

# "THE GENERAL THEORY OF META-DYNAMICS SYSTEMICITY"

*Part four: Early Earth and origin of Life's metadynamics systemicity*

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The "Cosmo-planetary and terrestrial meta-dynamics systemicity", the "Life's meta-dynamics systemicity", and "Biological meta-dynamics systemicity" are the core of a general theory resulting from a "Bioethism transdisciplinary approach" of the whole set of dynamics that made and sustains Life as to exist throughout the atomic and molecular universal cycles systemicity.

Part four of this theory describes the Universe Cosmo-planetary metadynamics as having participated in the Sun system and its planets to form, particularly the Earth at the right "habitable zone". The physicochemical environmental conditions of this site became propitious for Life to "hatch" within biochemical thermodynamics<sup>1</sup> and evolution development metadynamics.

## ABSTRACT

Ever since 1996, J.-J. Blanc, the author of this theory, made an extensive research on "Systems science" that induced to his developing a new systemic<sup>2</sup> paradigm in terms of a *transdisciplinary* approach to "*Living systems*" that he named "The Bioethism" (see note <sup>3</sup>). The transdisciplinary approach is meant to support the acquisition of a large understanding of living systems' origin, of their natural structure and their adaptive behaviors. Their specific bonds and traits, as well as their evolution trends, while permanently interacting with environmental events for survival<sup>4</sup>, require actions-reactions from ago-antagonistic signals and stimuli. Endogenous within their body milieu and exogenous, these signals and stimuli are adapting with conditions of ecosystemic and sociosystemic environments. Thereby, living beings are closely linked with and affected by - a) Cosmo-planetary and terrestrial meta-dynamic forces, - b) early Earth metadynamics conditions for Life to have happened - c) the specific biological individualities and social traits and statuses accounting for the biodiversity of species to thrive and/or to get extinct – d) behavioral and evolutionary trends emerging

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<sup>1</sup> - **Biological thermodynamics**: "the quantitative study of the energy transductions that occur in and between living organisms, structures, and cells and of the nature and function of the chemical processes underlying these transductions"

<sup>2</sup> - **Systemic (adj.)**: "nature of a dynamic and retroactive process pertaining to or affecting an organ or the body of an organism".

<sup>3</sup> - "**The Bioethism transdisciplinary approach paradigm**" (acronym for **Biology-Ethology, ecology - Humanism**) fosters universal specificities relative to the complexity of Life's processing, which in form of open systems, appeared on Earth from biochemical components and survival properties, in propitious physicochemical environments (J.-J. Blanc 1967).

<sup>4</sup> - **Survival**: "the continuation of life or existence".

from the systemicity of biological metadynamics sets. For example the drastic extinction of species, except some bacteria, when the Earth became a "snowball" from a nearly total glaciation (-600 Mo/y) and, on the contrary, an extraordinary explosion of marine species bearing new functions (- 545Mo/y) after the planet reheating.

At this point of publications, this theory work has required several communications and a few more are expected to come. The "General Theory of Systemicity", here "fourth part" describes largely the metadynamics systemicity at the origin of Earth and the "hatch" of Life with a progressive apparition of living organisms (pre-viruses...) capable to reproduce, to survive and evolve. This large transdisciplinary work describes the fluxes and moves that structure the complexity of the Universe, the Cosmo-planetary, terrestrial and biological metadynamics that are part of the universal atomic and molecular systemic cycles.

For billions of years, fluxes and moves of the universal matter and forces participated in building up stellar systems, the Sun system, and the planet Earth on which a flourishing phenomenon called Life found an adaptable sustainability. Sets of meta-drivers, their systemicity with synergetic moves are sustaining a large number of cycles (water, rocks...) and are permanently adapting, changing environmental events, which occurrence values have to be observed in the short and long term.

This 2011 communication stands for a large description of the "Early Earth and the origin of Life's meta-dynamics systemicity". It also stresses the observation of both the "molecule cycle" and the "universality of metabolism". In the conclusion, it assumes the fundamental objectivity, evidence and realism of a "General Theory of metadynamics Systemicity".

**Keywords:** Systemicity, Bioethism, dynamics, meta-drivers, synergy, cosmic physics, emergence, early Earth, metabolism, early Life, abiogenesis, virus world, cellular organisms.

## FOREWORD

### A General Systemicity of the Metadynamics of Universe and Systemics

#### *The Reality of "Forms"*

A survey in the different scientific disciplines concerned with the actual "Science of Systems", shows too many scientists as developing systems' knowledge in the strict philosophy of human "reason" (ref. to logic and metaphysics) and under anthropocentric and theoretical viewpoints. Consequently, such "academic systemics" learning (Mario Bunge 1970s), often not pragmatically related to the Universe and Life's realities, offers moderate interests for application preferment. The "verb" as related to insights and spirit, in essence, if expressing the reality of survival necessities, in philosophical or other terms should also mean to be propitious with the care of sustainable and evolutionary behaviors.

Throughout the World, Cultures express the transfiguration of humans' insights, in their reality and imagination, their mentality expresses then a spiritual "form" or an "idea". Greek philosophers Plato, in its Allegory of the Cave and Aristotle in Metaphysics, suggest that: "With their sole senses and insights, humans cannot access to the knowledge of reality since their sensible bodies are in constant flux and imperfection". Plato's theory of "Forms"<sup>5</sup> postulate there are the most fundamental kind of reality, but Aristotle associates Plato

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<sup>5</sup> - **Forms:** "Plato supposes that there is a class of **stable, permanent, and unchanging** objects that warrant our knowledge claims".

“Forms” to the nucleus of the individual thing, which is called *ousía* (English as *substance* and *essence*). And essence is a real and physical aspect of what philosopher says “*the inward nature, true substance, or constitution of anything, is opposed to what is accidental, phenomenal, illusory, etc*”. The World sustains from cataclysms and cycles deviations.

Our modern democratic and technological world behaves towards the will to build and progress as the contrary of fatalism. However, it is yielding to counterproductive “verbs and behaviors” because social and climate changes as always, encounter the “impermanency of things”. The Nature is and always was confronted with the permanency of moves and flux cycles bringing the best and the worst: cataclysms emerge from cosmic and planetary changes, that impermanency of things and a great anthology of civilizations. If our learning on how to survive was permanently oriented with a large knowledge and apprenticeship to manage the changing conditions of science and evolution of the livings, then our philosophy of forms and ideas would become much more symbiotic with the reality of Life, by pragmatism and the philosophy of the impermanency, a far status from rationalism.

The Scientifics confronted with the reality of the world, particularly those concerned with biological disciplines, biochemistry, physicochemical phenomena and physiology are making science much progress at which point individual and societal feelings and emotions are taken into consideration so as to support a paramount and pragmatic understanding of “*survival rules*” and negentropy<sup>6</sup> as necessities while confronted with environmental changes.

#### *Teaching and Learning the Science of the Livings Reality*

An adequate learning for a sustainable development of societies, respecting the required survival diversity needs, is here based on a new general theory the author called “The general theory of meta-dynamics systemicity”. A new theory that relies on the transdisciplinary knowledge of the whole body of forces and dynamics that made and makes physicochemical and biological moves and objects to exist and sustain a certain time in cycles at the different dynamics levels of the Universe. By essence, the dynamics levels are: atomic and cosmic, galactic, stellar, planetary, terrestrial and biological.

Though diverse in structure and mechanism, the dynamics, being all interrelated provoke intricate moves and fluxes of differential changes from the necessary permanent retroactivity with their milieu and environment. At such a level interdependence of things, should not we be on a permanent alert in perspective to the great danger of the “domino effect<sup>7</sup>”? Young generations must acquire such new learning giving them a prominent ability as to take protecting and fulfilling decisions in adequacy with the interdependency of the rules of Nature and of their evolution.

Within the whole of the Universe environment, various objects emerge and develop “postures<sup>8</sup>” (behaviors) bound to adapting to the permanency of environmental changes. These objects (e.g. the Sun system, planet Earth, Living beings...) adapt from the constraints and the effect of sets of forces and phenomena so as to sustain their differential temporal fate. A feedback phenomenon develops into dynamic cycles that induce to the repetition and/or the adaptive replication of moves and fluxes together being subject to changes and the wearing of

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<sup>6</sup> - **Negentropy**: a factor of organization of the physical, and possibly social and human systems, of an organization, a structure, a form, an operation, ruled with energy consumption, coming from the outside of the organism.

<sup>7</sup> - **Domino effect**: “it is a chain reaction that occurs when a small change causes a similar change nearby, which then will cause another similar change, and so on in linear sequence”.

<sup>8</sup> - **Posture**: “state or condition at a given time especially with respect to a sustaining capability in particular circumstances.

entropy until death and its molecular and atomic recycling happen. Because of the permanency of change, no object or system can be theorized. Many former theories, even in Physics become obsolete because some “constants” are finally changing.

*Living Systems Science, Systemicity and Human Creation of System Science*

The necessity of a "large clarification of systems science" is principally due to the fact open system permanently changes their status, in other words the livings adapt and reproduce for survival. Therefore, "a general systems science", or a "theory of system science" cannot assume Life's reality. The "Systemics as theories" (actually developed) apply to so many concepts and disciplines that they are not available for application since the reality is permanently changing. A large amount of morphological and intellectual form of systems molded to many works in all disciplines provoke confusion by using the noun or the adjective "systemic" as assuming theoretical ends.

On Earth, the undisputed contextual situation as related to permanent changes of living events from feedback, with "retroaction differential ago-antagonistic results" have induced to adopt research activities centered on "transdisciplinary fundamentals" and on the new paradigm named "The Bioethism", which is pertaining to build up a scientific and realistic development of Life's science taking into account the systemicity of metadynamics forces, fluxes and moves.

In order to comfort the specificity of the "Living systems Science ", and thereby explain Life's origin and the sustainability of survival principles, methods and means, this study was based on understanding the retroactivity of fundamental metadynamics. It was found out that, beyond the sense given to the noun (and adjective) “systemic”, generally qualify most "systems" in about 30 different meanings others than living systems, the notion of “metadynamics systemicity” was an appropriate inference, assumption and conviction. It turned out becoming a new theory, based on the forces and moves dynamics that participate in Earth and living system to survive. Far more suggestive and realistic to observe how the Earth and Life originated and how they sustain however they are confronted with permanent universal metadynamics changes. Globally and adequately dynamic, the sense of "systemicity" is not to be understood as synonymous to the noun systemic but it is yielding to the same connotation in terms of moving retroactions that participate in Cosmos and Life to exist and systemically sustain for a short, medium or long time.

*The Swaying of Life's Pendulum*

The neologism "systemicity" I have *launched* (Monterey CA, 2004), is referring to "Life's driver dynamics" understood and described along with "The Bioethism transdisciplinary approach paradigm" (acronym for **B**iology-**E**thology, ecology - **H**umanism). It fosters universal specificities relative to the complexity of Life's processing, which in form of open systems, appeared on Earth as physicochemical environmental components and survival conditions (see p.....) Dynamic phenomena were physicochemical moves of matter and energy, all of them being, with solar system forces and planet cosmic constraints, progressively sustaining chemical survival reaction evolutions until forming biological chemistry. Understood as a universal move, the primordial systemic "tick tock" of interdependence, interrelation and interactivity statuses induced to the permanence of intermediation. A phenomenon that, in terms of "in-between" quantitative and qualitative positions and values, provided with ago-antagonistic the circular swings as acting from birth to death of any object (Thermodynamics). This is why the Earth and Life were several times confronted with cataclysms that put “Gaia” at the fringe of becoming a dead planet (impact at Moon’s formation, creatures’ mass extinctions).

The Life's pendulum is though swaying! Throughout the interconnected living systems web and ecosystem networks, it is sustaining determinant survival dynamics in form of dual transactions (predator-prey specific species balance, symbiosis... thus energy exchanges). Permanently confronted with physicochemical and cosmic periodical forces, move pressures and opposite changes in environments and milieu (body interior) metabolisms, the living systems have to permanently adapt between "hunger and satiety". A predator-prey may lead to an unavoidable strategy that ends to a species group crisis and an environmental stress or a flux fracture! The fox chasing rabbits dynamic equilibriums in a predator-prey natural (and mathematical) model of survival describing interactions between two species in an ecosystem food chain, was developed by Lotka-Volterra (1925), allowing the description of a systemic game within which neither equilibrium point is stable. Instead the predator and prey populations seem to cycle endlessly without momentarily settling down. Birth, hunger, starvation, repletion and death are lying at the door of what I call the survival "in-between" opposing notions such as birth and death or high and low. The whole question resides within the game of the physicochemical elements that are constitutive of the universal "*Emergence of Everything*" (H.I. Morovitz, 2002).

### **SOME GENERAL PRINCIPLES GOVERNING SYSTEMICITY**

#### **An Object or Thing "Filtering Skin" As a General Survival Function**

A "filtering skin" is an interface of exchange that may be considered as the general protection of integrity of an element or object for its survival to be sustained for following reasons:

- To build up a frontier in between milieus or medium that may be called an interface,
- To have a specific mean as to absorb energy (heat, light...) or food or other elements participating in development for survival,
- To protect against harmful aggressions coming in from the environment,
- To cause oozing or spread out in specific directions (to exude) particles, elements, molecules propitious with the object's metabolism sustainability and excess of energy and wastes,
- To be an intermediary mean of communication and integrity protection

An object or element has sustainability for a certain period of time while confronted with thermodynamics. Survival forcefully depends on capacities to get protected and adapted from both the endogenous-exogenous events and changes of milieus. They both support functions of filtering and protection outfit.

At the molecular level, the interstellar medium consists of dust grains and gas. Dust grains have an icy surface protecting chemical bonds molecules from stellar radiation providing a surface on which a diversity of atoms and molecules congregate and interact in-and-out.

At planetary level, the earth crust and atmosphere have "filtering functions", the Van Allen belt (electromagnetism) and the magma playing an immense role in the metadynamics systemicity of terrestrial moves to sustain "Gaia" with filtering functions (volcanism, weathering..).

At individual unicellular organism levels, a membrane is both the interface of the nucleus and the cell in its water milieu. A virus has only an outside membrane.

At multicellular organism levels, like mammals, the interface is both the placenta of the developing embryo and of its newborn skin. The egg of egg-laying creatures is some sort of an exterior "placenta" with an inner and outer membrane as processing its own development (air, albumen and yolk) inside its shell forms the best protection, filtering heat and vibrations

under the hen. However practically all other animals have protecting “skins”: shell, carapace, armature, all with similar functions.

At many cultural, functional and survival levels, any creature, humans included, have “protecting and filtering skins” capable to participating in expressing a behavior, a fright, a feeling, an insight and an emotion: a cry, onomatopoeia, a sound, the “verb”, gestures.

An overview throughout the survival mean characteristics (food, habitat, reproduction ...) is showing the evident fact Life’s sustainability cannot be but supported with the metadynamics systemicity of a “filtering function” and a dynamic balance induced by feedback (retroactivity).

### **The Theory of Compartmentation and Molecular Processing**

Under interstellar conditions, icy water accretes from the gas phase on dust grain surfaces, and forms ice films that have a high porosity. In the dark clouds, H<sub>2</sub> formation occurs on such icy surface and that part of the energy (4.48 eV) is released when adsorbed atoms react to form H<sub>2</sub> deposit. We find here the phenomenon mentioned in the previous postulation assuming that “a filtering shell” was a universal function, as the “compartmentalization of identity units”. The NASA states that “organic material is found in both our solar system (in asteroids, comets, meteorites and dust) as well as the interstellar medium: “In laboratory experiments, amino acids and complex organic residues have been created by intense ultraviolet illumination of an icy grain type of surface. Organic materials are created in dense molecular clouds catalyzed by ultraviolet-driven chemistry. The organic residue acts as a “glue” and the grains stick together, helping to protect the fragile organic material from destruction when grains are exposed to ultraviolet radiation or high-energy particles such as cosmic rays. As “amino acids” are found within molecular clouds cycles, it is then assumed that a compartment phenomenon effectively protect and filter particles and molecules, inducing in/out the proper exchange of energy and molecules as sustaining each identity chemical unit.

The apparition of biological “membrane” is a consequence of compartmental necessities meant to control the cell as a system that is self-sustaining a function and acting towards the neighboring. The control and regulation are also preserving the integrity of the cell internal milieu from unfavorable influences and changes in the environment. The molecules which compose living systems comply with all of the physical and chemical laws governing the behavior of inanimate matter thereby enhance the specificity and exceptional character of living systems while sustaining from interactions dynamics between the physicochemical, structural and functional units that compose them. In other terms, the membrane of a cell constitutes “the compartment” within which a living entity “manages its specificity and temporal protection”.

Stirling A. Colgate et al. (2003) also states that the redox potential difference between hydrocarbons and oxygen is the energy source that drives autocatalytic reactions. Hydrocarbons are formed in the cooling molecular clouds and “fixed” on the catalysts of some bonded silicate dust grains ending into carbonaceous chondrites falling on Earth. Then also, a mathematical model finds its application as to describe the interaction phenomena between metabolic chains and homeostatic mechanisms in general.

Chemical interactions, physics of particles, astrophysics and cosmology, matter behavior, vacuum, time (“its arrow”) studied by Y. Prigogine (1977) led him to develop the notion of

"dissipative structures"<sup>9</sup> that he describes as open systems operating far from a thermodynamic balance in an environment of matter, energy exchange and entropic pressure as well as adapting to "surviving conditions" within the momentary limits of a dynamic equilibrium

### **Feedback Systemicity Induces in Differential Retroactivity Results**

A "feedback" is the process that enables "loop control" moves participating in the management of systems' regulations processes. In a closed-loop system, a feedback dynamic device has the property permitting to an output (or some other controlled variable of the system) to be compared with an input to the system (or an input to some other internally situated component or subsystem of the system) so that the appropriate control action may be formed as some function of the output and input balance.

Most cycles of the Cosmo-planetary and terrestrial dynamical materials and energies are retroactively sustained and then evolving, at least within the influence of galaxies gravity on the very long term of their "immense spatial survival". More generally, feedback is said to happen in a system when a closed sequence of cause-and-effect relationships exists between the system's survival variables. In parallel, an "open-loop control" function has a distinctive control action since it is independent of the output. (J. Distefano, 1967). The "Sun" and its planets, a star system, has an evaluated life length of another 5 billion years ending into a supernova blow out, from which matter, chemicals and energy will seed again the interstellar space and neighboring stellar-systems, in a cascade of retroactive moves.

The seeding is historically and retroactively sustained but confronted with the thermodynamic entropy that ends with a thermonuclear matter bust feeding the apparition of new star-systems (ref. to supernovae life). On Earth, organisms are all confronted with entropy and degradation (thermodynamic breaking down) that feed back new elements for survival such as energy, food chain and reproduction chain. The most important feature a feedback imparts to a living system's integrity and behaviors is in its comparison function that continuously detects differences existing between inputs and outputs effects. Endogenous and exogenous stimuli while emerging provide appropriate signals or information necessary to managing input-output variations.

One may name such retroactive moves as the "survival capacity drivers" submitted to the collective meta-dynamics systemicity (meta-drivers) of Cosmo-planetary and terrestrial environments. In a biological move, such as reaching an object or reacting to endogenous and exogenous events require some chemical specific reactions that interpret and decide what to reach, positioning a "body", what behavior to have for security or as getting a resource within reach. At different levels of action, variable signals are piloted out the sensitivity of chemical substances, cell's receptor filtering and organ functions (e.g., light chemical vision as conversion of information, like eyes ones) and from their reactivity to "biops"<sup>10</sup> drives. (e.g.: unicellular organism ' have a "brain"<sup>11</sup>, a chemical memory with enough capacities for an efficient survival management and also bar receptors regulating blood pressure by inhibition drives...). Biological processes might not have an accurate ability to reproduce faithfully an

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<sup>9</sup> - **Dissipative structure:** is a dissipative system that has a dynamical régime that is in some sense in a reproducible steady state. This reproducible steady state may be reached by natural evolution of the system.

<sup>10</sup> - **"Biops":** the acronym for a bio-physicochemical event.

<sup>11</sup> - **Unicell's brain:** biochemical processing information close to more elaborate neural function as the one neurone Aplysia.

input, then the reducing effect of non-linearity and distortion usually drives to some oscillation or instability. This is why the circularity of moves is primordial for the maintenance of survival dynamics. Life's infinite complexity within its chemical exchanges generates feedback drives (or biological interactive emergent "biops") of which results affect the object survival streams steadiness (dynamical balance) while confronted to entropy.

### **The "Cycle Principle": Retroactive Results Within an Ecosystem Cycle**

The process of sending status information back for comparison with previous status information called feedback, and the whole processing of inputs, outputs, errors or differences in signals, is called a closed loop; however differences in the status qualification induce the loop to get open the next step. Then, becoming an open system, variations of status qualifications in gains or losses oscillate around a critical point depending upon the type of system and its sensibility to entropy.

The environmental conditions on Earth, at the time Life gradually came out of the limbo, were strongly radioactive under an atmosphere with very little oxygen and no ozone exposing Life with much UV radiations. The pressure of Earth mass and accumulated energy of its radioactive components heated its interior to the point gases and vapor expelled from it, participated in the formation of air and oceans. Among these gases was enough hydrogen for life's elements - organic components – to form and survive: hydrogen presence in the universe is essential to life's components (carbon, nitrogen, oxygen, phosphorus, iron, zinc and calcium. Hydrogen is also the fuel of Sun that provides, together with water, the flux of energy essential to the physiology of organisms.

The presence of free oxygen induces in the development of oxydo-reduction in diverse environments: oxide components reject oxygen – rust become iron - and "hydrogen +" induces to balance acids and alkaline. If these condition have enough potential, then environmental milieu are prepared for the physicochemical development of the Life's components to structuring organisms. Furthermore, the average temperature of the Earth surface was sufficiently constant so as to participate in organisms to survive and develop. Cataclysms however very much changed the "life's tree".

Here again, at the Earth's Cosmo-planetary and terrestrial metadynamics level, the set of cycles having differential emergent results, at each instant, at different macro-median-micro levels, and permanently changing the interrelated ecosystems dynamical contexts, demonstrates the "historicity" character of "systemicity" with the action of the meta-drivers of evolution. The history of Earth, a true odyssey, is consubstantial to that of the Cosmos, given that the galaxies and stars (matter and energy cycle) have an evolving survival history to perdure in a limited long term period: such is the Sun and its system fate.

### **Primordial and Fractional Process Interactions**

In particle physics, fundamental interactions concern elementary particles interacting with one another. These forces are said as non-contact forces but interactive: gravitation (mass gravity, tides...) electromagnetism (magnetism, electricity, light, chemical and biological reactions), strong interaction (atom nucleus coherence) and weak interaction (beta radioactivity), are often mentioned in terms of cosmic or biological objects which retroactive systemicity specifically results from physical, chemical and biological processing actions and statuses.

The "Science of the Living" has made "immense progresses" at understanding its mechanisms, particularly since the entire genome of humans and of quite many organisms has been chemically deciphered. From such base and from digitized data, one may reproduce and describe some of the Darwin natural selection and evolution mechanisms. The



"paleomolecular biology" is a method applicable to genes sequencing, which is the DNA synthesis applied to digitizing some of its models. By sequencing models of gene fragments and test their capabilities to behave, it was obtained simulations of the reproduction of proteins that went silent for billions and, or hundred million years. However these tests cannot be but fractional since it will never be possible to biologically restructure the whole RNA, DNA of past species since the building up of genes should individually take into account the impact of environmental conditions of the moment. In other words, to reproduce the contextual "dynamical systemicity" of the surroundings they happened to emerge from, live in, reproducing and adaptively evolve can only be a theoretical model viewpoint.

### **The Problematic of Opposing Contraries and Threshold Effect**

The Yin-Yang<sup>12</sup> philosophy, "the principle of duality" between two opposing forces", as being complementary", describes "interactive extremes" a principle of "irreducible intangibility". Dual permanent games, participating in Cosmic<sup>13</sup> and Life's phenomena and objects to interact and evolve, are where systemicity against irreversible entropy takes its natural place. Thus, mostly being ago-antagonistic, the "in-between behaviors" meet my feelings and assumptions about "Systemicity" and reality. The fuzziness of reality in "what effectively happens" is usually any of a continuum of values in between the opposites until entropy takes over. This is particularly so when related to the role of time in the history of unconscious and conscious natural and cultural differentiated retroactions dedicated to organisms behavioral actions of individuals and societies:

"The everlasting rustle sound of the planet, the "Gaia's clock" tocks, echoes with Creatures' behaviors for survival, and together with the permanent change of things, build up their generation fate while confronted with environmental evolution (J.-J Blanc, 2004).

### **Synergy and Emergent Results in Between Ago-Antagonistic Things and Moves**

Synergistic moves, (as below defined) are links in processing chain development of phenomena. In reference to some specific works on "Synergy"<sup>14</sup>, published by H. Hackermann (1994), or P. Corning (2003), one may observe that the notion of pattern is intimately describing linked phenomena within a "model system of synergistic", as, for example, chemical macroscopic reactions in form of outgoing concentric waves, spiral waves, chemical oscillations...Consequently, the notion of physical dynamics is said describing a phenomenon of synergy: e.g. "a water vortex" is the effect produced by the combined actions of several different forces<sup>15</sup> like gravity, water pressure, air pressure, rotational forces as centrifugal (or centripetal) forces, even the initial status of a considered object or move. Examples are numerous, but here it is important to stress the fact "synergy" illustrates sets of linked phenomena, indeed combined and cooperative, given that they induce one emergent result. The orientation of a instant-t result is at next instant-t+1 one, usually combined with other chain of phenomena, forces and moves; and is, at term, having combined synergistic effects, which are differentiated from retroactive effects. Adding dynamical feedback moves,

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<sup>12</sup> - **Yin-Yang**: between those two complementary forces, there are "in-betweens" relating to some distance in between the two opposites. In fuzzy logic, at a point in between, one can evaluate its situation from one or the other of its opposite (like black or white: he is less dark than his sunburned father). This approach induced to the development of fuzzy-mathematics by Zadeh where "in-between points" are intra discrete numbers calculated in % (note by JJ. Blanc 1997).

<sup>13</sup> - **Cosmic**: the essence of the general relativity is in a space-time event point that has a dynamic cause and effect property.

<sup>14</sup> - **Synergy**: "combined action of two or more agents which produces a result stronger than their individual efforts".

<sup>15</sup> - **Vortex**: a vortex is the means by which states of motion are transferred from one condition to another. Twin opposing electrical vortices are therefore the means by which the infinite variety of motions and their resulting physical forms manifest themselves in our Universe.

the systemicity of cycles produce successive changes in the environmental status. Synergetics is then one of the meta-dynamics systemicity "arms" participating in the diversity of natural outputs.

In this work part, among many Cosmo-planetary and terrestrial dynamics involved in the systemicity of phenomena, we will describe the essential of natural flows and cycling moves resulting from the "universal retroactivity" as the major "meta-driver" between opposed forces, dynamics and differential emergences. Each dynamic has an imprinting<sup>17</sup> mechanism from interactions, at all physicochemical and, or biological character level that produces quantitative and qualitative effects on matter and energy destination. However, as being interrelated with the complex characteristics of other dynamics, the effective emerging result, at instant-t, which is usually the result of combined ago-antagonism moves, induces the environmental ambient metabolism to be permanently modified: each "ecosystem's neighborhood" status evolve by some sort of a "vectorial synergy or momentum". A synergistic move, at short and/or long term in space-time, produces a temporary output effect, which confronted to the permanence of changes, becomes a possible evolutionary factor within the meta-dynamic of the Cosmo-planetary and terrestrial systemicity of events (solar vents, tides..., predator fear... social moves).

### **Percolation, Interactivity, Amplification of Disturbance**

Life has happened through the "dynamic percolation" of physicochemical reactions phenomena, which is a process of communication in an extended environment where quite a number of "sites" (also bifurcation areas) are likely to locally relay information (physical, biological or of a fluid property (J. M. Hamersley, 1957)). They communicate by way of links whose effectiveness is most of the time random. According to whether the proportion of active connections is, or not, higher than that of a threshold value, the information to long distance may be transmitted when over passing a critical point.

These phenomena explain clearly the genetic impact issued from the predator prey game: e.g. the capacity changes of opposed species as preys while genetically and physiologically adapting to the abilities of predators. Since percolation relies upon the critical point phenomenon, which is constitutive of a phase transition<sup>18</sup>, one observes that below the threshold, information remains confined in the spot where it originated; beyond the threshold, "percolated" information (ref.: genetics evolution, ecosystems transformation...) is then found far from its starting point by passing over critical points as it happens with domino or/and butterfly cascading effects initiated from starting conditions. The particular situation of transitions from phase is one out of many physical or chemical move phenomena occurring to number of cosmic, planetary and biological mechanisms and their metadynamics systemicity.

The appearance of highly sensitive behavioral conditions issued from phase transition is also observed in social life organizations. Disturbances permanently modify living creatures' behaviors and their metabolism while they interact with environmental events and stimuli. Alike the butterfly effect, a small fact can induce to important and perverse cascading effects in proprieties, attitudes and physiological statuses amplitude. Societies of creatures are meta-organizations functioning at the verge of a lethal equilibrium that is a compromise between contradictory constraints not predictable and controllable, but maintaining a timely and temporal survival. However, from feedback effects, the situation might be severely sensed as depending on their weight down on people expectations.

### **Changes of Status And Phase Transition**

Matter and energy exists in various forms, or phases. If the temperature and, or pressure of matter or energy is adjusted, the phenomenon may undergo a phase transition. Pierre Papon,

(2002) describes the change of status together with the dynamic of phase changes as confusing the boundaries with metastability. He wrote about different classes of phase transitions such as: vaporization, (the passage of the liquid to gas), fusion (the passage of the liquid or solid and its reverse that is solidification), the transition between the ferromagnetic status (the material with a permanent magnetization) and the paramagnetic status (without permanent magnetization), the transition supra conducting (the material becomes a perfect electric conductor, etc). These phenomena between opposite statuses usually pass by an intermediary qualification known as the phase transition move that over pass a threshold.

During the phase transition move, matter shifts between its three statuses: solid, liquid, and gas from which distinction of two phases is "almost non-existent" and fuzzy. "*The statuses of matter are like the countries of a complex geography, separated by borders*" said Pierre Papon, the passage from one status to another as named transition phase corresponds to the crossing of a border. But transition is usually fuzzy; in certain conditions, the substance can pass by a status known as *metastable* before changing course towards a stable status (reference to thermodynamics: the entropic move). The passage of a status to another is not instantaneous and there are "undecided" statuses with particular properties, halfway between liquid and solid, such as the Earth's transformation status at the Early Achaean, or grounds at the status of permafrost.

Metastability scrambles the thermodynamic borders separating the solid, liquid and gas status. Beyond of a certain range of thermodynamic parameters, the phase considered becomes unstable and necessarily passes in another status through a transitory status. The complex history of the Earth has proven successive statuses of an "evolutionary planetary body"; a history that illustrates the results of slow sequences of fuzzy changes of phase within ago-antagonistic dynamics that Cosmo-planetary meta-dynamics systemicly engenders. These phenomena, perpetuating themselves throughout the Earth's and Life's actual context, show that Earth's evolutionary living conditions and survival sustainability are "governed" with the systemicity of the Cosmo-planetary and terrestrial set of dynamical forces that retroactively sustain moves far from equilibrium unless a major thermonuclear catastrophe should wipe both out.

A change of status, as observed at the passage from one status to another, is called the "threshold effect". Nature is permanently confronted with critical point examples, such as natural selection in terms of a population having adaptive responses; inhibited developments, etc. They show that the threshold effect is typically sensitive to certain characteristics of individual and group behaviors while confronted to environmental changes within specific contextual conditions. Phase transition critical point is an important phenomenon that participated in a major primordial manner to form, for example, part of atmosphere and oceans volcanic and gaseous contextual milieu at the origin of cells apparition (ref. Archaea, Cyanobacteria or blue algae) emerging from the systemicity of meta, intra and subdynamics.

This paper, after a large analyze of actual scientific and transdisciplinary information and works, describes general aspects of "the metadynamics systemicity" in terms of physics, chemistry and biology principles, statuses and facts, given that it has to illustrate postulations and realities of Cosmo-planetary, terrestrial and biological forces, processes, fluxes and moves interdependence.

## THE MOLECULAR CYCLE IN THE UNIVERSE

### *The Physical and Chemical World of Matter in the Universe*

More generally, the universal medium is a world of atoms, dark matter with clouds of dust and gas (helium, hydrogen, carbon...) where galaxies and stars evolve from the big bang “expansion” (inflation) drive. The move of such Baryonic<sup>16</sup> matter is impelled to mass gravitation interactions and temperature: the cosmic microwave background (CMB) radiation as thermal radiation, is filling the universe where occur interactions between the elements in galaxy clusters. One may infer that the complexity of moves in the universe is a set of gigadynamics (inflation of the Universe, galaxy interactions, gravitation, radiation, diversity of mass density and temperature) and metadynamics (molecular cycles, clouds thermodynamic formation, low and high interactions...) of which “systemicity” participates in the cosmic objects evolution. Molecule drivers are X-rays and UV hard radiations that ionize atomic and molecular sets as inducing cross section chemical interactions, which systemic drive of additional chemical pathways is yielding smaller molecules in diffuse molecular clouds. There low-density atomic hydrogen clouds moves produce the chemical pathways to the molecular sets in a universal cycle, a gigadynamics systemicity move.

### *The Life Cycle of Molecules in The Universe Diffuse Interstellar Clouds*

Interstellar molecules are formed through networks of chemical reactions found in cool cosmic medium where molecular chemical bonds hold together since confronted with high-energy radiation and high temperatures of the dark interior of dense clouds (as also in comets and planetary atmospheres). The interstellar material is present in dark space (nebulae molecular clouds), in most galaxies and stellar systems medium, particularly within spots named “hot cores” where chemical reaction networks largely concentrate and provoke a molecular diversity. The molecular cycle as originated from dark clouds and the interstellar medium, moves on embodying into baby stars, stellar systems medium, then within the interplanetary medium where planetesimals accretion formed planets according to differential gravitation. Thereon, Planet Earth in the course of the molecular cycle and early life inherits sets of molecules that participate in the formation of Life’s premices, and the “chemical fertilization” of planetary environment.

### *A Stellar System and the Metadynamics Systemicity of Molecule interactions*

Present in diffuse clouds, hydrogen atomic elements, gas and dust accrete within the interstellar cloud, inferring the birth of a star system. Dust grains surfaces (water ice and various carbon compounds) allow chemical reactions as accreting molecules that interact with neighboring sets of element. Molecular clouds are therefore “fertilized” with some of the components evaporation.

Being pathways towards molecular clouds, those elements represent the transition between atomic and molecular phases within the whole universe medium. The molecular clouds being of a low temperature and high density are propitious for new stars to develop within an accretion disk of atomic objects constricted by clouds gravity (dust, gas and other molecular particles like CO<sub>2</sub>, H<sub>2</sub>O, and HCN- hydrogen cyanide are their components). The life cycle of stars yields several chemical elements to the interstellar space, thereby under specific environmental conditions, some atoms combine with other atoms and form simple and complex inorganic and organic molecules.

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<sup>16</sup> - **Baryonic matter:** “all material made up of protons, neutrons and electrons”.

The “molecular world” in the space medium described by C.Dariusz et al. (2004) forms around 140 molecules<sup>17</sup> producing quite a large amount of complex organic species e.g. amino acids. Hard radiations (UV, X-rays), ionizing atomic and molecular sets, increased and still increase the cross section of these chemical interactions, dissociating large molecules to small ones.

Pascale Ehrenfreund and Steven B. Charnley, 2006, describe the organic molecules as having evidence for carbonaceous compounds (carbon-hydrogen bonds) in the diffuse interstellar medium. Most common molecules (H, O, C,N,S,P...) implicated in the apparition of organic molecules are present in the interstellar clouds like phosphorous with carbon as a major driver, as well as H<sub>2</sub>O in phase transition pathways from pre-biotic to biotic chemistry, particularly forming 18 of 20 amino-acids.

Guillermo Muñoz and Emmanuel Dartois, 2009, explain that “dust grains” present in the interstellar clouds and around young stars have a mantle of ice rich in water and other simple molecules as carbon monoxide (CO), methanol (CH<sub>3</sub>OH) or ammonia (NH<sub>3</sub>), subject to light and rays action". They are describing a yellow substance that is composed of organic molecules, such as carboxylic acids, glycine and other amino acids molecules essential to the biochemistry of living creatures (proteins, nucleic acids...).

The evolution of molecules towards macromolecular compounds emerged from highly complex physicochemical dynamics (photosynthesis processing carbohydrates ...) retro-feeding biochemical matters and energy interactions. Organically-laced molecular compounds from interstellar and interplanetary clouds induced prebiotic reactions as to very early originate some of the bricks of Life on Earth. Then, as in water (a solvent), the prebiotic molecules shape with proteins, lipoproteins and polysaccharides and start propitious structuring bio-molecules with enzymes. Consequently, the general “molecular cycle” existence is a cosmo-planetary-terrestrial cycle, particularly understood in presence of physical and chemical thermodynamic rules as entropy.

## UNIVERSALITY OF METABOLISM AND HOMEOSTASIS

### Metabolism Definition

In general, the metabolism is the dynamic balance of physical and chemical processes producing, sustaining and destroying prebiotic and organic compounds and by which energy is made available. The theory of abiogenesis<sup>18</sup> accounts for two aspects of life: metabolism and replication. However, several theories are actually present: the “metabolism-first” theories (Oparin and Haldane) and the “replication-first” approach. Next paragraphs will describe both metabolism-first and replication-first perspectives with early Life that are major to its metadynamics systemicity.

### *A General Universal Metabolism as a Metadynamics Systemicity?*

Anthony J. Remijan, 2007, describing the largest negatively-charged molecule, parallelly to common positively-charge ones<sup>19</sup>, says it continues to add to the molecular diversity and

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<sup>17</sup> - **Molecule:** “a molecule consists of 2 or more atoms joined by covalent bonds that are the attraction-to-repulsion stability that forms between atoms when they share pairs of electrons”.

<sup>18</sup> - **Abiogenesis:** “the study of how biological life arises from inorganic matter through natural processes, and the way Life surged on Earth”.

<sup>19</sup> - **Ion molecules:** About 130 neutral and about a dozen positively-charged molecules have been discovered in space, but the first negatively-charged molecule (carbon atoms and one hydrogen atom) was discovered last year.

complexity known in the interstellar space chemistry of giant clouds. The number of chemical paths available for complex organic molecules and other large molecular species as potential precursors to life is much increasing at the different levels of the molecular cycle (clouds, stars, planets...). The expression of such a massive set of flux and moves is significant of the presence of its physicochemical metadynamics systemicity yielding the step by step building up of primordial “bricks” of inorganic and organic molecules.

The chemical reactions of molecular metabolism are forming networks of chemical pathways in which one chemical is transformed into another chemical. Postulating that the content of molecular clouds evolve according to which level it is present in space, and to which temperature it is confronted with within the different gravitational medium, it is significant to highlight the presence of the differential dynamic balance of molecule species that step by step induces new molecule thanks to the metabolic dynamics of catabolism and anabolism processes. Thereby, it reinforces the existence of the characterization of a general metabolism whereas basic universal metabolic pathways of chemical components yield to cascading very similar ones along the population of all molecule species networks while structuring throughout space from molecular worlds down to the Earth and back.

*Catabolism and Anabolism: an Ago-Antagonist Couple of Systemicity*

Catabolism is the breakdown of large molecules into small molecules. Its opposite process is anabolism, the combination of small molecules into large molecules. These two cellular chemical reactions are together called metabolism. Catabolic reactions degrade larger molecules in order to produce ATP and raw materials for anabolic reactions. In contrast, anabolism uses energy stored in the form of adenosine triphosphate (ATP) to build larger molecules from smaller molecules. In enzymatic reactions, the molecules at the beginning of the process are called substrates, and they are converted into different molecules, called the products. As the environments are permanently changing, metabolic reactions produce differential molecules within the medium

Collectively all ecosystems are autotrophic from small C, H, and O molecules (CO<sub>2</sub>, ), ammonia, and simple inorganic salts and acids. At such level of aggregation, they also share a common chart of intermediary metabolism. As a matter of fact, Astrochemistry studies the abundance and reactions of chemical elements and molecules in the universe, and their interaction with radiation. Molecular gas clouds formation, atomic and chemical composition, evolution and fate participate in the birth of solar systems, thus showing the flux and move of primordial molecular species from one cosmic level to another, probably conserved and multiplied within a differential status of the dynamic balance confronted with mass in presence, gravitation, temperature and radiations.

As protein catabolism is the breakdown of proteins into amino acids and simple derivative compounds, it is postulated that some interstellar medium molecules formed some organic proteins in form of organic compounds and are at the origin of some of the amino acids found in meteorites.

The production of some proteins into amino acids as organic molecules is described constituting one of the first “drivers” in the emergence of life. Furthermore, the presence of

these compounds in certain meteorites has led many researchers to consider space as one primordial source.

Ammonia and other chemical precursors from the solar nebula, or even from the interstellar medium, have combined in the presence of water (icy dust grains) to make proteins and the amino acids. Groups of complex organic macromolecules (proteins) that contain carbon, hydrogen, oxygen, nitrogen, and usually sulfur are composed of one or more chains of amino acids. Metabolism consists of hundreds of enzymatic reactions organized into chemical pathways. These pathways proceed on a step by step transformation of substrates into end products through many specific chemical intermediates. Metabolism is referred to as intermediary metabolism (see below: chart of intermediary metabolism) and the postulation is that a “general metabolism”, with its “catabolism-anabolism couple” is driving the diffusion of molecules, organic compound as proteins and amino acids along the molecule cycle, thus down to developing the premises of Life.

#### *The Intermediary Metabolism and Dynamics Systemicity*

H. Morowitz, 2004, assumes that “the core of intermediary metabolism in autotrophs<sup>20</sup> is the citric acid cycle. In a certain group of chemo-autotrophs, the reductive citric acid cycle is an engine of synthesis, taking in CO<sub>2</sub> and synthesizing the molecules of the cycle. Having examined the chemistry of a model system of C, H, and O (carbon dioxide, redox couples as energy source), he assumes that the metabolic chart or parts can be traced to the earliest organisms and contain information about the chemistry of biogenesis and the prebiotic planet some 4 billion years ago. This period is it the pre-enzymatic world?”

At this step of the “Systemicity theory” and as previously postulated, it is assumed that the universal “molecule cycle”, sustaining more than a 140 inorganic and organic molecules (as per the chart of intermediary metabolism), is, within the permanency of its constituent, in constant adaptation to gravitation and ambient thermodynamics thank to a general dynamic balance (cosmic metabolism) between cataclysmic events (cosmos objects collision, asteroids or meteorites bombardments...), and aging (end of a star in cosmic time...). Consequently, I have proposed that metabolism was to be considered with a gigadynamics systemicity of particles interactions as present in the Universe.

The intermediary metabolism, and its physicochemical catabolic-anabolic couple interactions has then a larger meaning at dynamic balance levels since it supports the general systemicity of interdependent flux and moves resulting from giga and metadynamics interactions. The molecular world represents the whole content of space media (cosmic clouds, interstellar, interplanetary and terrestrial milieus).

At the period of early Earth’s abiogenesis, the intermediary metabolism of the “systemic soup” integrates more and more chemical pathways particularly influenced with the planetary and terrestrial “habitable zone” conditions of both its medium and the presence of evolving chemical interactions at a very large scale within water (solvent) and carbon (energy) ecosystems. Three flux and moves participated in the structuring of molecule species: transportation, transformation, and energetic interactions within 3D compartments (see filtering shell). Little by little, tidal moves, kinetics, abiogenesis and genetics in relation with the different atmospheric and ground cycles together made emerge living organisms.

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<sup>20</sup> - **Autotrophs:** microorganism which independently produces the compounds which are necessary for its survival.

*Structure and Metabolism for Survival in a Contextual Milieu*

In order to describe a "systemic process", the specifications and configuration of system's components must be seen in a form compatible to analysis, design, and evaluate their structure and behaviors, as providing systemic dynamics possibly "self-managing" a individual morphology and metabolism. Many primordial creatures learned how to extract oxygen from water or how to produce it. Furthermore, as unicellular organism, they acquired a neural-like chemical function with proper centers (memory chemical basins) for survival information treatment or for example, a jellyfish that is the simplest organisms having neuronal functions in form of a one neuron brain can retroactively manage its survival.

In perspective of a molecular phylogenesis (evolution) approach of primordial biological matters as corresponding to genes producing ancestral proteins, Joseph Thornton, (2006) developed and tested primordial proteins as big molecules intervening in most functions of organisms: primordial proteins that had not participated to organisms' metabolism for billions or hundred million years. The physicochemical biological world, in terms of Life's sustainability, cannot be described to the sole universal laws as Evelyn Fox Keller, MIT, wrote in *Nature* 2007: "Biological phenomena are permanently contingent upon evolution". Which evolution? Planet Earth, the "Gaia" ecosystem, is also subject to evolutionary metadynamics, in the context of its body milieu homeostasis within a framework of long term structural changes. These dynamics are contingent to Cosmo-planetary molecular clouds metabolism and terrestrial flux and moves. Also confronted with ecosystems' environmental changes, prebiotic and biotic sets of molecules metabolism are differentially balanced due to their retroactivity and so much natural metadynamics are interdependent.

## THE DYNAMIC FORMATION OF THE SOLAR SYSTEM AND EARTH

### The Universal General Forces Feedback

The feedback of universal general forces and flux moves is defined as "The General Metadynamics Systemicity". The term "systemicity", analogous to "velocity"<sup>21</sup> (referring to dynamical behaviors) must be understood as a successive and/or parallel retroactive ago-antagonistic move that has convergent and differential results (ref. variability or volatility). The systemic moves make emerge whole sets of adaptive proprieties, traits and postures while confronted and coevolving with environmental changes. Thereby, understood as evolutionary<sup>22</sup> moves: thus, the Earth orbiting around the Sun, having a tilting axis that produces season cycles, is submitted with the variability of sunlight received that rule the organisms survival and their evolving adaptivity.

Universal forces and fluxes permanently influence physicochemical reactive dynamics and permanently affect the biological world. Within the molecular world, metadynamics, sub dynamics, intra-dynamics have specific systemic moves. Dynamics, converging, produce always retroactive results, which emergence drive living creatures in their behavior choices as to adapt to a situation supporting their temporal sustainability and survival (A prey submitted to a predator pressure defends or flies away according to environment conditions).

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<sup>21</sup> - **Velocity:** "the rate of change of position along a line and/or throughout a 3D network of cosmic fluxes, with respect to time or the derivative of emerged positions with respect to time. It is also a rate of occurrence or action as the differential speed of historical changes.

<sup>22</sup> - **Evolution:** "the process by which different kinds of living organism are believed to have developed from earlier forms, especially by natural selection. It is also, in chemistry, the giving off of a gaseous product, or of heat.



## The Formation of The Solar System, Planet Earth And Metadynamics Systemicity

### *Apparition of a “Baby Star” To Be The Sun*

The Solar system emerged about -4, 6 Go/years, within a mass of molecular grains and gas from a nebulae, our galaxy. The Sun, a low-mass star (hydrogen and helium + molecular particles) began with the accretion<sup>23</sup> of particles forming a circumstellar protoplanets disk essential in the formation process of young massive stars and planetesimals. Then on, a large number of cosmic objects: asteroids, meteorites, planetoids, comets and interplanetary dust orbit the nascent star. Called “baby stars”, they grew/grow by gravitation further attracting interplanetary gas (mainly protons and electrons) and dust grains (of a few molecules) from the orbiting disk own dynamic inducing gas and particles from the interstellar medium to increase the mass of the central star (Sun’s accretion). Dust grains accrete molecules and catalytic particles from gas phase and are the seat of reactions driven by UV photons and cosmic rays.

### *Apparition of the Earth’s Metadynamics Systemicity*

The Sun permanently radiates a stream of plasma<sup>24</sup>, namely an energy flux released in the solar atmosphere (solar wind mostly consists of electrons and protons) that travels into interplanetary space. High temperatures, then, drive the emergence of molecular material phases and complex refractory organic layers on the dust grains and planetoids to pile up. Energizing the magnetosphere and influencing the composition, energy balance and dynamics of the ionosphere, the plasma stream also carry out the Sun’s magnetic field electrically highly conductive. Consequently, the accretion of molecular particles is a cycle within which molecular particles occupy layers specific space. According to the Pauli Exclusion Principle, the elaborate electron shell<sup>25</sup> structure of atoms and the way atoms share electrons, explains the variety of chemical elements and their chemical combinations. Molecules as components of matter are common in organic substances (and therefore biochemistry). They also make up most of the oceans and the Earth atmosphere.

The whole interstellar environment is thereby under siege of an immense volume of fluxes and moves of stellar energy and molecular particles, from which the metadynamics systemicity make emerge gas planetoids (forming Jupiter...) and rocks ones as to form planets like Mars, Mercury and the Earth. Gravitation and electromagnetism are with cosmic interactions the fundamental interactions (dynamics) that participating in their formation<sup>26</sup>.

Our solar system is about 4,567 million years old. Earth's Moon formed -4,450 million years ago, just 50 million years after the Earth's formation. At -4,1Go/y, the surface of the Earth cools enough for the crust to solidify, the atmosphere and the oceans also form. Then, about -3,900 Go/y, a cataclysmic meteorite bombardment happened, most probably because the impact of Moon’s formation left an important volume of debris that were not captured by the Moon’s gravitational mass, then falling back on Earth. Between -4,1 and -3,8 earliest life forms appear, possibly derived from self-reproducing RNA molecules.

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<sup>23</sup> - **Accretion:** matter capture by a star under the effect of the gravitation.

<sup>24</sup> - **Plasma:** a gas of positive ions and free electrons with little or no overall electric charge (charged particles).

<sup>25</sup> - **Electron shell:** electrons orbiting around an atom nucleus form a shell and each shell can contain only a fixed number of electrons, and is only associated with a particular range of electron energy. The fixed number of electrons in the shell determines the chemical properties of atoms.

<sup>26</sup> - **Electromagnetism:** “the force which holds electrons and protons together inside atoms, which are the building blocks of molecules. This governs the processes involved in chemistry, which arise from interactions between the electrons inside and between atoms”.

The early Earth primordial context induced physicochemical and organic systems to emerge from the apparition of new properties proceeding from a new atmosphere composed of oxygen, hydrogen, nitrogen..., and with new terrestrial conditions that considerably changed the environmental and biological structures and the retroactive orientation of chemical reactions. Energetic resources, from numerous feedbacks, enabled more complex molecules to evolve towards cellular organisms. Successive new generations evolved from predator (virus) aggression, into "eukaryote cells" structured with both a nucleus as protection of reproduction abilities. The efficient filtering membrane became capable at regulating endogenous and exogenous resources and information perceived from environmental events, together with expelling wastes as product of the internal chemical treatments of proteins for surviving. The complexities of sub-dynamics that pertain to the Cosmo-planetary and terrestrial meta-dynamics conservation, in terms of survival, obviously refer to the systemicity of dynamical physicochemical forces, energy pressure and space-time dimensions.

### **THE EARLY EARTH'S PROPITIOUS CONDITIONS TO LIFE**

#### **The Habitable Zones for Planet Earth and Formation of Liquid Water**

The planet Earth, -4,55 billion/years old, as accreted from dust and embryonic planets under the pressure of thermodynamics and gravitation, was structured from a core of heavy elements (iron, nickel) and a coat of lighter elements and volatile molecules (H<sub>2</sub>O, H<sub>2</sub>, etc), which gradually escaped out in the atmosphere. Fifty million years later, a young planet collided with the Earth, at a force that ejected volatile molecules together with some of the oceans, seawaters and parts of its coat, as much as to structuring the Earth-Moon, in the ambient gravitation.

The Earth, at such high thermal forces, was covered with viscous magma, which then after slowly cooled and was constantly restructured under an extraterrestrial rain of material: comets, meteorites and micro meteorites falls. The components of such materials, in particular volatile molecules, participated in the appearance of diverse liquid water areas and flows forming up geological configurations. Thus, about -4,4 Go./years ago, the most important impact of a small planet on Earth, from which the Moon emerged and built up, induced continents and seas to form.

The "zone of habitability" of a planet, where liquid water is stable is limited: it varies according to the luminosity and heat produced by the star, together with its effective distance at a moment-t and the degree of heat makes the vital habitability zone to vary. Since the volume of liquid water is between both the cold and too hot limit, the fragile liquid molecule can be maintained between ice and gas as a perfectly volatile element. Then, Earth conditions adjust from regulations counteracting the Moon gravity effect with:

- Evolution of the gas composition of space and atmosphere that induced to the apparition of ocean waters, seasons...
- Retroactive moves due to atmospheric conditions that implemented a physicochemical medium and a synergistic context for Life to appear, within the seasons timing (Earth orbiting and axle precession...).

The universality of "the general meta-dynamics systemicity" notion, illustrating the number of retroactive processes that produce matter, gas and energy (thermonuclear, thermodynamic, physicochemical, stellar, kinetic, radiant, gravitational, electromagnetic, volcanic, climatic...) is factual. Interrelated Cosmo-planetary meta-dynamics effects have influence on stars and planets existence, and are consubstantial with the terrestrial physicochemical metadynamics

and biological circular cycles on Earth. As one example of a permanent pressure, let's mention the "climatic recycling" of vapor into water.

### **The Historical Metadynamics Systemicity of Earth for Life's conditions**

The Hadean time (4.5 to 3.8 billion years ago) is not geological. During its history, the Sun formed as the result of neighboring stellar systems gravitation and "baby stars" getting born within the nebula until its thermonuclear activity gave off light and heat in the environment filled with matter, dust and gas. The planet Earth formed from such gas and materials dust mass, including carbon, oxygen, nitrogen, and iron elements (some of the future Life's bricks) that were ejected by ancient stars wherein environment, the Sun has formed. As the Sun's density increased, the surrounding gas and dust slowly condensed, spinning around. The gravitational force of denser areas attracted more gas and elements to the young star disk while it was orbiting. At the same time, gravitation induced to the consolidation of some masses, which growing in size and density, formed the planets of the Sun in a stellar system. The Cosmos meta-dynamics systemicity had made emerge planetary objects that have a seeding critical point, an evolving "life" and a "death" trajectory in terms of their matter and energy coherence. The threshold of such events is in an energy collapse from nuclear fusion and gravitational pressure where matter and energy metabolic cycle is re-engineered by phenomena issued from the whole set of metadynamics systemicity drives until entropy would put an end to the process.

In the time of its youth, the Earth's global planetary structure and climates were (and still are) heavily influenced by cosmic forces, by solar system additional nuclear dynamics and the Moon's gravitational attraction once formed. Since the Earth has a history of successive emergent moves resulting out of interrelated cosmic mechanics and forces that produced its "volume" as originated from a supernova<sup>27</sup> bust, it formed alike many other planets in the universe from materials accretion. Formed from the coalescence of particles by gravity into larger objects (*planetesimals*) they went on aggregating into rounding planets from matter rotation. The solar system, in this case, has been like a spatial factory within which grew the different rocky planets Mercury, Venus, Earth and Mars. "Left-over" material forms asteroids and comets. Earth, at the beginning of its history, and because of collisions between large cosmic bodies releasing a lot of heat, has probably been molten. Its surface progressively cooling down became geographic crust structure and acquired vital properties from its atmosphere in development. Furthermore, the bombardment of its surface by meteorites, asteroids and comets and the apparition of oceans completed its morphology from fierce pressures of forceful retroaction, fractures and compressions, some because of physical forces, tectonic plates magmatic moves, and from a great quantity of chemical reactions, climate aggressions and water erosion. The Earth, in itself is not a close system but an open cosmic object that has a provisional but sustainable systemic dynamic balance and temporality.

### **Cycles of Retroactive Influence are Cosmic, Planetary and Terrestrial Dynamics**

Largely produced by the Moon's tidal forces, combined with Cosmos meta-dynamics (laws of physics e.g.: gravitation), the Earth's spins slowly reduced at one revolution in its axis making days to become longer, a retroactivity that is having an influence over natural terrestrial cycles. In the early of Earth, if abundant volcanic activities emitted off much heat, they diminished, inducing the formation of the first rocks from a crust cooling down. Together the

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<sup>27</sup> - **Supernova:** "extremely bright star that has exploded due to gravitational collapse of the star's core".

molecules emitted by volcano and atmospheric molecules seeding participated in a great change in the atmosphere composition (more oxygen and nitrogen, but also several of today's atmosphere molecules) that provoked great changes of weathering effects. The oldest rocks (cratons) are known to have been in the mechanical coupling between the outermost layer of the mantle and the crust (asthenosphere and lithosphere), as one of the forces that drive plate tectonic and is dated 3.8 billion years old.

Known as the Archaean<sup>24</sup>, this period of time would be 200 million years younger than life's origin also dated at 3,8 billion years, so was raised the problem of its origin at high temperatures. As the Earth's rocky crust slowly formed continental plates (small embryonic surfaces called "cratons" were found) the stable part of continents was "excreted" from the Earth's mantle systemicity (cycle of magma-rocks). The cycle consists in internal moves from the Earth's core up to the surface of the continents and bottom of oceans, in other words the convection system of the mantle, away from hot mantle zones toward cooler ones. This process known as continental drift, together with the subduction of plates into the mantle is a systemic drift move (Plate tectonics) that produces earthquakes and volcanic eruptions with major changes of continents geography over hundred millions years like the surge of mountain chains and the apparition of crust fractures forming oceans and seas basins or their *disappearance*. Together with the "cycle of rocks", the "cycle of water" participates in the "cycle of air" and the "cycle of climate". At the same time, as having interrelated effects, the cycles participate in the adaptation of large varieties of physical mechanisms and chemical molecules. They, later, brought up survival abilities to living creatures as to adapt their surviving to environmental conditions (cells' diversity). The sets of terrestrial dynamics permanently participate in "Life's Systemicity" where retroactivity is paramount to the survival of living systems out of synergistic emergent temporary facts and actions. An evolving climate during billion of years prepared conditions propitious to the apparition and development of Life: the terrestrial aqueous context combined to temperatures of relative heat and different weathering cycles participated in the formation of livable ecosystems. The set of these cycles, as having differential emergent results, at each instant and at different macro-median-micro levels, permanently changes the interrelated dynamical contexts, which demonstrates the "historicity" character of "systemicity" as the meta-driver of evolution.

### **The Terrestrial Metadynamics Systemicity**

The Universe gradual evolution is a matter of primordial "negentropy systemicity" due to the very slow transformation of the Universe. Over -12 Go/years elapsed until the Earth was formed as a planet, and the "hatch" of Life at an early Archaean period coming around -3.8 billions of years is an authentic illustration of "an evolving historicity". An immense diversity of dynamical phenomena was together involved:

- High constraints of thermodynamics over cosmic objects, and their practical implementation,
- Universal force of gravitation that governs the motion of cosmic objects, all forms of matter, and energy,
- Retroactive effect that induce endogenous and exogenous status changes, while sustaining the formation and evolution of galaxies, star-systems planets and the dynamic effects on Earth's while originating and actualizing its temporal integrity,
- High benefits of dynamical effects, in terms of an endemic dynamic balance, that maintain planets at distance from an early thermodynamic death,

- High interrelations of the Cosmo-planetary and terrestrial meta-dynamics, and their effect over the Life's intra-dynamic systemicity.

Environmental conditions in which life originated on Earth, at near -4,6 billion/years ago, have to be remembered here, since "vital conditions" to settle down took around 800 million years (until -3,8 go./years) for primordial living organisms to emerge out of physicochemical process fluxes within different geographical milieu. This very long period of maturation time for geological and vital process to emerge and sustain is difficult to be apprehended by humans' understanding as appreciating such length of time. However, it is factual that these immense periods promoted the permanency of physicochemical metadynamics systemicity fruits, as primordial organisms (protocells) that "hatched" (emerged), reproduced and evolved from the systemicity of biochemical cooperative reactions and propitious milieu. Moreover, they survived several mass species extinctions from global cataclysms.

## **EARLY EARTH SYSTEMIC MECHANISMS<sup>28</sup>**

### **Cosmo-Planetary and Terrestrial Force of Gravity Systemicity**

The whole thermodynamic mechanisms and processes of the universe (cosmic, planetary and terrestrial), because of their interwoven forces, made Life to exist from molecular, matter and energy cycles. Within the solar system, natural forces and chemical streams induce to the emergence of energetic surface changes (atmospheric, oceanic and continental): they provide (and provided) circular information and stimuli for the reproduction of vital processes as structuring and sustaining the metabolism of living organisms (microorganisms, vegetation and animals). Creatures momentary survival came then from biological meta-intra-dynamics systemic fluxes and moves (positive biological feedbacks), which brought and bring up together chains of energetic and biochemical resources (nutriments, food, tools) for their adaptive survival. In body milieu, the processes sustain the metabolism, and from interactions with other species for acquiring survival means, both are propitious to the sustainability of ecosystems' unavoidable diversity.

The terrestrial force of gravity holds back any "object" being on a body surface to be projected out of its "sphere" in rotation (Isaac Newton). The attraction of the Sun prevents planets, revolving around him, to fly away in space. The Moon under the influence of the terrestrial attraction remains in the Earth's orbit. From such action, pressure from gravity becomes the main "sub-meta-driver" that sustains things to happen on Earth. The air that is basic to survival with breathing (nitrogen, N<sub>2</sub> and oxygen, O<sub>2</sub>) is maintained on terrestrial surface by gravity and is a relatively protective shield against meteors, meteorites and dangerous radiations for living species to survive. Air is charged with oxygen, as the paramount molecule to life respiration, which, being an air-water cycle, sustains diverse corpuscles and molecules that structure organisms' diversity. The atmospheric pressure, as a result of gravity, pulls the air downward, giving air molecules enough weight as to exert a force upon the Earth's surface and everything that is on it.

Winds of different forces, caused by horizontal variations in air pressure, carrying air particles and rock dusts, participate in building up deserts from benthic sedimentation of oceans depths

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<sup>28</sup> - *Systemicity mechanisms: reaction, retroaction, circularity, replication, reproduction, adaptation to physicochemical moves, changes and apparition of new proprieties.*

and by drifting coastal beach sands over as inducing dunes up to. Moreover, the pressures of terrestrial tectonic moves, forcing the orogeny of crust surface, shape up mountains of reworked materials such as benthic sedimentary rocks. Very many cycles that participate in both Cosmo-planetary and terrestrial meta-dynamics levels and in planetary ecosystems' evolution, corroborate the notion of dynamics systemicity; therefore, confirm the meta-drivers differential retroactivity thus "systemicity" moves.

### **The Cycle of Rocks and Tectonic Plate Systemicity**

The prebiotic Earth is active, thus dynamic: rigid plates are driven below a more fluid coat, into movements taking part in recycling the rocks of surface. Observed today, the cycle renews nutrients exhausted by marine living creatures present by the surface of oceans: the sediments excreted include in particular organic waste (vegetable and died animals, excrements of all kinds...) and get hidden in the continental coat, where they mix with fresh elements. Lastly, they go back to surface in various forms: *lava from* volcanicity, hydrothermal water fumes, charged gas, all of them rich with nutritive elements for living beings food take for existence and survival. Within such environmental systemicity, the cycle of rocks is regenerating, but is also destroying in the sense movements of tectonic plates participate in the destruction of Earth's primitive crust. Some enclaves dated as rocks -4 to -3,8 billion/years old, called "cratons" were located in the pre-Colombian era (Canadian and Greenlandic anterior to -542 million/years).

Tectonic forces, heat and pressure metamorphose, breaking process of weathering and other surface processes (running waters, glaciers, waves, and winds) are transforming bedrocks down into smaller, moveable pieces that shape the different ecosystems. The rock cycle begins while rocks are lifted up in the magma, pushed up the planet surface and eroded.

The particles, or sediment, are travelling by wind or moving waters until they are deposited as a material that settles into layers. Additional sediments may bury these layers, and/or change the underlying sediment to metamorphic rocks. Other sediments may also compact the layers into sedimentary rocks. Rocks may be again sunk down into the lower layers of the earth by plate tectonic processes. Buried in subduction, rocks usually meld and recrystallize<sup>29</sup> into igneous rocks in the magma, ready to be recycled onto the Earth's surface. Metamorphic, sedimentary, and igneous rocks, then often uplifted into mountains particularly because of lithosphere broken plates drift. The weathering then starts the rock cycle again.

### **Oxygen Isotopes, Water And Systemicity**

Oxygen isotopes show that sea water, which circulated at the core of the oceanic crust, is still circulating through hydrothermal sources. Rain water quality, volume and circulation, which had already an influence on the temperature and the composition of oceans and seas, is also depending on the rate of erosion of continental rocks from other forces (climate, volcanism...) Its charging minerals, matter and salts, while its run-off is streaming down marine basins, are the product of interactions on the way down ground surfaces. The primitive grounds have received more acid rains than today, which more strongly eroded emerged grounds at a point of reinforcing the oceans salinity. Thus, the ocean pH influences the probability for prebiotic molecules to assemble and, in the same way, the pH of rainwater, depending on the

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<sup>29</sup> - **Recrystallization** is a metamorphic process that occurs under situations of intense temperature and pressure where grains, atoms or molecules of a rock or mineral are packed closer together, creating a new crystal structure.

atmosphere composition, seeding a variable density of matter and gas, influences the biotope organisms diversity at search of energies.

### **The Atmospheric Air Composition**

Data on primitive atmosphere are correlative with the history of water: the primitive Earth, set at the thermal limit of Life, was not iced (oceans presence) and the first traces of glaciations are shown much later (around -2,9 billion/years ago), which represents about a "one billion/years" period of time from the threshold of Life's biotic conditions for organisms to evolve along with a favorable atmospheric status.

#### *Terrestrial Temperature Dynamics*

Heating planetary surfaces requires a rather dense atmosphere with a high "greenhouse effect", initially made up of methane, and CO<sub>2</sub> of which quantity was not sufficient to maintain water at a liquid state over primitive Earth surface (low temperatures close to - 0°). The isotopes of oxygen and silicon make it possible to describe primitive Earth's ocean surface temperatures as having been between 50° and 80° C. However, in low depth basins, where rocks were formed, hydrothermal waters have certainly took part in the level of oxygen isotopes.

#### *Effect of Rain on The Lithosphere*

The atmosphere, made up of CO<sub>2</sub>, acidifies rains, therefore oceans and lands. However, the prebiotic reactions, subjacent with the creation of Life's bricks (nucleic acid for proteins and purine bases for the ARN/AND) adapt better with an alkaline water than an acid one. Earth's hydrologic cycle is connected with clouds, rain precipitations, groundwater infiltration, water wells, lakes and oceans evaporation, trees transpiration, solar radiation, topography and absorption by the ground, or runoff, glaciers impact and thaw, volcanoes fumes emission, river flows... all phenomenon that are showing the systemicity of the hydrologic cycle complexity.

#### *Effect of Hydrothermal Water and Sea Water Content*

Elements essential to Life are present in hydrothermal water flows: *monoxides and* carbon dioxide (carbonaceous molecules), nitrogen, hydrogen, sulfide, metals forming 80% of the atmosphere content. These elements are constitutive of the organic compounds found in all living tissues. Conversely, in hydrothermal sources vent, the pH higher than in water is also favorable with the apparition of Life. The energetic interface of catalysis is differentiated: on one side, at low temperature, oxygen and UV rays intervene in the reaction, on the other, at high temperature, carbon, sulfide, nitrogen and metals intervene as well. The first living systems, as chemical entities capable to survive from adaptation and replication were resulting from organic molecules, and still are: each one is to bond atoms of carbon and hydrogen (methane, CH<sub>4</sub>) atoms of oxygen (O) and nitrogen (NA) as well as catalytic abilities.

#### *The Cycle of Salinity: Vitality or Liveliness From Ionic Cycle*

The oceans get most of their salt from rivers, volcanic gases and hydrothermal vents on the ocean floor. When rain falls on terrestrial rock (mountains, etc.) it contains some dissolved carbon dioxide from the surrounding air causing the rainwater to be slightly acidic due to carbonic acid (from carbon dioxide and water). Weathering and acidity erodes rocks components, which ions broken down are carried along in the runoff to the streams, rivers, and estuaries to the ocean. If a large quantity of the dissolved ions is used by organisms in the ocean and are removed from the waters, others not reactive or not used up are left for long

periods of time concentrating. The two other ions left over are 90% of all dissolved ions more slowly cycling in seawater, are chloride (Cl<sup>-</sup>) and sodium (Na<sup>+</sup>).

As water is cycling between the oceans, the atmosphere, and lands since over hundred millions of years, the salts from rivers remain in seawater and ancient salt deposits indicate ocean salinity as having remained relatively constant along 1.5 billion years. Salts are removed from seawater when they bond chemically to clay sediments as they sink to the sea floor in a process called "reverse weathering".

Salts are also removed to the profit of marine plants and animals to form body parts and by evaporation forming minerals. They are also blown from waves into the air, leaving a salty aerosol in the air or a salty film on nearby land. The cycle of salinity goes on when uplifted ancient rocky seafloors are weathered releasing ancient sea salts that rivers carry back to the sea. The density of salt participate in the current of the seawaters across the world, together with their temperature, so seeding the systemicity of those dynamics. The dynamic is retroactive and participate in Life's to exist: cells, animals, plants, humans, all must retro-regulate their "osmosis" to a certain amount of salts in their tissues in order to provide chemical exchanges within the living organisms for hydration.

### *The Cycle of Carbon*

The cycle of carbon usage by which energy flows through the Earth's ecosystem is basic to cells existence and survival evolution. When photosynthesizing, algae use carbon dioxide (CO<sub>2</sub>) found in the atmosphere or dissolved in water. Incorporated in plant tissues as carbohydrates, fats, and protein, the rest of CO<sub>2</sub> is perspired to the atmosphere or water (respiration cycle). Since herbivores eat vegetation, their metabolism uses, rearranges, and degrades the carbon compounds: CO<sub>2</sub> as an aerobic respiration is partially stored in animal tissues and is cycled on to carnivores feeding on herbivores. Wastes and decomposition matters are broken down and their CO<sub>2</sub> is then being used again by plants. Continuously circulating within the Earth's ecosystems, the carbon dioxide gas from the atmosphere is the energetic mean for plants in photosynthesis process. Animal respiration and photosynthesis balance to keep the amount of atmospheric carbon relatively stable given that a certain amount contributes to underground by-products (petroleum...). However, nowadays, the humans with extra carbon dioxide production from industries and fuel usages perturb climates cycle, ecosystems and milieu metabolism. As a conclusion in this part of work, the systemicity of terrestrial dynamics, the different levels of their synergy, retroactivity and convergence of emergent results, at instant-t, explain that, from feedback effects, perturbations, so minimal would they be, induce to amplified moves within the different cycles as illustrated by the "butterfly and domino effects" metaphor. It acknowledges the actual critical situation of the global warming cascade of threats to natural Life.

## **THE EARLY EARTH'S PREBIOTIC PERIOD**

### **A Timeline of Earth Premices**

*Hadean eon (-4,567 to 3,800Go/ya)*

- Earth's original hydrogen and helium atmosphere escapes Earth's gravity.
- Earth day is 6 hours long
- Minus 3,9Go/ya: Cataclysmic meteorite bombardment.
- Earth's atmosphere becomes mostly carbon dioxide, water vapor, methane, and ammonia.
- Formation of carbonate minerals starts depleting atmospheric carbon dioxide.
- No geologic record for the Hadean Eon.



*Archean eon (- 3,8 to -2,5Go/ya)*

- Minus 3,8Go/ya: Surface of the Earth changed from molten to solid rock.
- Water started condensing in liquid form.
- Earth day is 15 hours long
- Minus 3,6Go/ya: Monocellular life started (Prokaryotes). First known oxygen-producing bacteria: cyanobacteria (blue-green algae) form stromatolites
- Minus 3,0Go/ya: Atmosphere has 75% nitrogen, 15% carbon dioxide.
- Sun brightens to 80% of current level.

**The Earth's Prebiotic Environment: a Systemic "Soup"?**

The heavy meteorite<sup>30</sup> and comet bombardment of the early Earth (-3.9 Go/ya) brought down immense quantities of inorganic and organic materials comparable to inorganic and prebiotic ones produced by other energy sources (volcanism...). On Earth, then on, within the surface of the cooling medium, inorganic and prebiotic materials as nucleic acids, proteins and enzymes in interaction produced the essential macro-molecules to forming biological processes. Both aqueous and mineral, the ecosystemic<sup>31</sup> medium (the systemic "soup") produced from specific environmental physicochemical conditions and metabolism, those "proto-organisms" thereafter developing the first living creatures (proto-viruses, prokaryote and unicellular organisms as micro virus, virus and bacteria). These prebiotic reactions produced endemic capacities for enzymatic reactions and regulations from interaction feedback and yielded cascades of positive ago-antagonistic "differential biological values" resulting in premising Life. Since ecosystems media – "the soup"- were being top-down run around with currents because of temperature gradients change, the circulation from downstream of prebiotic molecules, and proto-organisms could be mixed with other upstream molecule species, in quickly evolving cycles from the extreme rapidity of replication modes.

**Life's Planetary and Terrestrial Premices and Their Metadynamics Systemicity**

In low oceans, shoal rather than ponds, along different type of coasts and shores according to the move of tectonic plates and under lava, sulfur fumes and an early atmosphere of carbon dioxide, nitrogen, and water vapor, most of the prebiotic precursors coming from different space and Earth areas were assembled forming new chemical pathways: "the soup" which was cooling. It seems effective that on early Earth, the abiotic synthesis of organic molecules is supported with three complementary scenarios saying that organic molecules -1) were synthesized from inorganic compounds in the atmosphere; -2) rained down on earth from interstellar medium; -3) were synthesized at hydrothermal vents on the ocean floor.

Stanley Miller experienced a biochemical mixture with water (H<sub>2</sub>O), methane (CH<sub>4</sub>), ammonia (NH<sub>3</sub>) and hydrogen (H<sub>2</sub>) considering this mixture to resemble the atmosphere of the early earth submitted to spark discharges. The "primeval soup theory" requires the atmosphere of the early earth to be rich in methane and ammonia so that small molecules associated to Life might be obtained. At such stage, the question on how to reproduce a milieu so billion years old in terms of the so many parameters to be taken into consideration stays unanswered? Given that, further experience stepped in the beginning of many molecules to get synthesized: 17 amino acids (protein synthesis), purine and pyrimidines (nucleic acid synthesis), then pyrimidine ribonucleotides.

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<sup>30</sup> - **Carbonaceous chondrites:** meteorite groups that contain high percentages (3% to 22%) of water, as well as organic compounds, mainly silicates, oxides and sulfides, and some minerals (olivine and serpentinite).

<sup>31</sup> - **Ecosystem:** "the complex of a community of organisms and its environment functioning as an ecological unit."

However, since it is asserted there were carbon dioxide, nitrogen, and water vapor in early atmosphere, then it becomes significant to links things together because of the metadynamics systemicity of flux and moves interdependency. Organic molecules identified in the interstellar space are numerous: methane (CH<sub>4</sub>), methanol (CH<sub>3</sub>OH), formaldehyde (HCHO), cyanoacetylene (HC<sub>3</sub>N) a precursor to the pyrimidine cytosine); polycyclic aromatic hydrocarbons as well as such inorganic building blocks as carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), ammonia (NH<sub>3</sub>), hydrogen sulfide (H<sub>2</sub>S), and hydrogen cyanide (HCN), water (H<sub>2</sub>O)... Finally and environmentally, they were exposed to a temperature close to that of space (near absolute zero) and intense ultraviolet (UV) radiation.

We find then that terrestrial physical and chemical metadynamics processing the organic synthesis of biomolecules are being driven by action/reaction, impact of shocks and other energy sources such as ultraviolet light or electrical discharges (e.g. Miller's experiments). Some extraterrestrial molecules are delivered by cosmic objects (e.g. inorganic and organic materials as carbonaceous chondrites...) or from the gravitational attraction of organic molecules or primitive life-forms from space. Recently, some estimates of these sources suggest that the heavy bombardment before 3.5 Go/ya within the early atmosphere made available quantities of organics comparable to those produced by other energy sources like volcanism, geothermic vapor and atmospheric rains.

*The "Soup" Theory Today: Subsequent Works*

Aleksandr Oparin (1924) suggested that the organic compounds could have undergone a series of reactions leading to more and more complex molecules. He proposed that the molecules formed colloid aggregates, or 'coacervates', in an aqueous environment. The "coacervates" were able to absorb and assimilate organic compounds from the environment in a way reminiscent of metabolism. They would have taken part in evolutionary processes, eventually leading to the first life forms.

John Haldane (1929) said the sea became a 'hot dilute soup' containing large populations of organic monomers and polymers. Haldane envisaged that groups of monomers and polymers acquired lipid membranes, and that further developments eventually led to the first living cells.

Biochemist Robert Shapiro (2007) has summarized the "Primordial Soup" theory of Oparin and Haldane in its "mature form" as follows: The early Earth had a chemically reducing atmosphere. This atmosphere, exposed to energy in various forms, produced simple organic compounds ("monomers"). These compounds accumulated in a "soup", which may have been concentrated at various locations (shorelines, oceanic vents etc.). By further transformation, more complex organic polymers - and ultimately living things - developed in the soup.

Joan Oró (~ 1960) most important step in research on the prebiotic synthesis of the nucleobase adenine (a key component of nucleic acids) was the demonstration the nucleic acid purine base, adenine, was formed by heating aqueous ammonium cyanide solutions. In support of abiogenesis in eutectic ice, more recent work demonstrated the formation of s-triazine (alternative nucleobase), pyrimidines (including cytosine and uracil), and adenine from urea solutions subjected to freeze-thaw cycles under a reductive atmosphere (with spark discharges as an energy source).

Finally, the "prebiotic soup" relies on the assumption proposed by Darwin that in an environment with no pre-existing life, organic molecules may have accumulated and provided an environment for chemical evolution. The spontaneous formation of complex polymers from abiotic monomers under the conditions posited by the "soup" theory is not at all a straightforward process. More fundamentally, it can be argued that the most crucial challenge

unanswered by this theory is how the relatively simple organic building blocks polymerize and form more complex structures, interacting in consistent ways to form a protocell. For example, in an aqueous environment hydrolysis of oligomers /polymers into their constituent monomers would be favored over the condensation of individual monomers into polymers.

#### *The Deep Sea Vent Theory*

The deep sea vent, or hydrothermal vent, theory for the origin of life on Earth posits that life may have begun at submarine hydrothermal vents, where hydrogen-rich fluids emerge from below the sea floor and interface with carbon dioxide-rich ocean water. Sustained chemical energy in such systems is derived from redox reactions, in which electron donors, such as molecular hydrogen, react with electron acceptors, such as carbon dioxide (see iron-sulfur world theory developed by G. Waëchstershauser). However, the study of ancestral chemical reaction provides pathways to the synthesis of organic building blocks from simple gaseous compounds. Therefore, this is why some of these originated in the interstellar molecular world.

#### **A General Systemicity of Life under Early Earth Conditions**

Life arose within the limits of a particular set of flux, moves and forces within specific local physicochemical environments integrating a common liquid medium where were circulating molecules forming relatively short RNA molecules, viroid-like particles as small virus, replicating with great accuracy.

The convergence of Cosmo-planetary forces in the Sun system (thermodynamic pressure, energy, cosmic radiations, magnetism, gravitation...), the Earth-Moon accretion , its mass gravitation, its orbiting and new terrestrial conditions (geologic, geochemical, geophysical, geo-climatic...) were retroactively sustaining the Earth within an “habitable zone” where Living systems emerged from their own meta-dynamics survival means (replication, biotope equilibrium, local ecosystems biodiversity, food chains, sustainable behaviors, reproduction ...) enabled with processes that have a "re-seeding" ability. The mass replication of molecules, then organisms is a matter of energy, space, and building blocks, which soon became limited, inducing the proto-organisms to compete, bringing a process of natural selection favoring efficient molecules at replication.

At the livings' level, the set of meta/intra-median/dynamics systemicity sustains temporal survival within biological, physiological and psychological intrication at different body sublevels. Consubstantial (atomicity and molecularity) and interrelated with the cosmic<sup>32</sup>, galactic, stellar, planetary and terrestrial meta-dynamics, the biological general principle of Life and its metadynamics systemicity" are participating in the whole of Earth and organisms to function and temporally survive called “Gaia”.

An overview upon the entire body of universal interdependent physico-chemical mechanisms, moves, processes and streams of atomic and molecular particles (molecular velocity, massive clouds, accretion disk, stellar system, gravitation ...). The processes, interwoven in systemic "3D networks", shows that cosmic objects “survival abilities and performances” are epigenetically provided with the resulting effects of the meta-dynamics systemicity of the particles and molecular world diversity.

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<sup>32</sup> - **Cosmic**: the essence of the general relativity is in the space-time that has a general dynamic cause and its effect properties.

## EARLY EARTH AND THE ORIGIN OF LIFE

### Chemical Pathways and Molecular Interactions at Life's Origin

The abundance of organic chemicals together with side waters and solar energy provoked reactions in favor of the production of Life's components (acids, reactors...) that were progressively interacting and reproducing while tossed around within bubbles in shallow and tidal waters and downstream ocean currents. Alexander I. Oparin (1895) described the formation of cells' membrane from "coacervates" as tiny spherical droplets of assorted organic molecules (specifically, lipid molecules) which are held together by hydrophobic forces from a surrounding liquid. In order to observe the living's origin phenomenon, in the primordial soup, it is assumed here that the seawater currents and tidal backwash, by rebounding off beaches, naturally create bubbles that capture propitious assemblies of molecules, everlastingly replicating along very long periods of time, went structuring viable systems from the in/out materials filtering within a proto-membrane (coacervate).

#### *Dynamics and Ingredients Essential to Life*

The ingredients of Life are: *carbon*, a common element in the universe, *liquid water*, an element which is on some rocky planets, *nutrients*, as elements emerging from rocks and minerals, *energy*, produced by solar light, the heat of hydrothermal sources and exergonic chemical reactions produced from interaction between minerals and water. In biology the reactions of catabolism are exergonic (releasing energy in the form of work) while component molecules, present in various forms in the universe, are especially gaseous or solid and provide with carbon and water the unavoidable physiological means for Life to exist and sustain.

#### **Carbon**

The tetravalent carbon atom shapes up diversified complex structures. With *hydrogen*, it produces the family of hydrocarbons (more or less long chains, opened or closed, ramified or not) whose connections are simple, double or triple; with additional *oxygen* come up alcohols, sugars, ketenes, and with *nitrogen* amino acids structure emerged. An amino-acid (ref. to esparto, a fiber) was detected in a micrometeorite in the Antarctic. Carbon existing everywhere in the universe, contained in such micrometeorites went heavily bombarding the primitive Earth during 200 million/years, at a rate volume of 25'000 times more than the biological carbon recycled onto the surface of the Earth.

#### *The Hydrogen Bond in Organic Molecules*

In the structural chemistry and biochemistry of amino acids, the hydrogen bond is usefully ubiquitous and spanning a wide spectrum of energies, lying between covalent and van der Waals interactions. Permitting hydrogen bonds to associate and dissociate rapidly at ambient temperatures, it brought a vital prerequisite for biological reactions to take place.

#### *Water Is a Chemical Reactant<sup>33</sup> For Survival Ordering Organic Molecules*

Essential to Life, liquid water is the base of multiple chemical reactions: the water molecule (H<sub>2</sub>O) is polar, with the direction where it carries opposite electric charges: the oxygen atom

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<sup>33</sup> - **Reactant:** "In organic chemistry, reactants (reagents) are compounds or mixtures, usually composed of inorganic or small organic molecules that are used to effect a transformation on an organic substrate".

is of weak load (-), the two hydrogen atoms are slightly (+). Thus the dipolarity<sup>34</sup> takes part in the ionization of salts and groups of atoms which increase by as much the molecular solubility that carries them. Moreover, the polarity of water produces weak hydrogen connections between the atom "oxygen" of a molecule and an atom of a close molecule. Then, connections which form the very dense network of liquid waters, as remaining liquid with the atmospheric pressure, sustain its state in spite of a molecular weight weaker than that of gas (e.g. H<sub>2</sub>S).

The synthesis of A. Strecker (1860) shows that amino-acids are, at a rate of two water molecules, allowing the transformation of intermediate components into amino-acids. Such synthesis involves the reaction of potassium cyanide, ammonium chloride, and an aldehyde to make an alpha amino acid. The reaction can also be run with ammonia, hydrogen cyanide, and an aldehyde. The assembly a+b makes emerge amino-acids, such as glycine specially obtained by hydrolysis of proteins and produce of proteins by hundreds or thousands interacting in between them, interfiled like the pearls of a necklace. The organic groups, containing oxygen, nitrogen and sulfur, separate into ions (ionize) in water and become very reactive.

Because of the relative simplicity of the reactants, the Strecker's synthesis has suggested both proto metabolism and meteoritic amino acids were to be considered as origin of Life drivers.

#### *Other Elements, Their Systemic Effects as Constituent of Life*

Sulfur is a nonmetallic element that reacts either free or especially combined in sulfides and sulfates, becoming a constituent of proteins. Parallely, silicates are any of a large number of mineral compounds, which form over 90 percent of the rock-forming minerals of the Earth's crust. The deterioration of silicates produces clay that is found in great quantities on the primitive Earth. Clays have a great capacity of organic compounds concentration, allowing chemical processes to be essential with Life to originate. The physicochemistry relates to the interparticle forces of sediments. They result from the physical interaction arising from gravitational forces and the electrical nature of *the particles and the surrounding fluids*. Because of the ubiquitous nature of organic materials, clay-organic interactions are believed to be significant mechanisms in the developmental history of microfibrils<sup>33</sup> and sedimentary deposits (Bennett et al. 1988). Bioorganic processes became important in marine and coastal environments during transport and sedimentation of particles in organic-rich water as areas of high productivity. Processes of burial diagenesis<sup>35</sup> drive microfibril<sup>36</sup> development when overburden or tectonic stresses dominate physicochemical and bioorganic bonding energies.

### **Early Earth Terrestrial Conditions**

#### *The Cycle of Water and Oceans Currents Systemicity*

The geological history of the Earth began in a lapse of time of around 800 million years, while it changed from liquid to solid (True age: -4.6 Go/years old; oldest rocks found: - 3.8 Go/years). Today, the origin of water on Earth has *not* been clarified; even so the world's oceans were described to have formed over the past 4.6 billion years. From a systemic point of view (retroactive differential evolution) and under the effect of the "systemicity" of cosmic and terrestrial metadynamics, as contributing factors to the origin of the Earth's oceans, principles are described by the cooling of hot gases. Released substance, "out-gassing" or

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<sup>34</sup> - **Dipolarity:** The concept of dipolarity is about the combination of complementary but opposite principles.

<sup>35</sup> - **Diagenesis:** "the conversion (as by compaction or chemical reaction) of sediment into rock" refers to the cycle of rocks.

<sup>36</sup> - **Microfibril:** Texture or appearance of a geological material.

sublimating and evaporating into a gas ("phase transitions results"), were then potentially bringing water to Earth in a probable ocean-continental atmospheric water cycle. Comets, trans-Neptunian objects or water-rich asteroids (protoplanets) from the outer reaches of the asteroid belt colliding with a pre-historic Earth may have also brought water to the world's *oceans*. Liquid or vapor, water "locked" in the Earth's rocks leaked out over a few million of years. The release is photolysis, the direct process as defining the interaction of one or more photons interacting with one target molecule since radiations can break down chemical bonds separating liquid from a hard mass.

### *The Oxygen Clue*

The most primitive organisms existing today include bacteria that live in terrestrial hot springs and in deep-ocean hot water vents native of volcanic activity. The evolutionary significance of these organisms was found from ancient sedimentary rocks much more abundant in iron than in modern marine sediments. The waters that deposited actual sediments (deepsea or weathering) are rich in dissolved oxygen, and iron in the presence of oxygen that quickly turns to rust, in a process called oxidation showing that rust does not dissolve in water. In contrast, non oxidized iron dissolves, moving in waters flowing down rivers into oceans. However, traces of oxygen cause this iron to precipitate out of the water and fall to the ocean bottom, without turning it to rust. The abundance of iron in primordial sedimentary rocks, therefore suggests that there was very little free oxygen on the early earth, either in the atmosphere or dissolved in the oceans.

While it is said that "more than one of these factors contributed to forming the vast *oceans*", it is also likely to postulate that the first living creatures capable to increase the oxygen rate in the atmosphere were algae and some bacteria structuring stromatolites rocks. Algae chloroplasts with chlorophyll use sunlight to assimilate carbon dioxide and produce glucides, while releasing from oxygen. A chemical component of water that, over more than a billion years, was produced in such a volume that it progressively changed the atmosphere composition<sup>21</sup> so as to be breathable but also capable to activate the amount of water vapor that induces in different paleoclimatic changes, precipitation into rains, runoff waters and recycling with evaporation.

### *The Cycle of Air and Atmosphere*

At the time of its completion as a solid body, the Earth's atmosphere was of water vapor, nitrogen (N<sub>2</sub>), methane, some hydrogen and small amounts of other gases: some carbon dioxide (CO<sub>2</sub>), very little breathable oxygen (O<sub>2</sub>)...J. H. J. Poole, University of Dublin (~1947) postulated that the escape of hydrogen from the earth led to its oxidizing atmosphere. The hydrogen of methane (CH<sub>4</sub>) and ammonia (NH<sub>3</sub>) might slowly have escaped ("rinsed out" by the Van Allen belt moves?), leaving nitrogen, carbon dioxide, water and free oxygen. At the Earth's surface, warmth was of a temperature over 49° C (120°F) as a result from volcanic and tectonic activity still going on with less intensity and frequency. The air composition is primarily described in terms of temperature, pressure, wind speed, wind direction, precipitation, and humidity. Cool air sinks and creates high-pressure air flows. It is drawn back to low pressure near the equator, creating a cycle of air winds. Winds converge there and create a zone of dynamic weather, recycling vapor, air and sunlight heat energy up to the troposphere, then moves toward the North and South poles and gradually cool to sink down again. Waters of the oceans have the same kind of cycle, while heated from solar energy. The winds recycle energy, dissipating more of it in the air process than energy dissipated by the combined ocean currents, tides, continental drift and mantle convection. However, these dynamic cycles, that are permanently interrelated, show how much they

participate in the differential of retroactive effects on nature. The long-term fluctuations of the average weather – the climate – together with the fluctuations of ocean waters – currents - make earth historicity an important part of life's dynamic systemicity and evolution of the planet life to sustain.

### *The Cycle of Seasons*

Seasons result from the Earth's annual revolution around the Sun and the axial tilt<sup>37</sup>. They are marked by changes in the intensity of sunlight that reaches the Earth's surface. In temperate and Polar Regions, seasonal variations usually cause some animals to go into hibernation or to migrate, and plants to be dormant. *A metadynamics systemicity drive* that has retroactive differentiation results in both the environment and survival terms in *the body milieu*. Contrary to common beliefs, the seasons do not result from the varying distance between the Earth and the Sun. Instead, the tilt of the Earth causes the Sun to be higher in the sky during the summer months which increases the solar flux. *Another metadynamics systemicity drive* that has multiple retroactive differentiation results at both terrestrial and biological dynamics systemicity levels.

### *The Cycle of Climates*

Sun's radiation has long-term climatic seasonal effects (temperature and precipitation) on earth atmospheres and surfaces, while it is rotating and orbiting around it. The Earth's rotation deflects winds circulation: tropical and polar winds and two intermediate belts go east in each hemisphere. The atmospheric structure and composition, the heat currents transported by oceans, the latitude and altitude of plateau, mountains and lakes induce to different climate levels. The average ambient temperature grades from tropical above 20°, subtropical, temperate and cold between 10°-20°, polar below 10° C. Precipitations falling down in each hemisphere are differentiated by their frequency (all seasons, summer, winter) and climatic zones (equator, tropics, arid and dry, temperate, polar) are causing erosion cycles and sustain Life development.

For example the zones called the "selva", for equatorial rain-forest with hot tropical rains much of the year; the "savanna", with warm, strong seasonality; and the "tundra", with cold, strong seasonality. Climate effects on life are significant in all bio-physicochemical processes: solar radiation, the chemistry of the atmosphere, clouds and waters, and the biosphere are all affecting Earth's living conditions (cyclonic catastrophes, drastic flooding, desertification, oceans level changes, etc.). Thus, the climate of a region depends on those many factors, including the amount of sunlight it receives: neutrons and protons recombination provokes, from ionization effects (Thermodynamics), all sorts of damaging effects in terms of cell's mutation, burnings, etc. The height of the Sun above sea level, the shape of the land, and how close it is to oceans, are factors influencing living conditions. Since the equator receives more sunlight than the poles, climate varies depending on distance from the equator, much influencing ecosystems components (fauna, flora, soils and kinds of living conditions...).

Consequently, the ambient processes that sustain ecosystems at a dynamical balance are under the entire influence of permanent effects of the coevolving and combining metadynamics systemicity, emerging results that converge and mix. Animals, humans and vegetation acquire their diversities according to the different ecosystems of continents and the type of food

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<sup>37</sup> - **Axial tilt:** "the axial tilt is the inclination angle of a planet rotational axis in relation to its orbital plane".

chains involved. Humans nowadays alter the Earth's climatic zones, consequently Life's creatures' future (genetics, organic functions, aptitudes for survival..., since pollutants and chemicals on the soils and in waters, and carbon dioxide into the atmosphere become intensely aggressive and damageable for health.

### **The Planet Earth Named "Gaia" as a Living System**

The "Systemicity outputs" are illustrated with some of J.E. Lovelock's developments (1979) on planet Earth existence as being a living system he called "Gaia". Lovelock's theoretical approach is based on:

- The "thermodynamics second principle" where matter tends towards an increasing entropy, or disorder, in terms of physicochemical balance, thus its degradation and extinction,
- The "survival principle" opposes itself against disorder since Life constantly renews its molecules from biological retroactivity and adaptation (see later the "molecules of emotion"),

The hydrologic and winds cycles, described as a transdisciplinary approach of contributing dynamics, are in the circulation and conservation of Earth's water that is in a frequent status of change (surface water evaporates, cloud water precipitates, and rainfall infiltrates the ground...). Most probably, the whole volumes of water contained on land, in oceans and the atmosphere was progressively attained to in a dynamic balance with the increasing volume of oxygen in the atmosphere. The formation of the Earth crust under a changing atmosphere, changing land and ocean environments was modifying temperatures, and still is.

The hydrologic cycle cannot be considered as a closed system since it is reactive with the planet cosmic behaviors, under the influence of the presently described "Cosmo-planetary meta-dynamics systemicity" and other terrestrial dynamics. Participating in, the Sun dynamics, gravitation and orbiting position are some of the components of the set of "the general meta-dynamics Systemicity" of the solar system governing the climate cycle and Earth reactivity. Winds, one has to consider other dynamics that influence the systemicity of moves: air masses and circulation fronts. Cold fronts and warm fronts and different type of advection collectively form global and local climates according to the status of water or air, temperature, moisture and vortex advection conditions.

If global winds result from solar heating of the Earth and the differential heating between the equator and the poles, the rotation of the planet (Coriolis effect) and the magnetic field have major influences on the atmospheric circulation of air and clouds masses. Analogues are the characteristics of the parameters that participate in the formation of oceans currents (natural convection). The complexity of "Cosmo-planetary, terrestrial and life's meta-dynamics systemicity" where interrelated Cosmo-planetary and terrestrial forces interact is a well specified phenomenon. The interconnectedness of every physicochemical and biological cycle inside the 3 dimensions of geographical ecosystems produces differential opportunities for matter, energy and organisms to behave, adapting themselves to temporal conditions and evolving as adapting to environmental reactivity. The "cycle of rocks", the "cycle of water", the cycle of winds and temperature"... as well as the "cycle of cells' individual and social survival", even though physicochemically different in their changing and evolving statuses are formed from a certain number of emerging results. Issued from dynamics differential retroactivity, they reveal the specificity of cycles that participate in Cosmo-planetary and terrestrial meta-dynamics systemicity outputs.



## THE RNA WORLD AND VIRUSES APPARITION

### The Organic Molecule World of Self-Sustaining Species

During the long period while the Earth cooled down, after the Moon's "gestation" and birth (-4,6Go/ya), the terrestrial molecular prebiotic soup was containing both inorganic and organic molecules permanently circulating and interacting along chemical pathways under energy drives of different nature. This "reactional medium" where mutual action of substances were undergoing chemical change, and their flux and moves induced in the surge of new chemical bonds, which step by step and under the velocity of replication, formed a vast population of molecule species. Capable to sustain their integrity either from their atomic self-sustaining structure and replication or their species ability to produce enzymatic functions<sup>38</sup> protecting their integrity and coherence as confronted with environmental change.

Among these changes, physicochemical aggressions would destroy the molecule species chemical pathway or develop "counteractions", differential defense retroaction adapted to the violence of the environmental event. Such behavior progressively developed the metadynamics systemicity of the "predator-prey 3D network rule for survival (Darwinian selection and evolution). As assumed here, the sole "coevolution pathways", assorted with symbiosis, convergence and emergence moves become evidence in terms of the apparition of the "virus-first way" of which RNA function<sup>39</sup> evolved from complex molecules of protein and nucleic acid at the same time as unicellular proto-organisms for billion years. Both the "ripple effect" and the "domino effect" are drivers at the evolution of the molecule world, thereby the evolutionary relationships between different viruses which RNA progressively evolved from a simpler form.

### The RNA World Built From Simple Molecules

The prebiotic formation of RNA is viewed as a simpler polymer that preceded RNA. However, polymers proposed as possible ancestors to RNA would require synthesizing them as well as RNA itself. Anyway, first RNA bribes were though capable to produce some protein functions. Proteins are assembled from amino acids using information encoded in genes. Each protein has its own unique amino acid sequence that is specified by the nucleotide sequence of the gene encoding this protein. The primordial soup received so many inorganic and organic molecules, including some amino acid sequences that the nascent evolutionary biochemistry was very quickly giving birth to new chemical pathways compatible with co-evolutionary behaviors. John Timmer (2009) describes new pathways giving out evidence that RNA, in addition to carrying genetic information, can catalyze a variety of chemical reactions and undergo a form of chemical evolution when placed under a selective pressure. Central to modern life, key molecules such as ATP and NADH are derivatives of RNA components, and finally RNA appears to catalyze a production of proteins.

Shelley Copley and Harold Morowitz (2007) have centered one of their works on the catalytic function of RNA that then was added to its providing genetic material. Previously, it was postulated metabolism was a key systemicity dynamic at each level of the molecule cycle

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<sup>38</sup> - **Enzymes:** proteins that catalyze (*i.e.*, increase the rates) of chemical reactions. In enzymatic reactions, the molecules at the beginning of the process are called substrates, and they are converted into different molecules, called "biological products".

<sup>39</sup> - **RNA:** function as a carrier of genetic information, a catalyst of biochemical reactions, an adapter molecule in protein synthesis, and a structural molecule in cellular organelles.

downward Earth as a planet. Here, it is assumed metabolism induced RNA genes in being structured bribes after bribes within the prebiotic early Earth molecular medium. The “protometabolic reaction networks” (Copley & Morowitz) generate RNA in form of a macromolecule that supplied both catalysis (dynamic acceleration) and genetic information. Metabolism dynamic, then, is right in the core of the general co-evolution, symbiosis and convergence of chemical pathways: a universal metadynamics which systemicity yields things and objects, from replication, a sustainable and temporal survival status.

In the RNA world, successive chemical synthesis yields new products adapting with “glocal” temporary events and evolve. However, past sudden event like cosmic cataclysms (e.g. “snow-ball Earth”) wipe out things and livings on Earth but leaving “ecological niches” where to survive and re-develop to some macromolecules and embryonic proto-organisms. Replication and evolution time after time <sup>40</sup> led to living organisms to develop functional structures and adaptability capacities, some sort of a “mind” (pre-neuronal chemistry) able to cope with competition between molecular species and proto-organisms species (obcells). Cavallier-Smith T. (2001) said “a symbiosis of membranes, replicators, and catalysts probably mediated the origin of the code and the transition from a nucleic acid world of independent molecular replicators to a nucleic acid/protein/lipid world of reproducing organisms”.

Communities of small molecules species were consecutively best able to self-replicate as supported with the chemical dynamic of nucleotides, amino acids, etc. then, above mentioned bribes formed new longer “chains”, from the coalescence dynamic of RNA parts that made emerge (ref. ATP process) out of monomer blocks longer oligonucleotides<sup>41</sup> and peptides. Furthermore, sets of RNA catalysts were able to produce nucleotides as necessary at self-replication in symbiosis with amino acids and other cofactors to sustain the catalytic process. Strongly linked with the catabolic-anabolic process of the general metabolism, self-replication is the key stone physicochemical dynamic able to cope with neighborhood in/out exchanges of the eventfulness.

### **The Systemicity of the Primordial Information Process in the RNA World**

The whole physicochemical world, at its different levels, is confronted with temporal sustainability phenomena that “memorize” and/or expel internal or external information (ref. the filtering shell metaphor) chemically interpreted in terms of thermodynamics. The 2<sup>nd</sup> law of thermodynamic systemicity principle of energy is expressing the fact a “chemical system” confronted with entropy produce retroactive flux and moves and reactions establishing a temporal dynamic balance of the entity said reversible and selective pressure.

The ability to respond to stimuli is a key stone to things and livings’ survival. Proto-organisms and organisms with a nervous unit are adapted to cope with changes in the internal milieu and external environment. The chemical neurons have specific functions:

- collection of information about changes in its environment, both internal and external,
- processing this information and often relating it to previous experiences,
- acting on this information by coordinating the response of the organism,
- the speed of the response which is virtually instantaneous,

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<sup>40</sup> - **Time after time:** “A non spatial continuum in which events occur in apparently irreversible succession from the past through the present to an uncertain future”.

<sup>41</sup> - **Oligonucleotides:** “a polynucleotide whose molecules contain a relatively small number of nucleotides”.

Protocells maintain an electrical potential difference across their membrane as well inside than outside. This is called the membrane potential of the chemical proto-neuron having the ability to change it.

At a certain symbiotic period of time, RNA sets contributed to the structuration of proto-cells named “ribosome units<sup>42</sup>” which, from their own RNA build proteins while free in the milieu. Parallely, some were “engulfed” by the first unicellular species such as bacteria, Archaea, Prokaryotes and Eukaryotes, participating in the production of new functional proteins. The molecular world provoking the evolution of specific type of proto-viruses named “viroids”, has enabled RNA structure, function and evolution to be understood. Minimal RNA replicons<sup>43</sup> characterizing proto-genome are about ten-fold smaller than the smallest known virus RNA and they can therefore be considered at the frontier of life. Viroids differ from viruses in the absence of a dormant phase (virions) and in the having much smaller genomes.

### **The Virus World And Replication as A Metadynamics Systemicity**

A virus is basically a fragile strand of chemically encoded instructions in the form of RNA that lives in its food, which in this case would be the amino acids suspended in the pool of water. Although a mutating virus is not technically an organism, it is a first step towards Life. Better structured organisms with an outer cell membrane spread to the oceans: viruses have evolved little by little, the number of their nucleotides strands adapted, they grew in length and self-replicating capacity until a symbiotic dynamic with proto-cells emerged. Consisting in an outer viral structure docking with a specific molecule on cells surface, it induced the virus genome to replicate inside the host (endosymbiosis for advantageous genomic replication).

Eugene V. Koonin et al. (2006) developed advances in genomics of viruses and in “the ancient virus world and evolution of cells domain. They said that several genes coding for key proteins promoted three important dynamics: viral replication, morphogenesis and the capsid protein (filtering coat) of virions structure that were shared by many RNA/DNA virus species. The principal phyletic of viruses and related selfish agents have merged from the primordial pool of primitive genetic strands (not much twisted as a ropelike). Main classes of viruses originated in conjunction with a specific protocell evolution and several of their genes as central to virus replication and structure are considered as virus hallmark genes corresponding with an ancient virus world preceding the cell’s world. They say “a considerable number of genes that encode proteins with a replication role, expression and encapsidation are shared by overlapping large number of unrelated groups of viruses”, which reinforce the idea the virus genome adapted while confronted with flux and moves of the medium, by then increasing its capacities as to produce specific proteins best able to cope with evolutionary trends.

Some of the RNA segments in the virus population formed “selfish cooperative species” which evolved together, under the survival vital principle of “secure flocking” against “predators”. As a matter of fact, way ahead throughout molecules chemical pathways, it is assumed the predator-prey cycle plays its role within the molecular reaction world since Darwinian moves have been detected as influencing the differentiation of molecule populations. The model proposed by Hamilton, shows how flocking can arise as a result of “selfish” behavior by individual prey attempting to avoid great risks of nearing predator: it

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<sup>42</sup> - **Ribosome**: the component of a biological cell that creates proteins from all amino acids and RNA representing the protein.

<sup>43</sup> - **Replicon**: a nucleic acid molecule, or part of one, which replicates as a unit, beginning at a specific site within it.

applies to cases where the predator emerges in the midst of an aggregation of potential prey. Another model accounts for cases where the predator approaches a loose aggregation from the outskirts of its immediate neighboring. The selfish cooperatives have sheltered genetic parasites that cause to change the course of the population and resources while confronted with a scarcity rate that increases the reproduction dynamic.

### **Transitory Move from Viruses towards Prokaryotes and Eukaryotes Organisms**

Michael Lynch (2006) observed the existing continuity in genomic scaling from prokaryotes to multicellular eukaryotes and the divergent patterns of mitochondrial evolution. From viruses to prokaryotes and eukaryotes unicellular species, particularly prokaryotes, their genome structures are greatly reduced in size and simplified as compared with multicellular eukaryote ones. Such continuity is relative to distinct evolution stages within a greater diversity in eukaryotic viruses than in prokaryotic ones. The transition from viruses towards evolving unicellular entities may be understood in the heterotrophs hypothesis that suggests the aquatic milieu, full of organic molecules including ATP, provided such energy for cellular functions; deriving it from externally produced organic compounds. The first heterotrophs would have survived within the “molecules soup”, but at some point would inevitably exhaust their food supply, letting emerge autotrophic entities capable of synthesizing nutrients from simple inorganic substances.

## **THE BACTERIA AND ARCHAEA CELLS: A TRANSITORY WORLD TOWARDS LIFE'S COMPLEXITY**

### **Origin and early evolution of bacteria**

About -4,0Go/ya, single celled microorganisms appeared on Earth, and for about a very long period of time of about 3 billion years, all organisms were under the dominance of Bacteria and Archaea<sup>44</sup>. The phylogeny of bacteria is an indication on their having diverged from the Archaea/Eukaryotic lineage which common ancestor (Thermophile<sup>45</sup>) lived about -3,2 to 2,5Go/ya . The different groups of bacteria are characterized on:

- a) - their specific response to gaseous oxygen:
  - Aerobic bacteria survive and thrive require a permanent oxygen source,
  - Anaerobic bacteria cannot survive on oxygen then requiring an underwater sedimentary milieu,
  - Facultative anaerobic bacteria growing with oxygen and without it.
- b) – the source of their energy:
  - Heterotrophic bacteria<sup>46</sup> derive energy from breaking down complex organic compounds taken in the environment (decaying materials, fermentation or respiration) such as the “cyanobacteria” species,

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<sup>44</sup> - **Archaea:** living fossils, the survivors of an ancient group of organisms that bridged the gap in evolution between bacteria and the eukaryotes (multicellular organisms).

<sup>45</sup> - **Thermophiles:** thermophilic eubacteria as among the earliest bacteria living near 80 °C. in various geothermal heated regions of the Earth such as hot springs like those in Yellowstone National Park , sea hydrothermal vents, and surface volcanic areas.

<sup>46</sup> - **Heterotrophic cells:** they must ingest biomass to obtain their energy and nutrition. In direct contrast, autotrophs are capable of assimilating diffuse, inorganic energy and materials, and using these to synthesize biochemicals

- Autotrophic bacteria drive energy from fixing carbon dioxide as own food energy source, such as light energy (photoautotrophic) or by oxidation of nitrogen, sulfur and others (chemoautotrophic).
- c) – their metabolic traits:
  - Energy metabolism according to their source,
  - Energy mostly oxidized or from electron acceptors (respiration).

The bacterial activity is primordial throughout global and local ecosystems' dynamic balance (metabolism) within the nutrient cycles of carbon, nitrogen and sulfur. Their morphologies and arrangements display a large variety of size and shape enabling the acquirement of nutrients, attach to surfaces, swim through liquids and escape predators. Their activities are supported with chemical reactions filtered across their membrane (gradient of energy concentration). Since the bacteria have no membrane-bound nucleus, their genetic material is a single circular chromosome nucleoid present in the cell cytoplasm liquid where ribosome are neighbors for the production of proteins.

At this point of the fourth part of this work, one was conducted towards the verge of the full formation of multicellular organisms' structuration and development, the metadynamics systemicity of which will be described in the fifth part of the theory after 2011.

## **“METADYNAMICS SYSTEMICITY” AND EVOLUTIONARY MECHANISMS**

### **Effects of Systemicity Emergent Results**

Emergence is the "door of evolution", a threshold as being "*the gradual development of something into a more complex or better form*" or pattern that arises out of multiple interactive feedback effects. In other terms, the metadynamics systemicity at any environmental level, e.g. here, the terrestrial level induces in emergent new statuses, conditions, properties and behaviors. Being central to a coherent integration of sustainable survival means, a complex dynamic milieu is like that of the metabolism of the Earth or of an organism. The emergence of livable functions to grow and reproduce, maintain structures, and respond to their environments is the keystone of survival. Metabolism is homeostatic and results from catabolism breaking down organic matter, e.g. harvesting energy in cellular respiration.

Complementarily, it results in anabolism that is the use of energy to construct components of cells such as proteins and nucleic acids. The emergent properties, in biology, are the combination of individual atoms to form molecules such as polypeptide chains, which in turn possess behavioral properties folding and refolding to form proteins and reshuffling reactions. Assuming their functional status (eg. enzymes for survival sustainability) from a spatial conformation, these proteins interact together thus achieving higher biological levels of survival functions in form of organelles..., cells..., thereby inducing to sustainable tissues, organs, organ systems, organisms, all holding with behavioral reflexes of protection (fight or fly, habit...) and of survival efficiency.

Cascading phenotype reactions, arising from individual genes replication, mutate bringing about biological communities in the world to form the biosphere, where living systems, e.g. ants..., and humans participate in becoming interactive societies, and meta-social systems such as ecosystems (or the global stock-market). As being open systems, "if the condition is left random, the result of conditioning is also random", and the effect of the environmental metadynamics systemicity drives forth evolving and adaptive behaviors inducing endo-exogenous changes. Evolution is a notion considering the Darwinian natural selection as a

driver, and is also, and more broadly, the result of the permanency of change in one or several directions.

Among the metadynamics systemicity moves, some of its components are to be mentioned here in the way their asymptotic effects are usually deviant or perverse. Domino effect effects indicate the multiplying risk constituted with several events and behaviors at risks present on the same site and tending to evolve, spread and settle well beyond the initial condition of its appearance. The expression of “the domino effect” is used as a physical metaphor to represent the propagation by “contagion” (biomedical metaphor) of a local event or of an ideology. It refers to the concept of “coevolution” in ecology where a change at a specific level can promote and facilitates cascading changes at another one. The domino effect suggests that some change, small in itself, will cause a similar change nearby, which then will cause another similar change, and so on, in different sequences, by analogy to a falling row of dominoes standing on end.

For example, the food chain networks are very fragile since if one element, predator or prey, matter or water, miss, then the global ecosystemic conditions becomes hectic and nears death for many species, if not also that of humans, which very serious and deleterious thermodynamic effect drives towards mass extinction.

### **Butterfly effect**

Besides differential emergent results, an effect of amplification of a phenomenon may occur well beyond the place of its apparition named a “butterfly effect”. In other words, "the butterfly effect is a notion of sensitive dependence on initial conditions" and happens in the course of some chaotic events. The behavior of chaotic systems usually shows such exponential growth of perturbations as of in nature, small variations of initial conditions of a dynamical move may produce large variations in the long term behaviors of the system as for example winds or a population genetic drift or stress.

### **Coevolution**

Coevolution takes the form of different aspects of dualism, often ago-antagonistic between living species that have reciprocal influence from their interactions. For example, the keystone of survival is in the predator-prey dynamic, host-parasite, symbiosis between two species, or associations of several species as being systemic phenomena much significative of the "survival principles" mostly common to living species. The biology of evolution makes it possible to observe these dual forms and the importance of coevolution in the history of species and sexual conflicts. Some biologists, as Thierry Lodé and Richard D. Alexander, 1990, describe the effects of these antagonistic interactions, particularly at the sexual level, and the evolutions of characters as leading to an antagonistic coevolution of entities.

### **Kinetic factors and chemical reactions**

As Earth is an open system, it interacts with a part of Cosmos and Sun system forces and moves and from their metadynamics systemicity, it brings down on Earth energy-filled light rays which retroactive effects are differential in climate cycles and in living systems survival potentialities. Cascading, this excess of energy is minored from the dynamic balance of gravity, the Moon effects and atmospheric pressures. However, this resulting energy is adequate to overcome the negative effect of entropy on emergent chemical reactions results as keeping up sustainability requirements and adaptation abilities for living systems to cope with the permanency of environment changes.

### **Kinetic factors as decisive in multi-step processes**

The origin of Life was a matter of convergence and interactions between chemical systems during interrelated processing as adequate with survival moves (e.g.: replication, photosynthesis and autotrophic capacities of cyanobacteria to assemble for). Emergent results build up chemical structures acting like proto-living systems and having a chemical evolution, a molecular self-organization and a biological adaptation reproducing and change. The chemical environment initiated the assembly of chemicals that formed the first polymers (repeating structural units) able to provide information for others to assemble (proto-nucleic acids?) leading to reproductive polymers and catalytic activities. From then on, the whole environment flourished with properties which dynamic systemicity induced to replication and evolution into more adaptive polymers. Thereby, biological evolving conditions emerged originating different substrates (site of enzyme actions) where the RNA-like molecules formed and later engendered singled-celled organisms, some of them getting differentiated into multicellular systems in a proto-metabolic milieu. Such overview of successive metadynamics systemicity phenomena supporting living systems must be understood having occurred during an immensely long period of time of about 800 million years and plus. While getting more inquisitive about the immensely long period from -4,6 Go/years (the Earth birth) up to + 2'009 years of nowadays, in the history of Life, it becomes highly important to have a transdisciplinary learning as understanding the universal and natural interconnectivity.

### **THE "METADYNAMICS SYSTEMICITY" IS A GENERAL PHENOMENON**

On the whole, "Systemicity" is particularly explicit of the physicochemical process fields that have ago-antagonistic forces with differential outputs; particularly those promoting dynamical balance statuses e.g. that evolve. Their direction induced retroactive phenomena to being irreversible; results from "connectivity", "coevolution" and "synergetic" are sustaining the momentary survival of the phenomenon. In no time, such sustainability is a one way move, since permanent successive outputs and "bifurcations"<sup>47</sup> (ref. Systems complexity, biological open systems) emerge in a synergistic environment from sets of reactions and counteractions though submitted to the permanency of thermodynamic effects, named entropy as balancing with physicochemical systemic moves.

One may observe why "metadynamics systemicity" is a general phenomena issued from the expansion of the universe since it is confronted with the relative speed of thermodynamic processes (process of tempering entropy production from heating and cooling of objects environment called "annealing"<sup>48</sup>).

"Velocity" and "gravity" is a dual force that participates in generating cosmic objects that have a transitory survival. Why a survival? Because of the above mentioned effects of ago-antagonist forces like that of gravitation and accretion<sup>49</sup>... (birth of our planet). Two major systems of object survival are those of a galaxy life and of its components as stellar systems submitted to the driving of thermodynamic free energy. The free energy is "a subtraction of

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<sup>47</sup> - **Bifurcation:** "a bifurcation occurs when a small smooth change made to the parameter values (the bifurcation parameters) of a system causes a sudden 'qualitative' or topological change in its behavior".

<sup>48</sup> - **Annealing:** object (glass or metal) submitted to a process of heating and slow cooling in order to toughen and reduce brittleness,

<sup>49</sup> - **Accretion:** " a disk, or other object like a planet, of usually gaseous matter surrounding a massive celestial core in which the matter gradually spirals in toward and accretes onto the object as a result of gravitational attraction, progressively bringing up processed results capable to reproduce, assemble and form biochemical proto-elements able to cooperate and interact until the apparition of entities sufficiently autonomous to track energy and replicate.

the entropy of a system" in terms of temperature giving out a thermodynamic status of "useful energy", in other words the system is in a survival state while "burning" energy.

For example, the metadynamics systemicity sustains the momentary survival state of the actual Solar system, which energy depends on the Sun's life thermodynamic evolution, burning its own energy and sustaining from gravitation within our galaxy. The Sun's future will end "shrinking back" giving out a nebula, in about +5Go/years. From the nebula environment will thereafter raise new "baby stars" out of the metadynamics systemicity of the dust and gas environment of a molecule cloud.

Most changes are not being usually or mentally perceived at a human mind level. Considering micro or mega sizes and long lapse of time that are to be reckoned in thousands, million and billions of years, they cannot physiologically and mentally be apprehended. The major example, which is a fatal perspective for Life on Earth, is in its programmed end way before our star, the Sun will have consumed its energy away as evaluated around 4 to 5 Bo years ahead. On Earth, one small schedule exception in perceiving day and night light aspects under ever changing climates is however a false impression, given that the orbiting, revolving, contextual conditions are permanently differential<sup>27</sup>. Nonetheless, understanding "systemicity" as the combination, coevolution and cooperation of all dynamical Cosmo-planetary, terrestrial forces and moves, particularly in their interaction-retroaction dynamics, is an opening on main formats coupling what makes things permanently moving about from feedbacks and synergistic differential events.

The clue of the universality of emergent differentials seems to present itself as of being close to evidence, simply from referring to the incidence of global warming systemic domino and butterfly effects within the four dimensions of space-time; and because of the weight of Cosmologic metadynamics down to the biological levels and of its "horizontal" systemicity (a 4D intrication).

### **PROVISIONAL CONCLUSION**

Geophysics studies the Earth existence and its terrestrial moves (or pulsations) applying to physical and chemical principles of the Earth's subsurface and surface motions of tectonic plates. Thus, the internal structure of the Earth and of its metadynamics systemic circular moves (magma convection currents sinking again, rock cycles and shallow deposits) provides for an important inventory for numerous systemic data and geological forms. Many resource basins providing for mineral deposits, groundwater wells, chemical sources..., were and are well exploited by living systems, some of them at the origin of Life (minerals and water...) promote its evolutionary capability to survive. Domestication of fire, wood, petroleum oil, gas and charcoal reserves, at the origin of the industrial development of our modern humanity, induce in the surge of new survival consumption means, sometimes in form of their natural status or, for the many, in form of transformations increasing their purpose of utilization. Transformation of light and matter is basically a vital energetic necessity, primordial for living beings to fulfill their specific survival means. Required as direct from the Sun, or indirect from predation strategies among the multiplicity of food chains cycles, survival means are immensely diverse even though metadynamics systemicity survival principles involved (food, habitat, fear, reproduction...) are basically common to all creatures.

"Systemicity" and its dynamics as "Life's drivers" are consubstantial (of the same essence) to the cosmic origin of planet Earth's drivers, showing that the "tick tock" of the biological clock that sustains life against entropy are phenomena tuned with "glocal" planetary and terrestrial pulsatory tick-tocks of our Planet. Maxwell predicted with metaphors that dynamics are



inducing to the production of the "compost" for theories to emerge, which suggested to me the development of the "Theory of general dynamics systemicity".

These phenomena show the presence of sets of dynamics that have level after level of the physicochemical cosmic evolving world, structured up the emergence of "Life's meta-drivers", their development and the elements, forces and sub-dynamics that compose adequate chemical kinetic systemicity for Life to happen. Furthermore, this work strongly suggests that any species and its societal organization being scrutinized brings up a better understanding and description of the principle of "meta-systemicity drivers" sustaining survival behaviors as retroactive emerging results. It is particularly assumed here that interrelated and interconnected factors or functions have indisputable intricate cascading and collateral effects on species fate.

A large approach about "surroundings" (neighborhoods), and actual dynamic variations confronted to entropy status would enlarge the quality of any expertise of direct and collateral effects. Permanently emerging from the world of physicochemical and biological processes, vital survival behaviors usually result from sustainable, adaptable and enduring Life's principles within the context and today require an important effort for humanity to better update and govern new survival strategies. The survival of the livings is in danger because mankind produces aggravating degradations. A danger that is implicating the global society, its intelligence, actual human cultures, socioeconomic fulfilling attitudes and human systems as to protect the fruits of thinking, creativity, survival competition and a set of political attitudes, understanding the irreversibility of the obverse side of entropy as per the second law of thermodynamics lessons. My intimate conviction here is that a "general system(s) theory" cannot be assumed since Ludwig von Bertalanffy biologist's theory is superseded, as I expressed it since 2000, and is here proven.

Since I have inventoried and linked most of the physicochemical events issued from "Cosmo-planetary and terrestrial meta-dynamic mechanisms, drivers and processes systemicity, I found them to bring up strong evidence of "Systemicity, as a general universal set of moves" converging the natural moves from the reality of differential emerging result seeding dynamic retroactions. Since the apparition of Life, every individual living organism and communities, from unicellular organism to the actual living creatures (humans included) is submitted to a universal contextual "meta-dynamic systemicity" that shows cosmic objects and living beings having a diversity of specific and common survival behavior dynamics while submitted to the evolutionary effect of the Cosmo-planetary and terrestrial forces.

Microgravity at the subatomic level is probably getting behind a general subatomic and atomic systemicity. These processes are all constitutive of the "Cosmo-planetary and terrestrial metadynamics systemicity" drives. In this work, dynamics interrelations are usually described in general, in other terms, the whole development of the theory is supported with an up to-date science approached about a transdisciplinary point of view. In conclusion, it is here assumed and postulated that "Systemicity" is the general propriety of meta-dynamic moves and forces retroactivity, inducing to a general evolution from feedback, which result emerges in particular forms within coevolution, synergistic and collateral effects.

"The general systemicity" of cosmic objects environments is part of the entire physical universe metabolism, its dynamics equilibrium since it includes gravitational effects and retro-feeding capacities.

It is therefore assumed that "Systemicity" is naturally concerned with abstractions and theories. The next field of this theory: "The Life's metadynamics Systemicity" will be

developed, step by step, later after 2011, the result bringing up the 5th part of the theory, and it is assumed it will not be the last.

The theory of "A primordial general systemicity" (6th stage of my works), will be the keystone at considering the "General Metadynamics Systemicity" as a universal phenomena issued from the thermo-dynamicity of matter and energy as confronted with gravitation and rays effects that slow down space-time.

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A much abridged list of references.