

## **FROM CHAOS TO CONSCIOUSNESS**

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### **Essay Abstract**

An ultimate theory for physics would illuminate the ways that nature works to organize the various levels of the physical material world – from quarks and gluons to complex adaptive systems and finally to conscious awareness. The formulation of an axiomatic, space-less and timeless Goedelian Physical Theory (Sixth Hilbert Problem) will describe the latent phase of particles and forces.

### **Introduction**

Looking to explain the creation of the world and the forces of nature in a bid to understand their own existence, humans invented religion. All ancient religions evolved around similar cosmologies and talked about the world being predated by chaos and about anthropomorphic deities that control the natural events. The universe was doomed to end according to some, or would perpetually go around in a cycle of creation and destruction (Big Bang and Big crunch). The proliferation of deities in ancient cultures was enormous.

However instead of providing answers for the creation of the world and the natural forces, the proliferation of deities complicated matters further and soon it became necessary to develop a more simple explanation of the natural world. Monotheistic religions proffered a unification of all deities into one, a simple explanation of the Universe by the adoption of one supreme Being. But while many deities were rejected in favor of the all-powerful One, monotheistic religions still maintained that the world was created out of nothing and no explanation was sought for the initial cause. When asked St. Augustine rejected the question what God was doing before the creation of the world.

In modern scientific theories deities have been replaced by particles, constants, conservation laws and conservation quantities, and new theories are looking for a simple explanation of the Universe by the adoption of few constants or “conservation laws” as opposed to several. But no explanation is sought for the initial cause (initial singularity).

The ancient Greeks were the first to try to explain the creation of the Universe with no resort to theological reasoning: air, water, fire and earth were identified as the four main elements of the world and they were not concerned of how these elements came into existence. Anaximenes seems to have held that there was only one preexisting substance namely the air, from which all existing things were made by rarefaction and condensation. Later Plato introduced his world of ideal forms, which exists independent of the physical world where we live. He supported that there is a reality beyond ourselves (see No6 paragraph 8.7 p-411 and No7,p-12) and that this world is neither mystical nor unscientific. Present day physics have identified 60 elementary particles as building blocks of matter together with 20 tuning constants and some conservation laws, and quantities: It is a model more complicated than the one of the ancient Greeks but more realistic. It is very difficult indeed to accept that the cosmos could rest on such a proliferation of Fundamental Objects and Laws.

The advent of modern science came with the meticulous observations of heavenly objects from Tycho Brache. Kepler made use of these observations to formulate his three Laws and from these laws Newton made his theory of Universal Gravitation .This theory had, from the beginning, three major problems to solve which Newton was well aware of.

- Action at a distance
- The absolute space and time
- The nature of light (wave or corpuscular)

### **Why it took us so long?**

The great achievements of the twentieth century in Physics were the formulation of Quantum Mechanics (QM) , Special Relativity (SR) General Relativity (GR) and Quantum Field Theory (QFT). The question is: *Did it take us long time to uncover and formulate these theories?*

This embarrassing question is posed frequently by the scientific community. The development of physics in the 20<sup>th</sup> century and earlier is full of such examples : Aharanov-Bohm effect, Dark energy ,Casimir effect, Olbers's paradox, Uranium Radioactive Property, etc.

Let us take briefly a short history tour to unveil the clues available at Newton's time, which could have guided the physicist of the 17<sup>th</sup> century towards the new theories of 20<sup>th</sup> century.

- (i) There is a well known quarrel between Newton and Huygens about the nature of light. Newton was in favor of corpuscular nature of light, although he had invented the diffraction of light which exhibits its wave nature. Why then did he not consider that light is both particles and waves and depending on what light is asked to do? An analogue procedure was already in use with geometrical optics. It was also known that standing waves exhibit a quantum behavior. Therefore ,for an enquiring mind there were some clues towards a new theory of light, but he had to wait for new tools in order to formulate the complete Quantum Mechanics.
- (ii) The absolute space and time as well as the action at a distance annoyed Newton. He believed that something conveyed the gravitational influence from one point to another instantaneously which means that the above influence travels with infinite speed. But it seemed more logical to accept the finite speed of an action rather the infinite one. If we accept that the speed by which information travels has an upper limit we have the rudiments to formulate the Special Theory of Relativity. Newton after all did not bother so much to ask *why* bodies move, but only *how* they move.
- (i) An enquiring mind could have formulated much earlier the Michel's and Laplace's Black Hole theory (1784) and suspected that a new theory of gravity is needed in order to cope with the singularities problems, but he had to wait for Riemann's Geometry and Mercury's perihelion precession, during the 1850's and of course the formulation of SR, for a complete description of this new theory of gravity (G.R.)

### **New Tools. New Physics**

If the FQXi 2009 contest was posed in 1900, then possible answers at that time could be as follows:

- There is nothing to be discovered in physics now.(Lord Kelvin, at the British Association meeting in 1900, see No3 p.98)
- The grand underlying principles have been firmly established ; further truths of physics are to be looked for in the sixth place of decimals.(Albert Michelson in 1984 at University of Chicago, see No2 p.33 and No3 p.98)
- Aware of the above three problems of Newton's Mechanics as well as the new data and problems (see 12 p.11) arising from:
  - (i) Geissler: Vacuum Pump mid 1850's- (ii) Ruhmkorff: High Energy source 1850's- (iii) Rowland: Refractive Gratings 1880's.

An enquiring mind could have answered in the following way.:

A new Theory is needed to describe microcosms with certain measurements problems . In addition it could have seen the need for a new theory of light and of gravity, where an upper limit of the speed the information can travel, plays a fundamental role.

The above mentioned 19<sup>th</sup> century tools (Vacuum Pump, High Energy source, Refractive Gratings) revealed new phenomena, such as Electron discovery, Cathode Rays, X Rays, Radioactivity , Photoelectric effect, etc. and helped physicists to find new underlying Laws of Nature. These new laws (especially quantum mechanics) brought a crisis in Science.

There was always a tendency within the science community to hasten to declare the end of Physics, especially after some big breakthroughs. For example during 1920s after the formulation of Q.M. Max Born declared that "Physics as we know it, will be over in six months" (see No9 p-207).

Although we have nowadays, the best and more accurate theories ever, physicists realize, perhaps for the first time, that these theories (Standard Model and General Relativity) must be modified. They are looking for the Grand Unified Theory which will incorporate the 4-knowing Forces and they hope to find TOE (Theory Of Everything) as an answer to Theological Theory of Everything (see No10).

### **Gulliver's Travels**

Let us start our travel from a large-scale structure of the cosmos, such as the Sloan Great Wall and proceed down to tiny elementary particles such as electrons or quarks. We find that the material world is organized in certain levels and in the transition from one level to another deeper level some physical quantities (mainly forces) disappear and some others emerge. If, for example our journey to the microcosmos passes through a liter of milk, then as we go to the molecule level, the milk temperature disappears and new forces (Van-der-Vaals or London ) appears and as we travel deeper and deeper our journey will probably end inside a QCD Field of Forces, in the middle of quarks and gluons. But if we try to go even further, in order to discover more tiny objects, we probably meet the Planck scale, where a singularity lies the same one as we have met before near a Black Hole and our journey is probably coming to an end.

Are black holes real or a scientific explanation of our ancestral fear that there are points of non-return (Acheron river) which guide us to the underworld (see No19)?.

All the objects we encountered during our journey were made from the constituents of the first family of particles and whenever we looked there was not any sign of 2<sup>nd</sup> or 3<sup>rd</sup> generation of quarks-leptons etc. Can there be additional fermions-bosons-quarks besides the three that are known? It seemed that all these particles were latent and revealed themselves only under specific conditions in the laboratories. Some other

situations of ordinary matter are very difficult to be achieved and probably never appeared throughout the whole history of the universe.

That was our journey through inanimate matter. Our journey through animated matter started from big mammals down to viruses and we noticed that consciousness disappeared when we cross the threshold from animals to bacteria while when we cross the threshold from microbes to organic molecules the reproduction ability disappeared.

During our journey through the universe, we found evolving non-adaptive systems, such as galaxies, to follow the same pattern with complex adaptive systems.

The galaxies' formation, for instance, depends on the external forces, that the galaxies themselves generate (gravitation, space curvature, dark energy) just as amoebae concentration depends on the chemicals that the amoebae themselves secrete – there is a similar mathematical model in both cases (see No15 Chapter one).

It seems like some ability of inanimate matter have been inherited to animated matter by some unknown process, which is the same as the learning process of living beings.

### **Clues and Tools**

During our journey through Cosmos we have noticed that ordinary matter was organized in levels and each one of those reveal its own special characteristics. In the above example of milk, the temperature was raised once we permitted the milk molecule to have many degrees of freedom. When we go from atoms to molecules, binding energy appears, due to energy stored inside the electromagnetic field, etc.

We can classify those levels as follows:

- Latent level
- Quantum Level: All the elementary particles according to the standard model
- Nucleus level
- Atomic level
- Molecule level: Organic Molecules and inorganic molecules
- Substances- microorganisms
- Huge agglomeration of matter, that is Non-adaptive evolving systems such as Galaxies and stars, which are self-organized and produce local order.
- Complex adaptive systems such as Protozoa-animals (ex. Bacteria becoming resistant to antibiotics )
- High Level of Organization (Human's brain).

Notice, that each level is more complex than the previous one and the increase of complexity is due mainly to the passage of time. Toward more complexity is also inherent inside each level and especially in complex adaptive systems.

This drive towards more complex situations as time goes on, is a tendency of Nature for more stable offsprings and fitness. In the atomic level the simple hydrogen atom passes to more complex ones like say, iron . The emergence of more and more complex atoms finally comes to an end and then Nature switches to the next more complicated level (in this example the molecule level) and an evolution towards more complexity starts all over again from the simplest one , say water molecule, to highest complexity say DNA. Therefore, as time goes on , we meet more and more complex systems (Human's brain from simple ingredients quarks) , where chance and selection play an important role.

Science has made a lot of progress to explain how new attributes are added as we pass from one level to the other. However two major problems remain which maybe solved by a new theory of physics and these are:

- (i) The quantum gap: Quantum Laws in the micro cosmos are quite different from the laws of the macrocosmos . The ancient Greeks believed that the Laws of Heaven are quite different to the Laws of earth and
- (ii) The emergence of consciousness that occurs once we move from the Quantum level to the animal's level (brain).

In order to answer the first problem we need new theory of physics which will emerge from new tools namely the big detector machines (LHC) and the probes in outer space .These tools, already in development, will help us to clarify the behavior of elementary particles and Cosmology.

The new physics must clarify all the questions quantum mechanics pose and may have two branches: The first could be a Goedelian Axiomatization Physics (6<sup>th</sup> Hilbert's Problem) a spaceless and timeless physics more or less like the Plato's ideal forms where the latent Beings (elementary particles) and isolated points of space of the order of Planck's length abide together with two deities: one unification force of the three existing forces (E/M-weak-and strong) and the second one (gravity), which combines points and particles. Under specific circumstances and via a certain mechanism this pre-existing latent chaos will rise to the appearance of ordinary matter and the fabric of the universe .We postulate the existence of a certain mechanism inherited by nature to produce the Universe out of Latent Particles and Points of Space ,such as the yet-to-be-discovered inflaton field.

Have you ever wondered where music goes when we do not hear it? It is just in a latent state and all we have to do in order to hear, it is to find some specific mechanism to produce music. A similar procedure can be applied to Ideal Forms of preexisting Chaos to give rise to Elementary Particles, Conservation Laws and Quantities, as well as the fabric of Space, that is, the appearance of time , the Low-Entropy State in the Past, Dark Energy, Aether, etc. A similar Physical Theory to this one is Q.F.T. which describes how particles vanish and reappear. Therefore, a journey through Goedelian Axiomatization Physics to Plato's ideal forms is needed in order to answer the problem of creation.

The new theory may have two mediate bosons and two elementary particles and from the fact that gravity is something different from the other forces, some kind of *emergent phenomenon* (see 4 p. 217, paragraph 4.4), therefore quantum gravity is not feasible as well as its unification with other forces. We will finally have timeless-spaceless quantum gravity for the singularities only and once we transverse the quantum gap the GR is the semi classical theory of gravity.

Once we have the new physics (in Quantum Level) we can proceed to solve the second mystery, how does consciousness come out of elementary particles. That will require a transformation of Classical Physics to some kind of new science which will combine Physics with biology, astrobiology, neurology etc. In order to solve this problem we have to go step by step starting from the first level of the material world, that is from elementary particles up to complex adaptive systems and finally understand the mechanism of how each level acquires its own characteristics from the previous one .Why the number of protons defines the chemical nature of an atom and the number of neutrons the isotopes of this chemical element and not vice-versa?

The definition of life is not completely clear .Is a virus, alive or not? Is a prion, alive or not? Are cellular proteins complex forms like crystal formation? According to the Grand Unified theory, proton is inevitably unstable and so is all atoms, and this marks the end of a certain atom. Is this the underlying mechanism of the degradation of inanimate matter, natural mutation and eventual death of living things? Is death after all a manifestation of second Law of Thermodynamics? What is the role of time and second Law of Thermodynamics (see No11 p-255)?

Do we have to draw a line somewhere between animate and inanimate matter, or do we have to consider that both have the same behavior. Galaxies and stars formation is

made by continual gathering hydrogen under the influence of gravity .Galaxies merge or divide like bacteria do. Hydrogen is metabolized into Helium inside stars or metabolize matter completely through the gravitational collapse of stars(supernovas).Finally, the explosion of a supernova contains the seeds that inoculate the whole universe like sperms inoculate the eggs inside a uterus. Would this make galaxies alive? This process which comes from the very beginning of the cosmos is finally inherited in the final level of living things and therefore maybe there is not a line that separates animate and inanimate matter and therefore we have an explanation of how life is generated from non living matter (Abiogenesis).

Two models are isomorphic (or homomorphic) if they are mathematically identical, or in other words similar in patterns. From this point of view we can say that two Humans are isomorphic models or one person is isomorphic with his parents , or with his grandparents or with his ancestors. In so doing and according to the biological evolution, we can say that a person is isomorphic( or better homomorphic ) with the first organism on earth.

The question, we would like to pose is whether this primitive organism is isomorphic to something else. Or in other words whether we can find another model which has a similar pattern to the evolution of living organisms.

So far, the best way to understand the biological phenomena is to regard the various biological systems as open systems. Open systems exchange both matter and energy with their surroundings. The processes that go on in living systems are irreversible and once a living organism has grown-up is in a stationary state.

Prigogine has suggested a method to apply the theory of stationary non equilibrium processes to biological phenomena, which may lead to a better understanding of the relation between entropy and biological systems. When a plant for example, absorbs sunlight, that is photon of which energy is approximately 2 ev and thermally re-emits an equal amount of energy in the form of 0.10 eV photons, it is acting like a stationary non equilibrium system and in fact a wide range of biological processes seem to fit into this pattern.

A similar process can be found in interstellar grains of our galaxy. The interstellar dust grains are in a state of stationary non equilibrium .When starlight arrives at a certain grain from directions lying within the plane of the galaxy tends to orient the grain so it is spinning with its angular momentum axis lying in the plane. An oriented set of grains shows greater order than the randomly oriented dust, and the decrease in the grain's entropy is produced from the absorption of low entropy starlight and emission of high entropy isotropic infrared radiation.

The above can be illustrated in the following table:

INPUT: Absorption of Low Entropy Anisotropic Starlight	Interstellar Dust Grain in Stationary Non-equilibrium State	OUTPUT: Emission of High Entropy isotropic infrared radiation.
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The *perfect cosmological principle* states that for any observer regardless of his position and the instant he makes the observation, the image of the universe surrounding him is the same, except for local variations. This means that the image of the universe does not depend on time, or in other words the density of matter in the universe does not vary. One possible explanation is that new matter is continuously being created and therefore the Universe is an open system and this leads to the development of the Steady-State Universe.

If we accept the *Perfect Cosmological Principle* we have to accept the Universe as an open system. Of course this model has to have an input and an output. As an input we can regard the creation of new matter and as output the expansion of the Universe and therefore we have the following table:

INPUT: Creation of new Matter	Universe in a steady state	OUTPUT: Expansion
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We can also say that the input is a consequence of the *Perfect Cosmological Principle* and the output (the expansion) is a consequence of the 2<sup>nd</sup> Law of Thermodynamics. And this is because of the expansion there is always more empty space being created and starlight can flow into this volume to fill it.

After this we can change the input and the output of the above table as follows:

INPUT: Perfect Cosmological Principle	Universe in a Steady State	OUTPUT: 2 <sup>nd</sup> Law of Thermodynamics
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Let  $\rho(x_o, y_o, z_o, t)$  is the mass density of the point  $(x_o, y_o, z_o, t)$  then in a steady state Universe  $\rho(x_o, y_o, z_o, t) = \text{constant}$ .

The Gravitational Potential  $U(x,y,z,t)$  is related to the density by the formula:

$$U(x,y,z,t) = -g \iiint \frac{\rho(x_o, y_o, z_o) dx_o dy_o dz_o}{\sqrt{(x-x_o)^2 + (y-y_o)^2 + (z-z_o)^2}}$$

According to the observation the recession velocity of distance galaxies increases in proportion to the separating distances. Consider a spherical volume with radius  $r$ , then the expanding rate is:  $dr/dt = H_o r$ , where  $H_o$  is the present day Hubble constant.

The volume expanding rate is:  $d(4\pi r^3/3)/dt = 4\pi r^2 dr/dt = 4\pi r^3 H_o$ .

If the density of the sphere is to be maintained constant at some value  $\rho_o$  during this expansion, the increased volume must be filled with matter at density  $\rho_o$  so that the rate of matter creation is  $\Delta m = 4\pi r^3 H_o \rho_o$  in a sphere of radius  $r$ .

We can assume that in every increasing of the radius  $\Delta r$  corresponds an increasing  $\Delta m$  in such a way that the Gravitational Potential  $U(x,y,z,t)$  remains constant. Therefore a circularity of action exists between output and input and maybe a feedback can be present (see No 18).

We can see now the previous model of the universe in the following way:

INPUT: Perfect Cosmological Principle	Universe in a Steady State	OUTPUT: 2 <sup>ND</sup> Law of Thermodynamics
There is a coupling between Gravity and input	Gravitational Field	There is a coupling between output and Gravity

The question we want to pose is the following: Are the primitive organisms Isomorphic to the Interstellar grains and finally to the steady state model of the Universe?

Galaxies exist in all parts of the universe, in an apparently unchanged form and undiminished numbers. In order to understand galaxy formation we think of gravitation or some other force (dark matter) acting to concentrate matter into a certain volume. This action is countered by the continuing recession of matter, as the expansion rate of the universe forces matter further apart. There is a tug-of-war between cosmic expansion (dark energy) and gravitation (matter and dark matter).

There is a similar process in biology and this is the aggregation of *Slime Mold Amoebae*.

The natural habitat of the amoebae is soil and they feed on bacteria by engulfing them and multiply by mitosis (dividing in two). When food sources are exhausted, amoebae begin to aggregate into a number of collection points. These points are points of high concentrations of a chemical which they themselves secrete. The same argument applies to galaxy formation. The matter moves preferentially towards relatively high *Gravitational Field*, which themselves secrete.

According to our Hypothesis the organization of Slime Mold Amoebae and the Galaxy Formation are two Isomorphic models.

### **Is it possible for a well to imagine the existence of oceans?**

I tried so far to find some clues for the proposed final theory of physics which will best describe the existing world. The new Physics will have two branches, one for microcosm of Quantum Mechanics (elementary particles) and another one for macrocosm.

Cosmology is a very new science and scientists have a long way to go to reach a complete understanding of the workings of the physical world, all the more because they derive their empirical data from 5% of the whole universe. We haven't decided yet, what is the large-scale spatial geometry of the universe (Euclidean, Hyperbolic, or Elliptic). There are too many theories about the creation of the Universe and Big Bang is the predominant one, but continuous modifications are needed in order for this model to be able to cope with new data, which frequently pose embarrassing questions.

At this point I would like to quote from No14 page 154, the following paragraph:

*It is fair to say that steady-state picture like Einstein's and Hoyle's are not fashionable. The preference for Big Bang pictures may be as much a consequence of Philosophical and Psychological leanings as of the rather inconclusive evidence of observation. The Big Bang is more exciting, more spectacular, more useful for the popularizers than the more pedestrian unchanging steady state. Honestly, I do not think anyone is really sure of the truth of the matter.*

The limits of physics would be probable near the Planck length where we found Goedel's Axiomatization Physics which is the physical theory of the lower limit and we cannot go beyond that limit, that is inside the world of ideas forms or the preexisting chaos. This physics embodies the mechanism of genesis from its constituents via the power of the two forces and this mechanism is inherited in every subsequent level of organized matter, therefore render animate and inanimate matter indistinguishable.

With the modified semi-classical theory, we will be finally able to find a model for the mind, which will explain the appearance of consciousness but we will not be able to construct an artificial intelligence with conscious awareness and that will be another limit of the physics.

Contemporary Physicists are trying to build bridges to the other great area of human intellectual activities the *arts* and more precisely Poetry and Philosophy to their rescue. This has been done many times before with the Creation Hymn of Rig-Veda, Greek Philosophers, Mach's Principle and so on. Great minds in the arts (like Bach ,Mozart, Picasso, etc.) have been able to see truth and beauty which is the other side of the coin of truth and beauty that the great minds of science see (Newton, Einstein, Goedel etc.).

The way to approach our search to unveil the mysteries of the cosmos is contained probably in the following poem of Greek poet Nobelist, Odysseas Elytis:

*Ο τρόπος να μετράς σύνολα αστερισμών είναι απaráλλαχτος  
Με τον τρόπο που μετράς σύνολα λέξεων σύν ένα. Αυτό το σύν  
Αποτελεί, όσο μικρούτσικο και αν είναι, ακόμη και δισύλλαβο,  
Τη μόνη μας υπεροχή απέναντι στον απέραντο όγκο του  
Υλικού κόσμου.*

*The manner of counting a set of constellations is identical  
With the manner by which you count a collection of words plus one.  
This extra, plus quantity as small as it appears ,even though it has two syllables  
Consists of our only predominance against the immense mass of the  
Material world.*

(translated by S. Pergamalis)

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