple, fire, a stone, air, the sun, the planets, a tree, a book, computers, an animal, atoms, quarks, etc., etc., and we assume, up to abstract things such as fashion, God, beauty, truth, good and evil, the devil, angels, lust, love, numbers, time and space, etc., although in these cases we do not yet have the adequate verification, apart from incipient experiences – through magnetic resonance – that allow us to relate our thoughts with certain electro-biochemical processes, such as the nervous impulses transmission or neuronal communications through synapsis, neurotransmitters, their later cortical processing, etc., etc.

According to present information, all scientific disciplines related to the study of our past, let us say cosmology, geology, paleontology, archeology, anthropology, molecular biology, genetics, history in

general, clearly show an evolutionary process where, from the primitive magma or plasma expansion on, the interaction of each level's elementary "waves/particles" gives way to the appearance or emergence of different structures, thus gaining at each step different elements of growing complexity and capabilities. Each with characteristics or properties of their own, which are different from the original elements that gave place to them which we define as "emerging" properties. For example, the formation of the first water molecule in nature can be explained by the electromagnetic force or interaction between two hydrogen atoms and an oxygen atom, which gave way to the appearance or "emergence" of a new compound: the water molecule, with characteristics of its own, different from the two constituent elements, the original oxygen and hydrogen atoms, which, in turn, had been previously created by another process, as we have seen, in which some of the nuclear forces in the primitive magma or plasma – hydrogen – or in the interior of the stars – oxygen - had intervened or interacted at different degrees.

Likewise, from the later interactions among certain and different molecules those with self-replicant characteristics emerged, and in turn, from the interactions among these ones, the first cells emerged, which gave place to the first organisms by interacting among themselves, in increasingly complex processes, which have not been explained yet.

What do we mean when we say that elements or things "interact"?

We mean that every thing or element is affected by another one (and vice versa or reciprocally), when its structure and/or behavior, and/or any parameter that defines or identifies it as such, changes in or by contact or proximity to the elements of the other.

Summarizing, the interaction between particles/waves under certain conditions results in the appearance of different behaviors or properties – emerging ones - from the original particles/waves, considered individually or altogether.

This interaction is always produced in the same way and proportion in our known universe, conforming nature's laws and constants; these relationships or regularities are the ones which science studies and technology applies.

As we know, at the most elemental level and according to our present knowledge these interactions are produced or manifested in our known universe only through gravity, electromagnetic and nuclear (strong and weak) forces, which act more directly.

It is worth mentioning that in recent years, these forces have been physico-mathematically interpreted or tried to be interpreted as the product of a sub-particles/waves interchange between the acting elements in the relationship or interaction, working with very innovative and complex ideas, such as the string,

superstrings theory, etc. However, I will stick to the word "forces" because I consider it conceptually and traditionally more comprehensible than the action of sub-particles, such as "gluons" or dimensional cords, which is more difficult to grasp.

Anyway, I think we can reproduce, and it is worth reproducing, the concept of "elementary particle" from the Greek thinking up to present time.

As we saw, the first renowned human being who thought that reality was made up of small indivisible particles was Democritus and for over 2000 years this conception was not questioned. It was by the end of the 19th century that there arose the suspicion that there might be something else inside the atom. This was confirmed during the first years of the 20th century by Rutherford's and Bohr's experiences and the speculations of researchers like Plank, Einstein, Heisenberg, Schrödinger, Dirac and others, which ended up in the unbelievable and contra intuitive Quantum Theory, with its group of subatomic particles. At about the middle of the century the growingly powerful particles accelerators allowed the determination of the existence of new elements in the guts of matter itself and of limits never conceived by human mind before.

Of course, all this development and evolution of concepts and new "realities" require a coherent physico-mathematical support, which is being strongly discussed and agreed upon in the scientific community today.

To this respect, one should mention the efforts of enlightened minds like Einstein among others, who worked to reach the unifying theory (Theory of the Unified Field) of relativistic and quantum concepts, which would link gravity to electro-magnetic and sub-nuclear forces, thus defining certain entelechies as gravitons, gravitational waves, branes, etc... evidently not an easy task..

Very frequently, we tend to consider evolution of scientific thinking as almost automatic or that this evolution directly does not exit, when in fact, it is a long hard road. Let us see a couple of paragraphs about these efforts and hope, written by the possibly future candidate to the Nobel Prize, the American researcher about the string or superstring theory, Brian Green (author of the book on scientific disclosure, "The Elegant Universe") in an interview edited and directed by Peter Tyson, chief editor of Nova online (Translation for Astroseti org.)

*NOVA: Is it an exciting time to be a string theorist?*

*Greene: It's an amazing time to be a string theorist.*

*The last few years have witnessed a tremendous amount of progress, so much so that I think no one in their wildest dreams would have imagined that we'd have gotten as far as we have.*

*NOVA: Do you think string theory will ever be accepted as widely as, say, the theory of general relativity? What would it take for that to happen?*

*Greene: Well, the real reason why general relativity is widely accepted is because it made predictions that were borne out by experimental observations. The primary one that put general relativity on the map was its prediction of the bending of starlight by the sun, which in 1919 was confirmed by observation during a solar eclipse. That was the moment when general relativity emerged from the realm of theory and entered the realm of being a piece of reality as we know it.*

*For string theory to have the kind of acceptance of general relativity, it's got to do the same thing. It's got to make a prediction that is borne out by some experiment. And as yet, we haven't quite gotten to the stage where we can make definitive predictions which, if they're found, the theory was right, and if they're not found, the theory was wrong.*

*But we have gotten to the stage where we can make some rough predictions for things that might happen at the future accelerators that are now being built, in particular one in Geneva, Switzerland, called the Large Hadron Collider, which should be ready about 2007 or 2008. If some of the predictions that string theory says might happen are borne out through experiment at that accelerator, then I think it's quite possible that string theory would be as accepted as general relativity.*

*NOVA: Can you give an example of a prediction that might be experimentally verified in coming years?*

*Greene: Sure. One of the strangest features of string theory is that it requires more than the three spatial dimensions that we see directly in the world around us. That sounds like science fiction, but it is an indisputable outcome of the mathematics of string theory. So the question is, where are these extra dimensions? One suggestion is that they're all around us, but they're small relative to the dimensions that we directly see and therefore are more difficult to detect.*

*What the theory also predicts—not necessarily but possibly—is that energy can escape from our known dimensions and leak into these extra dimensions under appropriate circumstances. Those appropriate circumstances might be generated in high-energy collisions that will take place at the new atom smasher, the Large Hadron Collider.*

*So it's possible that through these high-energy collisions we will find that there is less energy at the end of the collision than there was at the start. If the energy loss is of just the right sort, it could be very strong evidence that the energy has seeped off into these extra dimensions. If that were true, if that were the best explanation we could find, that would be strong evidence that the extra dimensions are real, and that in*

*turn would be strong evidence that the framework of string theory is correct. ...*

*... NOVA: Have you ever had doubts about string theory?*

*Greene: All the time! I mean, it is a very strange research career, in a way. So far I've spent something like 17 years working on a theory for which there is essentially no direct experimental support. It's a very precarious way to live and to work.*

*The funny thing is, I sometimes get the impression that some people outside of the field think that there's some element of security that we have in working on a theory that hasn't made any predictions that can be proven false. In a sense, we're working on something unfalsifiable. And there sometimes is a sense that we're happy about that. But let me state categorically, if the theory is wrong, I'd like to know it today so I wouldn't waste my time on it any longer.*

*We will have no certainty that it's right until the experiments show that it's right. However, I should say that in my mind there is a strong circumstantial case already that it's correct, because it puts together general relativity and quantum mechanics, and each of those theories has already received a fantastic amount of experimental support. String theory is the most developed theory with the capacity to unite general relativity and quantum mechanics in a consistent manner. I do believe the universe is consistent, and therefore I do believe that general relativity and quantum mechanics should be put together in a manner that makes sense. That's what string theory does, and to me, that's pretty convincing.*

### **Limits to understanding**

*NOVA: Is there any way you can make people who know little about mathematics understand the supreme elegance of string theory?*

*Greene: I think so. You know, when we talk about theories of physics being elegant, what we often mean is that a theory is able to explain a wide range of phenomena using a very small number of powerful ideas. The elegance comes from the tremendous reach of these few simple ideas.*

*"No matter how hard you try to teach your cat general relativity, you're going to fail."*

*And that really is a core characteristic of string theory. We have this idea that the basic constituents of nature are these vibrating strings, that their vibrational patterns dictate the properties of particles, and they dictate the kinds of forces at work in the world. If the theory is right, that simple notion will perhaps be able to explain, in principle, every physical phenomenon. That powerful reach is where the elegance resides.*

... NOVA: Do you think there are limits to how much we can know about the universe?

Greene: I don't know. I'd like to think that there aren't, but I suspect that's a little optimistic. An analogy that's used in the NOVA program that I'm quite fond of is: We are certainly aware of intelligent beings on this planet whose capacity to understand the deep laws of the universe is limited. No matter how hard you try to teach your cat general relativity, you're going to fail. There we have an example of an intelligent living being that will never know this kind of truth about the way the world is put together. Why in the world should we be any different? We can certainly go further than cats, but why should it be that our brains are somehow so suited to the universe that our brains will be able to understand the deepest workings?

..... NOVA: Well, for example, most people have trouble envisioning a fourth spatial dimension. Can you?

Greene: No. I cannot envision anything beyond three dimensions. What I can do is I can make use of mathematics that describe those extra dimensions, and then I can try to translate what the mathematics tells me into lower dimensional analogies that help me gain a picture of what the math has told me. But the picture is certainly inadequate to the task of fully describing what's going on, because it's in lower dimensions, and in higher dimensions, things are definitely different.

To tell you the truth, I've never met anybody who can envision more than three dimensions. There are some who claim they can, and maybe they can; it's hard to say. But it's very hard, when your brain is involved in a world that appears to have three dimensions and is well suited to envisioning that world, to go beyond that and imagine more dimensions.

... NOVA: What advice would you have for an aspiring string theorist? Go for it, or for God's sake stay away?

Greene: I think ultimately you've got to follow your heart in these matters, and if these are the kinds of ideas and questions that are burning within you, and you just can't imagine not having them at the forefront of what you do in day-to-day work, then yeah, you've got to go for it. On the other hand, this is a very speculative field, and it could turn out to all be wrong. And if that's the case, and you would feel, after putting years of research into the subject, that those years were wasted because the theory was wrong, then it's probably not the right field for you.

I and many others, however, would not feel it had been a waste of time if the theory turns out to be wrong, because we've developed a lot of important mathematics. We've developed connections to other, more well established areas of physics, which I think

will be important in their own right. We will have done some very valuable work. To me, if the theory turns out to be right, that will be tremendously thick and tasty icing on the cake, but without that icing, to me the work will still have been incredibly interesting and useful.

NOVA: You're just finishing up a new book. What's that about?

Greene: That book is about space and time. The *Elegant Universe* was about the search for the unified theory, and space and time were supporting characters in that story. In this new book, space and time are the main characters. It's really a discussion of our ever-changing grasp of what these seemingly simple notions of space and time actually are.

NOVA: You mentioned unified field theory. If string theory does lead to the so-called "theory of everything"—I know you don't like that term much—where would theoretical physicists go from there?

Greene: Well, I think an analogy that I believe Richard Feynman once used is probably the best one to explain where we would be. If you are learning the game of chess, the first thing you have to do is learn the rules. But after you've learned the rules, the game of chess for you is not over. It's just beginning, because now you can apply those rules to play all sorts of wonderful games that involve all kinds of strategy and allow you to explore the richness of that universe.

"A unified theory would put us at the doorstep of a vast universe of things that we could finally explore with precision."

Similarly, if we did finally have the unified theory, if we did finally have the deep laws of the universe in hand, that in a very real sense would also be a beginning. It would be the beginning of our quest to use that deep understanding to fully explore this universe, to fully understand black holes and stars and galaxies and even the big bang, to fully understand how things got to be the way they are. So in many ways, it would just be the start. A unified theory would put us at the doorstep of a vast universe of things that we could finally explore with precision.

As we have seen in this partial expression of thoughts of a scientist specialized in superstrings and super symmetries, there is nothing that assures us we are in the correct way to find the answers we are looking for, neither that these will come up tomorrow product of a miracle, but that is no obstacle, absolutely, to give up trying. There is too much work, effort, time and money spent on these activities maybe because historical experience shows that only through these speculations, trials, errors, refutations and confirmations known to be temporary, human knowledge progresses.

Let us remember something about these primary and fundamental forces:

**Gravitational force:** it is the force generated between particles/waves masses; although it is generally positive (attraction), there are suspicions about the existence of negative cases (repulsion, maybe responsible for the expansionist acceleration recently observed in our universe). Its reach is practically infinite, instant and proportional to the masses in consideration, but its power decreases as the distance between particles grows. Because of these characteristics, this is clearly shown between big bodies like planets, stars, galaxies, but it is almost neglectful in the subatomic or quantum level, in front of the high value of the nuclear forces present in those levels.

**Electromagnetic force:** it is the one generated by the particles' electric charges: when they have the same charge they repel each other and when they have different charges, they attract each other, with magnitudes which are inversely proportional to the distance between them. They are significant in the subatomic, atomic and molecular levels, although their effects can be also considered in the macro level, especially in the case of magnetism. The movements of electrically charged particles, which generate magnetic fields and vice versa are equally important.

**Weak Nuclear Force** (or Fermi's): These forces are responsible for certain interactions among elemental particles, such as neutrinos and matter, in certain nuclear reactions like the ones that take place in the sun and in radioactive processes. They have a limited scope: 10 to the power of minus 15 meters (one ten billionth centimeter approximately),

**Strong Nuclear Force:** it is responsible for keeping particles with the same electric charge together, as in the case of protons in the atomic nuclei. Its absolute value is high in terms of energy, but, like the other nuclear force, its range is only approximately some billionths part of a centimeter.

As I mentioned before, there is no scientific evidence of any other kind of basic interaction among elements of different nature from the four forces described or the ones derived from them, from electric transmission to love;

For almost a century, scientists have thought that there is a joining element among these basic forces of nature and they have been looking for it earnestly, in what is known as the theory of the unified field, or theory of the whole. In the same way, in 1868, Maxwell found the relationship between forces, charges and magnetic and electric fields; something so simple and practical like the fabulous relationship discovered by Einstein in the almost magic formula  $E = m.c^2$ , that relates mass and energy; but this wished relationship has not been attained so far.

*A matter of numbers*

When interaction takes place among a few elemental "particles", the results of putting or taking or moving some of them from their habitual locations do not imply major surprises; this is studied with a high degree of certainty in the particles' accelerators and colliders, where the work is done with incredible precision. This takes a dramatic turn when we speak of interactions at macro or everyday scale, where every real life experience means in every case, the interaction of millions and millions particles that intervene practically simultaneously and new "emerging" properties appear as product of myriads of interactions and combined geometries.

To this respect, we could remember with wonder that a simple water drop contains something like a thousand trillion water molecules.

With this, I want to emphasize maybe that the interaction of a pair of thousands or millions of "particles", atoms or molecules with one another, will almost surely be unnoted in every respect in the macroscopic world of daily life and it would hardly be considered a conscious or conscious aware experience or one that is somewhat part of the "reality" of our knowledge.

In other words, our everyday experience, no matter how specific the considered event may be, is the result of multiple interactions and I think it is not yet clear the role that they play in this multiple experience that conforms our consciousness and awareness, the big numbers theory, chaos, the progressive complexity increase with the consequent appearance of unexpected emerging properties in each step and even the evolution or Darwinian machines, especially in the interaction with the over one hundred thousand million neurons in our brain. (see: *The Society of Mind* by Marvin Minsky, 1987)

Not until recent years, with greater knowledge about atomic and subatomic structures, coupled with greater and better possibilities of handling them through nanometric-scale techniques, chemistry seems to work on preconceived strategies, not by accident or chance, as it occurred, for example with the first alloys or, in other times, with rubber vulcanization.

Still, we do not know the ultimate reasons for most changes or "emerging properties" we see in nature, for example, why a thermal treatment and, maybe the adding of certain metallic salts, transforms some opaque and dull sand and silicates into a wonderful lump of colorful, glassy reflections? Or, moving in the evolution scale we ask ourselves about the consequences or derivations of those first interactions among the elemental forces mentioned (gravitational, electromagnetism and nuclear) with the subsequent appearance of new and growingly complex attraction/repulsion forces, moving from the unknown interactions of the elemental components of the whole

among each other, to the waves/particles interactions at the subatomic level, to the following level of atomic interactions, then to the molecular level, etc., etc., up to the macro and every day level where the physico-chemical and electromagnetic affinity in general trigger the emergence of: surface tension, capillarity, osmosis phenomena, conductivity, the synaptic potentials, neurotransmitters, etc., that in turn give place to the more abstract or complex interactions in living beings where the homeostatic mechanisms appear, those that regulate thirst, hunger, sexual desire, love, hate, up to the feelings and thoughts of human beings that when they interact between each other and their environment, develop cultural guidelines that give place to ethic and moral values, etc., that according to popular saying they “move mountains” or “pull harder than a pair-bullock carriage “

We do know, instead, that every interaction between concrete things is, in the last instance, a manifestation of the action of any of the four elemental natural forces already mentioned: gravitational, electromagnetic, strong and weak nuclear ones and we also know, that this interaction has to have a certain number or “particles” in order to reach our knowledge or awareness, something like a critical mass or minimum interaction quantum, necessary to produce the wave function collapse, decoherence or conscious and awareness experience.

This way, we can study the case of a piece of charcoal in the open air, that apart from being exposed to the influence of the whole world gravitational forces and of the different radiations of the earth atmosphere like, for example, the photoelectric effect of solar radiations will remain unaltered (for our senses at least) as far as the surrounding energetic conditions do not change drastically. In turn, if we put enough energy on a spot of its surface, like a match flame or heat by the concentration of solar radiations through a magnifying glass, we can obtain the interaction between the external charcoal atoms electrons with their corresponding ones from the oxygen of the air surrounding it, in what we know to be a combustion phenomenon or process that can be self-kept and which will be over when most of or every part of the solid charcoal turns into gaseous carbon oxide.

Leaving aside certain technical details, that may be important in other analysis, we can say that we are facing a case where the basic characters of this change are electromagnetic and nuclear forces, as the main evidences are the result of an oxide reduction reaction, with energy relief, change of state, etc.

As we may remember, combustion reactions as described above are known in chemistry with the name oxide reduction and they are clear examples of the process through which some of the most external electrons belonging to the different intervening atoms,

adopt specific behaviors that confer certain properties to the resulting compounds. The same as with the water molecule above mentioned, in this case there are also new elements as final result, “emerging” elements: oxide or gaseous carbon dioxide molecules and the appearance, relief or transformation of an energy which turns from its potential shape in its original chemical state (the different energy contents in carbon and oxygen electrons according to their orbits) to a kinetic or dynamic state (heat and light radiation), and totally different properties in the newly formed products, at least for our sensitiveness, to the ones in the compounds that originated them.

As we have already said in every elemental interaction the four forces mentioned (electromagnetic, gravitational and the two nuclear ones) will always be present, but the participation or supremacy of one over the others is variable and depends on each interaction considered, for example, in the case of interaction among elemental “particles” of the surrounding concrete things and their sensitive manifestations. Although in our analysis the electromagnetic force is preponderant, the other forces that are always present and may be relevant in other type of analysis or consideration should not be forgotten.

As far as we know, most of the known things that make up our concrete and everyday “reality” are predominantly created by some kind of electromagnetic interaction between atoms and molecules, as it is the case with the above mentioned examples within the framework of an always present and practically invariable gravity, and as such, its presence seems almost unnoticed in face of the noticeable changes produced by electromagnetic interactions. On the other hand, at cosmic scale, gravity becomes preponderant to our attention, and the weak nuclear force will be the one which determines radioactive degradation; and at subnuclear level, the most outstanding interaction role corresponds to the strong nuclear forces.

In order to have an idea of the relative magnitude of these forces, let us consider a scale of intensity of the different acting forces of an atom’s constituting elements, where we assume that gravity has magnitude 1. Comparatively, in this case the weak nuclear force would be  $10^{+34}$  (10 to the 34th power, that is 1 followed by 34 zeros) times, electromagnetic force would be  $10^{+37}$  (1 followed by 37 zeros) times and the strong nuclear force,  $10^{+39}$  (1 followed by 39 zeros) times.

Let us think that a difference of only two zeros in the order of magnitude, like weight (for example from  $10^0$  a  $10^{+2}$ ) means the difference between lifting 1 and 100 kilograms.

*Here I want to highlight that in our daily experience, the one of common sense, lunar gravity attraction, for example, exists at every moment, but it is negligible compared to other experiences, let us say,*

*salt flavor, how we see an image or we hear the sound of a car passing by or the way we smell the scent of a flower. However, it is not unnoticed with respect to big water masses as it is the case of tides. Likewise, although in everyday life we do not appreciate the changes in the atoms nucleuses with which we interact (strong nuclear force), those changes do exist almost unnoticeably in our environment, or can "exist" according to the level we want to analyse. Such is the case of the thermonuclear reactions with which our star, the sun, gives us life with its photons imbrue and which is also responsible for the derived and subsequent energy and forces interchange that generate storms and climate disasters that, in other circumstances, takes life away or, with not that seriousness, burns our skin in a foolish day at the beach and even other ionizing radiations that play a extremely important role in the evolutionary change process are assumed.*

To better understand the world of big numbers and the possibilities and probabilities of fulfillment of a determined event – vital to understand the scheme proposed for the emergence of consciousness and “reality” – I propose reading the best-seller “Origins” (Shapiro R., 1986) by the renowned researcher in biochemistry Robert Shapiro, professor at the University of New York who in his Chapter 5 proposes his very practical allegory or metaphor of the “tower of numbers” that is very didactical to understand part of the phenomenon of big numbers and how the improbability of getting a number drawn in the lottery, turns probable for a lucky person every day.

As we see, the “reality” of the concrete things we want to take into account depends on the level of analysis we may or are willing to undertake.

Our ancestors did not have the possibility to know the subatomic “reality”; their tuners and the knowledge they conveyed were not enough. It may be appropriate to clarify in this respect that it is highly probable that the antennae - the senses- of our ancestors’ tuners as well as the tuners of some contemporary animal species have been and are superior than ours; for example, lynxes’ or flacon’s sight, hyenas’ or sharks’ smell, a spider’s touch, the geomagnetic orientation of certain migratory birds, etc., a Cromagnon’s sense of smell or sight, etc., etc., probably giving a greater or better consciousness level -signal profit-. But the fundamental difference from our perspective is given by the demodulator/integrator equipment of the human tuner - our bigger brain with its pre-frontal new cortex and its redundant functions - that produces an emerging property: awareness, which our ancestors lacked and still today our cousin animals lack.

However, if you asked me if having these new redundant functions and their consequent “awareness” is a big evolutionary advantage, something that would

make us feel superior or a cause for pride, I would answer that that is something we still have to see (without too much fuss, cockroaches and a lot other bugs could survive many more years than the, sometimes, miserable and cruel time human beings take on the face of the earth). Moreover, there are those who think- it is not precisely my case - according to their faith or luck, and seeing human experience, that all this is a real poisoned gift.

Not reaching such extremes, in more than one opportunity most of us use to agree with the novelist Milan Kundera (Czech Republic, 1929), on how right the title of his awarded book was: “The Unbearable Lightness of Being”

The processes that shape awareness, consciousness and knowledge

As I pointed out before, the “emerging” properties of awareness, consciousness and knowledge spring from the interaction (which can be direct or indirect) and at every level, of the basic elements from the “Whole” between each other, and with the sensitive elements from our body –or the other way round, if you prefer- since the moment of each human being’s conception, following patterns that evolution has been characterizing in the genotype, in permanent relationship with the environment.

According to some investigations and present conclusions of neurobiological sciences, it seems that though the rest of living beings in general have what we call consciousness in different levels corresponding to each individual’s cerebral and sensitive schemes; some of them with attributes and potentialities unknown or even superior to those of man. Only some superior primates show some hints of consciousness and it is only the human being the one that has developed so complex manifestations as language, abstract thinking and self-knowledge or awareness, that have permitted artistic prodigies, as “The Gioconda”, scientific prodigies, as differential calculus and technological prodigies, as the international space station.

Apparently, as neurobiologists say, these properties are characterized by the activity of certain parts of our brain mainly in the last neural developments of superior primates which are, among others, the qualitative/quantitative details of the pre-frontal lobules and the neo-cortex related to senses (for more information about brain functioning, I suggest reading interesting neurobiology investigation works, like The executive brain, by Elkhonon Goldberg, which has a Spanish translation, Editorial Critica, Barcelona, 2002)

Remembering the well-known case of the American Hellen Keller, who turned blind and deaf and who, in spite of her disabilities could achieve a remarkable social and cultural development thanks to her own effort and the help of her teacher Anne Sullivan, we appreciate the incredible flexibility of the

brain/tuner to develop new circuits of knowledge and awareness in spite of the limitations or alterations of some of its original neuronal conducts of the sensitive elements of our body and we understand the permanent malleability and growth –evolution in the last instance—of the “tuner” in face of the obstacles posed by the environment.

With this basic reference to our senses, I only wanted to highlight that all our knowledge, consciousness and awareness are basically formed, at a first level, by electromagnetic and nuclear interactions among electronic structures of the concrete things around us and the corresponding electrical structures of our senses. This is performed in a similar way as in every living being, generating what we call consciousness and growing knowledge according to the evolution scale in the phylogenetic and ontogenetic developments of each individual of every species.

It is only with the recent qualitative and quantitative development of animal brains, in particular the pre-frontal cortex of big anthropoid primates and hominids, which seems to act as a redundant element of the ancestral limbic system, there comes the gradual advent of the last “emerging property” of the known evolution: our awareness. This means that there appears a new “tuner” model which, apart from grasping “reality” it produces unedited abstractions as well: the self, not self, language and self knowledge in the individual together with culture and the accumulation of knowledge in individuals communities.

For the time being, there seems to be consensus in neurobiology sciences in the following questions: the brain’s (tuner’s) growth, the appearance of consciousness, awareness and knowledge in every individual is the product of interactions, inter-relationships and interconnections, synopsis, etc., among the neural cells or neurons of the CNS, as of the origin of that individual, between each other or with the environment. If this were also true onto and phylogenetically speaking, we would be facing a mechanism that would very well explain the development of, among other things, the cultural manifestations as sciences, art, and also humanity’s religions.

Analysing the development of great knowledge landmarks in man’s history, we see that, in general, any significant advance in human potentialities has been the product of observations and thinking that required suitable brains (“tuners”) fit to grasp the “reality” before their eyes at that time.

It’s hard to imagine a Neanderthal understanding God’s word or monotheist religions, or an Egyptian in pharaoh’s times grabbing infinitesimal calculation, or a citizen at revolutionary France discussing the general relativity theory. In no case were the “tuners” ready for such challenge: nor they harbored the concepts,

memories or knowledge of such “interactions”. It was necessary that our brains/tuners developed phylogenetically until they could elaborate abstractions and symbols that permitted the emergence of the essential physico-mathematical concepts to work coherently on the sensible reality.

In this sense, first language, then writing, were Copernican landmarks; no other alive or known species has achieved this so far.

Some conservative thinkers believe that there has been no trace of evolution in man in recent years and this may be true as regards their external corporal physical aspect, but this criterion is evidently very limited and chauvinist as, leaving aside the evident changes that took place and were reported in the aspect of our Australopithecus cousins, following the latest anthropological researches (Wikipedia Encyclopedia on the Internet), we can see the changes produced in a “single” bone as it is the sphenoid and its suspected relationship with human evolution:

- 60 million years ago the prosimians had a horizontal and flat sphenoid as the immense majority of the other animals with a brain.

- 40 million year ago, in simians the sphenoid had a first downwards inclination what allowed an increase in the encephalic capacity, the occipital lobules got more room and thus the perfection of stereoscopic sight and maybe visual memory were attained.

- Less than 12 million years ago, a new downwards inclination is produced, this in the evolution line that would originate the anthropoids, that would imply a brain even bigger in proportion to the rest of the body.

- 6 million years ago, with the Australopithecus, the sphenoid inclination is again accentuated, and thus, the neurocranial capacity is increased again.

- 2 million years ago, a new downwards inclination of the sphenoid is produced, what coincides with c total bipedism, such bipedism has required a voluminous brain and with complex neuronal nets in order to keep this position opposed to gravity; it is also likely that that new sphenoid position had allowed a rudimentary speech which phonemes were click/cluck noises and guttural tones.

- Between 200.000 and 160.000 years ago the sphenoid gets the inclination that it has in the Homo Sapiens Sapiens, it coincides with the increase in brain capacity (specially of the frontal lobules), accompanied by a greater blood irrigation to the brain.

On the other hand, the most interesting aspect of human evolution is its intellectual development and in this sense it is evident that day by day there are growing records in the memories of our brains/“tuners”, through new interactions that bring about the emergence of unedited knowledge and this seems to be the most important evolution process. This way, we have new

melodies, new cultural guidelines, new fashions, customs and also, why not? new scientific and religious paradigms.

Still not knowing if this will be for better or for worse, we are sure that brains/"tuners" developed and go on developing thanks to rules that are in force in our universe: rules of the attractor type, according to Ilya Prigogine, or morphogenetic fields, in the eyes of more esoteric authors, or the "intelligent project" according to some religions to such an extent that there are those who consider that if Newton, Michelangelo, Einstein or other similar geniuses had not existed, others would have surely and equally reached to the same conclusions and productions, or similar ones, some decades after or before.

This becomes more evident in the technological field, where similar devices are attempted to be patented or developed simultaneously—leaving aside cases of ill will—in different places not related between each other. Such is also the case of some monotheistic religions, which present a singular origin similitude, in place and time, as well.

According to what I explained above, if the connection between brain and "reality" were true and, without leaving aside other developments, will there be anything more promising to humanity than to study brain functions? Both, from the cost/benefit point of view, and, from the possible results that would affect every filed of thinking.

Or also, will it be possible or convenient to look for the improvement and acceleration of synapses, neurotransmitters and other brain/neural processes?

### Parallel Universes

Coming back to the wave/particle duality, you may ask yourself: what is the difference between considering "reality" made up of waves and not particles?: .... Well, when ceasing to consider elementary "particles" as specific elements, individual small matter or energy balls and assuming every interaction experience as the only possibility of making a determined and concrete "reality", the Quantum Theory, with its clouds of infinite and indeterminate probabilities – waves, strings, entangles - that replace every specific "particle", proposes a change for every opportunity, every synopsis if you prefer, every interaction of elementary particles/waves/strings between each other at every moment, an infinite number of interactions or simultaneous "realities", thus conforming the hypothetical "parallel universes" of which Everett, De Witt, Paul Davies, Tagmark, David Deutsch speak, among other renown physicists

This may sound rather strange at the first moment, but it is not so much if we remember isomers phenomena in chemistry.

Isomers are compounds, generally molecules, which are integrated by similar quantities and proportion of determined atoms; for this reason, one could expect to find similarities in their characteristics and properties.

However, as their configuration or geometry – the way atoms are linked between each other - is different, their behavior differs dramatically.

Such is the case, among many other examples, of Cis and Trans isomers of unsaturated fat acids. Their differences in terms of interaction produce dramatic consequences is cholesterolemia in human beings, which not until recent years have been addressed by nutritionists and which are alike only in their spatial structures, their geometry, though not in their composition as seen in their respective formulas:



(For a detailed study of this founded speculation or argumentation, I recommend "Quantum Evolution" written by my colleague, John Joe McFadden or to visit his website).

So, there exists the possibility that every brain, every self-conscious mind or a mind with awareness or in other words, every conscious individual can build up in his/her mind (perhaps with/in the new neural sectors of the prefrontal cortex and its connections, in the cortical and/or subcortical brain regions) numerous and different interactions –geometries—with the same signals conveyed by senses. This will provide what will be different, multiple, may be infinite "realities", which will have nothing to do with other versions of the same trunk, from which it separates in every bifurcation or interaction of its "tuner" – he/she himself/herself - with the (waves/"particles" of) the "Whole".

One will have to think, then, that from the transformation of the specific "particles" (electrons, quarks, etc) into clouds of probabilities (waves/strings), what we understand as a unique and definite "reality" is rather a cloud of interactions and consequent "realities", each one of these with the potential of "collapsing" – to "decohere" according to physicists— into different independent universes, or not causality -related : the "Parallel Universes".

*I think we are facing an obvious and inevitable conclusion.*

Inexorably, only future developments on the study of the brain and awareness will confirm or not these assumptions and I believe that the "whole" proto theory

and the “tuner” metaphor are quite appropriate to work on the comprehension and disclosure of this line of research.

Let us quote again the interesting article written by Dr. Fernando Cardenas Parras: “Anatomy and physiology of mental representation”

*“A controversy between two positions has recently appeared: a classical one, according to which the spatial topographic representation would be enough to explain awareness processes, and a contemporary one according to which this topographic representation is not enough in itself and has to be complemented by a temporal analysis. This second position is top ranked nowadays in research and has given rise to the concept of binding that can be translated into Spanish as integration (Llinás, R., personal communication; Horgan, J., 1994) or coherence (Cibilis, D., Lorenzo, J., and González, N., 1995). Anatomically speaking, the circuits responsible for this process have been described long time ago (for example in 1968, Krieg, E. They correspond, basically, to thalamus-cortex type projections, similar to the ones related to sensitive relief, but in this case it is not a specific projection bound to a certain modality, instead, it is bound to a spontaneous-type work of other neuronal populations related to the ascendant activator reticular system. Therefore, they are circuits highly parallel to vigilance and attention activity. Spontaneity should be understood as the process organized in space-time, in such a way that the spatial level establishes contacts with certain cortical dendrites branches (mostly in the superficial layers) throughout the cortex. Likewise, there exists a temporal functioning sequence that can be macroscopically understood as a sweeping away effect of the cortical state of activation, performed in the face-caudal direction at a very high speed (one every 12,5 milliseconds, approximately). Taking into account the momentary state of cortical activation, these circuits would allow the creation of a comparison continuum between the previous state (s) and the present one (s), process that would correspond, according to some authors, to the awareness phenomenon in itself. There are some experimental data that support this hypothesis; the most convincing ones of all are perhaps, the ones that belong to Urs Ribary and his group from the University of New York: in his typical experiments, he asks a person to listen to a sound, binaurally presented, and say if it is presented in one or two ticks. Simultaneously, a magneto encephalographic register is being taken in the temporal lobule. Originally, there existed psycho-physics reports, mainly as a result of Kristoffersen’s work, which could infer that there is a minimum time for the perception to be established. However, not until Ribary’s work, a neurophysiological correlate of the responsible mechanism could be established. According to the data obtained, if two*

*clicks are presented temporarily separated by 12,5 ms or more, the stimulus perceived will be heard as two sounds; but, if the temporal distance between the two clicks is less than 12,5 ms, the perceived stimulus will be judged as only one sound. In other words, the brain makes a reading of temporal quantum of 12,5 ms; all the information (translated as cortical activity dots) presented in each one of these temporal sweeps will be compiled as only one “cognizant image”, which will integrate itself with the next period of 12,5 ms, giving way to a topographic space-time representation. This hypothesis is in the frontier between the brain topographical representation and the mental representation, backing late 19th century William James’s intuitions, who considered awareness as a flowing or progressing course. However, it is clear that this hypothesis only takes us to another level in the process of clarifying this phenomenon, but it gives us the possibility of disentangling the subjective world’s mystery.”...*

It is also worth mentioning that in our universe not all the interactions among quantum elements are possible and that certain configurations of matter—quantum or not—are vetoed in such a way that, for example among a number of chemical elements as in Pauli’s exclusion principle, are impossible, or that only a few and determined variable values (never continuous) are feasible, as in the case of the photoelectric effect, that, when a photon come in contact with or is freed from an atom electronic structure, the detected electrons energy levels take perfectly defined but not continued values and it is always like this in the universe we perceive.

Isn’t it striking that only certain values of those variables can be observed and measured? Where are the mysterious and logically necessary intermediate values? Why is it that we can never detect the infinite intermediate values?

My appreciation about this incapacity, the fact that present sensitivity of our measurement and exploration instruments (our extended senses, the antennas of our tuners at last), beyond the marvelous scientific breakthroughs, is not yet enough to highlight or detect those “particles” and consequent interactions that, due to their smaller size or other characteristic, maybe typical or natural of our species, as it would be the case of a supposed agnosia derived from the lack or faulty interaction between our senses or brain/tuners with that set or area still unknown and for the time being inaccessible of the “whole”.

So far, the most precise instrument to study or visualize the subatomic reality is the electronic microscope, which, in spite of its amazing power to grasp matter’s inside, its sensitivity is limited by the size of the photons or electrons it uses as “scalpel” or measurement tool. Therefore, this will be its utmost

definition capability. Any particle, element, or set of elements smaller than a photon or an electron, will not be assessed by this device and that is just our present limit...further, there is only our imagination and intellect which keep us amused, for example, with the speculations of this essay.

Is it possible, then, to imagine thousands of other elementary particles—existent in the “whole”, perhaps the continuum—with special characteristics, with which we have not interacted yet, but that may make up or do make up infinite different universes, perhaps overlapped to our or other space-time as Bruno, Berkeley, Heisenberg, Borges, Everett and many others suspected in the past and that today De Witt, Davies, Deusch, Rees and other outstanding contemporary thinkers support with different shades of meaning?

¿Could there be the “mirror neurons” responsible for the redundant processing that produces the “I” phenomenon, in the way that Platon suspected that the shadows reflected on the walls of the cavern represented the true “reality”?

Since almost time immemorial, the concept of the “THE WHOLE, EVERYTHING” has a more than interesting background in conscious or unconscious allusions in the minds of different thinkers like Spinoza, Bruno, and, in general, of those who have speculated with infinite’s meme and mirrors, as Borges does in some lines of his fantastic story “The garden of bifurcating paths” that belongs to Fictions (1941):

*“the garden of bifurcating paths is an incomplete, yet not false, image of the universe...”*

Is Borges perhaps suggesting that there is a universal entity, more comprehensive and complete than the known or even imagined universe? ... or,

*“does that fabric of times to come (that come close to each other), that split, are interrupted or are secularly ignored, comprise all the probabilities...”*

Different times that are ignored? ... that do not interact?...To comprise all the probabilities... Could Borges have imagined something like a WHOLE? ... or,

*“time bifurcates everlastingly towards innumerable futures...”*

Perpetuity, eternity, to be for ever in every possibility? ... or,

*“the damp garden that surrounded the house was saturated to the infinite with invisible persons...”*

Saturation of the infinite, ¿the “Whole” again, the continuum?

Poets, literates, pintores, plásticos y artistas en general, teólogos “chamanes” (religious people), prophets, gurus and other intellectuals who, from different points of view, propose diverse connections between “reality” and fantasy, the concrete and the abstract, synthesizing between the outer world or environment and our brain/tuner, agree, though using

unlike methods and interpretations, with men of science when they dive *beyond* into the “Whole”’s depth.

As I mentioned before, the above description poses some objections by those who say that it has been impossible to see the other remaining elemental “particles” from the “whole”, even less their interactions with our or with other living beings of the known universe.

This objection reminds us of the situation ancestors lived in the world previous to the development of electromagnetic radiations’ knowledge: all of them were immersed in a sea of radiations, but no one was conscious of it; consequently, that universe did not “exist”. It was enough that Marconi and others developed/explained the interacting elements between them and our senses — the brains/“tuners” — for that “reality” to change.

So we see that there is a direct relationship between what we are likely to acknowledge that “exists” and what we would be able to “decohere”, according to our circumstantial data derived from our tuner’s capacity.

According to this interpretation, awareness and knowledge—as any other concept or element of the known “reality”—are products from the natural evolution of things, products, in this, our universe. Summarizing, “reality” changes and apparently will keep on changing at the same rhythm of the interactions of our brains/tuners with the environment and the own neural interactions – memories, knowledge – derived from them.

Attentive to this evolution changes, some thinkers as the informatics expert Ray Kurzweil (“The era of spiritual machines”, 1999), dare forecast that the manipulation of elemental waves/particles will allow, maybe in a not far future, to imagine true “chosen from a menu/customized” realities according to the wish of those individuals that can create and re-create their existence at their will on the artificial structures that remedy our present organisms, brain/tuner included.

As that almost mythological character of the universal literature said referring to his adventure mate: “Sancho, you will see things that you won’t believe” (“Don Quijote”, Miguel de Cervantes Saavedra, first 1605 or second 1615 version – ¿apocryphal?)

### **Decoherence and awareness**

The word *decoherence* in modern physics refers to the interaction phenomenon between quantum, elemental “particles” in nature – the “reality” exterior to us – and the terminals – also quantum – of our senses by which only one of the infinite and mixed (“entangled”) states of the matter are “crystallized”, thus it is a process that turns the world imprecise and overlapped of possibilities of the quantum universe in a unique and palpable “reality” for our senses, at least for our version of “reality”.

This process is precisely studied through appropriate instruments as would be the particles accelerators/colliders. Through this device the only one of the likely and infinite overlapped – entangled – states in which, according to Heisenberg's uncertainty principle, all the subatomic elements that constitute the known nature in this, our universe are, will “collapse” or become concrete for our consciousness, awareness and knowledge with also only of the likely and infinite overlapped states at subatomic level of our sensitive element or sense (nervous terminals in eyes, ears, skin, etc., etc.) transmitting a determined signal through a kind of “snapshot”, “imprint”, “trajectory” or “trace” in our brain of every event. In turn, this event, according to its duration and intensity can be recorded as a conscious experience or not by our body, at least in one of the likely and infinite versions of such.

In the model I am trying to describe, awareness is an “emerging” concept, derived in the first instance or stage from the interactions (relationships and decoherence) between the elemental quantum components or nervous terminals of an organism (the sense, that is, the brain/tuner's antennae) and the external environment quantum components, thus generating an hypothetical second stage or instance in the chain of events, relationships, electro-biochemical interactions (neurons circuits, synapses, neurotransmitters, etc. that is to say the tuner's conductors) already in the nervous central system, that finally reach the brain. There, by means of different mechanisms and ways - not yet elucidated although there are speculations of serial, parallel and holographic processes - they produce a “plaque” or own and exclusive print of the event that will be available as a kind of data base or memory, that processed in what we know as mental activity, will generate knowledge, consciousness, efferent actions and in human beings also awareness.

Moreover – though not less important and insisting on this aspect – it is worth remembering that “waves/particles” should not be considered to behave individually, except when interact among each other; as from that first relationship new emerging properties appear, different from their aggregates, not suspected in the original components, which keep on gaining complexity in the evolutionary diversity that commands Darwinian's machine “natural selection” mechanism, acting over million unities or individuals.

In other words, although we can see the interaction between a few individual particles through particles accelerators and their accessories, in everyday life, what we see, and know as an exclusive and specific experience with our senses interacting with the environment, is in fact, a multitude of connections in which it is liable to suppose a vast series of intermediate

emerging properties, hard to imagine in their original elements. (Marvin L. Minsky)

There is an extraordinary impressive difference between nature's macro and micro scales and we are beginning to appreciate them through the realities proposed by the Quantum Theory.

Thus, we can attempt to describe a new evolution scale, as follows:

1°- Cyclic or periodic situation in the “Whole” which originates the “Big Bang” (one-dimension oscillators/resonators? or may be black holes that collapse—develop—into “white holes” through “warm holes”)

2°- “Big Bang” that generates energy quantum, elemental particles/waves/strings that interact between each other (themselves) –evolve - to give:

3°- Subatomic components/radiations/nucleotides (forces, quarks, electrons, protons, neutrinos, photons, etc) that interact between each other – evolve - to give:

4°- Light atoms or elements (hydrogen, helium, etc,) that interact between each other - evolve - to give:

5°- Gases and cosmic powder, that interact between each other — evolve — to give:

6°- Agglomerated bodies: stars, galaxies, cumulus, etc, which interact between each other - evolve - to give:

7°- Heavier elements: oxygen, carbon, iron, etc), that interact between each other– evolve – to give:

8°- Molecules of increasing complexity that interact between each other - evolve - to give:

9° - Self-replicant molecules that interact between each other - evolve - to give:

10° - Life, cells, that interact among each other – evolve – to give:

11°- elemental organisms that interact between each other - evolve - to give:

12°- Organisms with CNS and brain (intelligence, consciousness animals, etc.) which interact between each other – evolve - to give:

13°- Men, minds, awareness, abstractions, ideas, memes, knowledge, etc. that interact between each other– evolve - to give:

14°- societies, cultures, etc, that interact between each other — evolve — to give:

... for the time being only God, or someone or something with his capacity, knows.

In this brief and concise summary of the evolution process, open on both ends, we should include the concepts belonging to D. Hofstadter, A. Damasio, P. Davies and many other intelligent thinkers, on the cumulative or increasing complexity produced in each evolution stage or level, each supplementary “meaningful layer” that is added by the “emergence” of new unexpected properties, which lead us to assert that, although it is true that a man (just to give a scale

example) is a set of atoms, it is also true that a man is not “only” a set of atoms.

In order to give a definition of man, it would not be enough to describe what the composing atoms or molecules look like or how they behave as for example, any living being - a cell - has properties such as self-replication that does not exist in any of the atoms, molecules or basic inert inorganic elements composing it.

It is the interaction among elements from each level of complexity the one that produces the “emergence” of new unedited and unexpected properties. Sometimes we see that anything added or the set of original components in a given level produce significant changes in the behavior of that agglomerate of elements that expresses itself in a new type of relationship with the environment, in a species of growing complexity scale, ... but always level by level.

In this way, atoms by themselves will never be able to make up cells, not to mention organisms, without first going through the molecules level and exploring the different types of interactions among them. Likewise, molecules alone could never give way to organs or living organisms without going through the cell level before and thus, going on in the complexity scale.

In living beings, the “reality” acquisition process and the consequent consciousness emergence is always produced very slowly in every individual from the moment of conception, that is, from the same and own conformation of the protobeing, according to time and manner established by the evolutionary process for each species. Practically, in an automatic natural or non-voluntary way - and little by little - as progressing ontogenetically and phylogenetically in the - supposed by us - evolution scale other attributes or emerging properties start to appear additionally and gradually until awareness is finally obtained as a further step, product not only just from elemental “particles” or quantum interaction but also by its aggregates that are turning to be more complex from the atoms to the first molecules, then from these cells towards organs and organisms, until the ultimate known evolution products: individuals who, when interacting among each other and with the surrounding environment, in turn create emerging properties such as social and cultural behavior - which in turn are emergent properties of previous stages - in an ontogenetically and phylogenetically brain growing and maturing process. In the case of human species and considering from the moment of conception, it is estimated that in every individual it requires around twenty-five years approximately to be completely developed. (There is a recent death by accident statistics that justify higher rates of brains immaturity in young people - under twenty-five years old )

Let us consider for a while a five or six year-old child. We can observe that, during waking hours, this child is well-structured and aware, with clear control of his/her movements and reasoning in response to the alternatives presented by the environment. This child lacks and adult’s amplitude, accuracy, complexity and competence, thus clearly showing that both his/her entire body and his/her brain are in a developing stage, they are not complete and that it will take an intellectual as well as physical maturity process in time an manner, the characteristics of which science is rendering more knowledge every day.

Rituals and customs that define the different stages and responsibilities according to the constituent’s age, from their childhood, through adolescence, until adulthood are thus produced in the different human cultures

So, we can then say that throughout a long period of our life, though we are conscious, we are not necessarily and completely aware of it and this is so because of our brain’s state and the different capacities during its evolution both onto and phylogenic. This capacity is also affected by accidents and illnesses, and it also declines, sometimes, during old age; not taking into account one third of every day in our life that we spend sleeping.

In other words, if we consider the moment of every human being’s conception as the moment the female ovule and the male spermatozoid join together, we can think about a very well known process that tells us that, in fact, the true origin can be traced back to the famous “Big Bang” and be marveled with those minute “particles” content and their interaction, where thousand millions years of evolution are represented - to name only what is known - and also potential and almost infinite futures are encoded, according to the interactions that are produced, at each step, among elemental components, to give way to determined groups with differentiated inside/outside and these, again also interact with their environment, during the development of things and beings. Nowhere in this process can we talk seriously about a homunculus being, “fleshless” entity or a supernatural will that guides it.

There are no real or scientifically proved experiences nowadays about the existence of any spirit roaming independently in the body or brain in time and/or space.

Instead we do have more than enough reasons—though nor certainties—to think of processes that, moving in accordance with natural mechanisms and rules in our universe, produce these new “emerging properties”.

With this I mean and I want to emphasize that there is no connection between evolution, behavior, awareness and knowledge with respect to the will or

presence of a homunculus, a spirit, or a supernatural soul that guide the events of our lives.

Any appeal to supernatural mechanisms or miracles to explain or support these human beings' characteristics belongs to the sphere of faith and here, there are as many explanations as religions in the world, each one with arguments that do not require any coherence and which are alien to scientific activity. This does not mean that the religious experience in itself can not be considered as an inherent part of the brain's normal activity and studied from different fields of the neurological, psychiatric and psychological research.

We are what our brain/tuner naturally interacting let us be: we are born, grow up, become old and die with our brain; there are no personal experiences out of or independent from our brain. We are our brain, body and what they generate.

*"We are our memory—Borges wrote—we are that fantastic museum of fluctuating shapes, that pile of broken mirrors"*, in that beautiful elliptical and poetic way he used to refer to abstract concepts, so elusive as mental representations and their neuronal registers can be.

Anyway, I want to beg may pardon to believers as well as agnostics for not carrying out any value analysis on the supposed "intelligence" of what is known as the "Intelligent Design" theory.

I understand that any action to that respect would offend feelings of any of the parts, and this is not my purpose.

#### ***Past, now and future, finally, time: is just an illusion?***

Another intriguing aspect of the vital process and awareness is that it always happens in real time; no matter if this activity is bonded to the information stored as memory (the past) and that it is also connected to those parts of the brain that define expectations (the future), reasoning, thoughts or value judgment with the existing information or records, etc., etc., as a simply marvelous task. What is true is that awareness of what is going on - in a healthy not altered brain—is only produced in what everybody knows as "the now", in only one of the infinite and possible trajectories of the "Whole", in the way a "tuner" would do, with the infinite and diverse electromagnetic radiations that reach its antennae; they are all there.....but only one manifests itself at a time.

I should not incur in any delay in making clear that I use the image of a "tuner", just as a parabola, metaphor or analogy that lets me shape awareness phenomenon referring to something already known. Before receiving justified criticism on an involuntary reductionist "in extremis" position, I must say that just as a radio tuner has got a series of necessary intermediate elements such as the antennae or waves

receptor, a conductor, a demodulator, a transducer, diaphragms, loud-speakers and so on, and, of course, a source of power to transform the waves or electromagnetic signals from space into vibrations that produce pressure waves in the air or sound, in the case of an audio equipment - and other more complex elements, in the case of image transmission and emission - TV - in the same, though substantially more complex way, a series of mechanisms, intermediate steps or processes in between space/time points or singularities are needed in the CNS of a living organism. Here this relationship, a contact, a detection, in the end, a "decoherence" or a "wave collapse" takes place among parts/ waves/particles or quantum or strings of external information and the receptor (sensorial organ or "antennae") of the body's nervous system that, through the brain mental process it finally shapes knowledge, consciousness and, in our case, awareness.

Have you ever thought that the *now, this present moment* I am writing these lines is conceptually the same, but literally different from the *now* when you are reading them, and from this *now* of this very last word?

There appears a confusion as regards the multiple use of the word "*now*".

It is always possible to think about the past and also the future but always and only from the present of this *now* that is ephemeral and not able to be grasped.

In every space/time singularity that you may consider as fleeting and intangible *now*, you only have "in your hands" (your awareness or aware thinking) the information that is arriving and being processed in real time, through the interaction of your senses (in fact your whole body, including memories, homeostatic answers and so on) with the signs coming from the external "Whole", in that instant without extension we call *now* and which wonderful neural processing by the more than complex central nervous system follows in a more than intricate and still inexplicit labyrinth of activations and inhibitions where many mechanisms are involved-conscious or not - such as memories, future expectations, reasoning, etc. coupled with our body homeostatic reactions associated with our body, that some people imagine in series, in parallel or even holographically and that evolution added and adds so natural and permanently to human background in a process which origins are lost in the night of times

From this conception of time and consciousness it is possible to think that all the elements that belong to our reality, and our ancestors—all our past-, also our descendants—all our future—exist, are, in so different as individual conduits of interactions among the elemental particles from the "whole" and they only become concrete for each of us, each version of the multi-universe, in every instant of our present, in those events of real time we call consciousness and

awareness making up the now, through the interactions/relationships or decoherence of our bodies' elemental parts - generally our central nervous system senses - with the corresponding elemental parts of the "Whole". This is performed in a similar way a "tuner" would do to catch radio or TV waves and give as outputs sounds and images through the processing of such in their demodulating guts.

All "realities" – interactions/decoherences - are possible in the "Whole", but for you, the version or versions being read at this moment, this piece of writing becomes alive now, and it is that probability the one that "collapses" in this singularity of space/time, according to the structure of the reader's consciousness or "tuner", making up this only "reality" that we share from so different and own nows.

As Borges would say in the mentioned story dedicated to his friend Victoria Ocampo:

*"... then I considered that that everything happens to one, precisely now. Centuries and centuries and only in the present is when facts happen..."* (El Jardín de senderos que bifurcan, 1941).

We only exist and are aware of it, in the present, the only and permanent now of any of us, yes, it is this same now I am writing and you are reading and, of course, also that other now when an unknown and remote reader is reading these words, may be with the smile of someone who now knows something we are ignoring now.

### Prospects

One can ask oneself: where do the new elements and "emerging" concepts come from? Is evolution process over? Is everything already discovered? Will the infinite parallel universes of which men like Borges, Everett, De Witt, Davis, and more recently, Davies, David Deutsch, Martin Rees, Max Tegmark and many others spoke about be "waiting for us" round the decade or the century? What other new emerging elements or concepts will be added today, tomorrow or next week to the "known reality"? Where do you think they will come from? ... I do not believe it is crazy to think about the "Whole" and the "tuner"...

If we consider the exponential growth in the amount of new events, concepts, things and individuals included –by invention, discovery, emergence, birth—to everyday "reality" along the time of the known history of humanity, it seems reasonable to suppose that the number of unknown elements, unimaginable today, that are still inside the "Whole" is to a large extent bigger than we can imagine. And all this thinking only in a simple extrapolation, keeping away from the enigmatic world of chaos and complexity, full of surprises that make our precarious certainties and predictions slip and stumble.

There are recent glances into that still concealed world, like the ones proposed by the new theories on chaos and complexity. In this respect, we can read Ian Stewart's (Editorial Crítica, Barcelona, 2001), "Is God playing dice?" It is the product of theoretical research about nature's regularities –or irregularities - as from the beats of our heart to meteorological changes, accurately confirmed by coherent concrete practical applications like the production of sensitive metallurgic elements. These ideas tore into pieces the old determinist precise paradigm that ruled the universe and they seem to illustrate that it is inherently not scientific to make absolute certainty long-term predictions about our long-term future by simple extrapolation of our present knowledge and experiences.

Yes, obviously, everything seems a little weird, but is like this in this strange world of modern physics and quantum mechanics...strange, but it works, not only in the tunnel-effect microscopes but also in the medical-diagnosis devices, where improbable and "virtual" particles become concrete under the spell of technology or in hundreds of other technological applications which only basement or explanations are, at least for the time being, the apparent incongruence to our common sense that the extraordinary quantum theory proposes.

Once Heisenberg's uncertainty principle was established and accepted, it was then Schrödinger who developed the corresponding wave function that allowed overcoming doubts.

That is to say, quantum physics turned a great amount of our certainties on nature's structure or "reality" into a world of probabilities eventually measurable. If we remember the old mathematics principles, any probability which measure is different from zero, will finally be factual in a finite time, or, if you prefer it, in the eternity ( the "Whole"?) the Creator has established farsightedly for these cases.

As D.R. Hofstadter puts it: What other esoteric questions and astonishing answers will hit our naïve and never-ending surprise?

Clues? At this moment, the greatest intellectual efforts in the world are focused on finding mechanisms and gadgets that would let us study "the quantum reality" from our macroscopic world, without distorting it.

In this respect, there is an important progress in quantum optics that allows to encode messages safely. In quantum computer science, there is the emergence of a new information unit, equivalent to the bit in classical digital computers (binary notation with only two possible values: zero or one): the qubit, which represents the decoherence of the infinite entangled states from their quantum world to the macroscopic collapse of our "reality" and consciousness.

Accepting that the formation of a remembrance, knowledge or an aware experience – our "reality" at last

– is as it is allowed to speculate from the Quantum Theory, a result of a limited but victorious multi-interaction in the Darwinian selection process that forms our particular and own version of our awareness, it is worth asking ourselves about the destiny of the resting and minority – in our version – interactions of every case or opportunity. May other knowledge, “realities” or coincidences participate in hypothetical parallel universes?

In order to answer these questions or hypothesis, I think that it will be necessary to wait for a greater development of very promising theories as the ones already mentioned on quantum computation, string theory, super-symmetries, up to new reasoning instruments as fuzzy logic, that allow to attain answers that will surely complement our present mathematical tools with greater precision.

Other fields of research where the quantum world is being focused, like nanotechnology, waves/particles teletransportation, the continuous antimatter production, etc., etc, allow to assure that evolution has not stopped and that, on the contrary, “tuners” task (our brain that produces our awareness and knowledge) seem to speed up, diving into the “Whole”’s infinite reservoir.

Those who have been working from mathematics and physics on the last scientific developments such as the superstrings theory, “M” theory, Higg’ boson, etc. as the important physicist Stephen Hawking or hundreds of renown mathematicians from the Internet, speak about strings, branes, and up to hypothetical “one-dimensional oscillators” as the possible nature’s or and hypothetic “Whole” possible basic components.

Finally, we can say that the “Whole” is the sum of what exists, either we perceive it or not (again, “the sum of all histories” according to R.P.Feynman); it is the place of every possible configuration of the true “elemental particles” conforming elephants, fleas and monkeys, brains, atoms and electrons, stars, planets and galaxies, etc. Some of them interact and they produce phenomena we can interpret as movement, time, space, life, intelligence, knowledge, consciousness, awareness and other things we can not even dream of.

That “whole” can be imagined as an infinite plane or volume – just to think about familiar dimensions - in which its constituent elements are related (Bohm, David, *La totalidad y el orden implicado* Ed. Kairós, Barcelona, 1988), each one is and conform part of multiple, maybe infinite, configurations which are arranged according to their interactions established among them. These interactions occur in the fashion of a snapshot or a cartoon in a magazine, recorded in a CD or a familiar video tape or film: they are seen from the perspective of their own dimension or dimensions; they can not abandon their singularity and space-time dimensionality; every picture, every bit, every case, every experience has a sole present an only now and in

such way they will remain for ever, in their respective chapter, only accessible as a set to a hypothetical external observer, who is irrelevant to the limiting dimension of the magazine, CD or video-tape or individual consciousness.

Is it possible to imagine other beings or self-consciousness configurations with a different and bigger sensitive dimension than us, in the immensity of the “Whole”?

There are people who suppose that intelligence evolution can drive us to “Matrix”- like realities, and even that perhaps our present existence is in the end something similar to the one shown on the screen by the Wachowsky brothers, while others, like the clergyman Theillard de Chardin visualise a future conjunction between man and nature and its creator in an omniscient Omega point.

We must admit we know very little about the “ultimate nature” of concrete things, let alone about abstract things and their interactions in order to assert undoubtedly that any of the fashionable interpretations of “reality” is more or less concrete than the other.

There is something about which there is little discrepancy today and that is that knowledge about reality evolves in any unexpected direction, with characteristics that appear in the complex and chaotic processes, like the emergence of new and unedited theories, in such a way that what we know today or our ideas about the world change every time more quickly, reaching the paradox to think that the only permanent thing is change and there we go with our dreams, hopes or maybe, only the illusion of being the owners of our fate..(Illya Prigogine. *Cuadernos Infimos* N°111, Tusquets Editorial, Barcelona, 1983)

“Patience, in the blue of the sky”, is what the well-known Canadian researcher on nucleosynthesis (the process of creating new atomic nuclei in the stars) and Research Director in the National Center for Scientific Research in France, Huber Reeves, asks for, author, among other books of the best seller *Cosmic Evolution* (Granica, Juan. *Colección plural* N° 2, Ediciones S.A 1982)

There seems that ends are open to any destiny we could attain and we would do well if we keep our “tuners” alert to understand and, why not, make a better world.

Like any other known species, I think that may be even us, the Sapiens Sapiens, would disappear from the earth some day and I hope our children—not the sexual ones but born from our intelligence—will be the ones to take nature’s evolutionary (infinite, circular?) post.

After all, and if the reasoning exposed above proves being correct, sooner rather than later we shall understand that our freewill has always an open end as the only possible choice.

I close my analysis or technical summary of the book about “Borges, Teoría cuántica y universos paralelos” where I intend to deal with the proto-theory of the “Whole” and the “tuner” metaphor as an expression or model about the nature of the relationship between “reality” and our awareness, with a poem or couplet that in a wonderful evidence of science and fantasy having a common fortune, delights us and summarizes in ten lines what would take whole bookshelves of judicious rational elucidation to explain, something so elusive as “reality” and human knowledge:

Caminante son tus huellas  
el camino y nada más;  
caminante, no hay camino:  
se hace camino al andar.

Al andar se hace camino,  
y al volver la vista atrás  
se ve la senda que nunca  
se ha de volver a pisar.

Caminante, no hay camino,  
sino estelas en la mar...

Which would go something like:

Walker, your footprints are your path and nothing else; walker there is no path: the path is made as you walk.

When you walk you draw your path and when you look backwards you can see the path you will never tread on again.

Walker there is no path, but trails in the sea (famous couplet by the Andalusian poet Antonio Machado, that could be translated or understood as something like: “Reality”, “what exists” is so solid and concrete, fleeting and ungraspable as life itself).

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