Shrinking versus Expanding TIME within Time's Arrow

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Abstract

This paper set around the theme (Time) of the inaugural issue of the Rosennean BioTheory Journal, due to appear in the Internet in January 2005, reviews its selected topic from three angles. The first, the *premise* – is a plunge into the past to look for deep roots of present theories of science, in particular, those underlying or coming close to Robert Rosen's ideas and theories, with some purposeful interpretations to help establish a mental link to our theme. The second, a *conceptual review* is a cursory look at concepts, a number of relational concepts underlying ever-existing opposites at times in conflict, at times in harmony in the struggle of an eventual balance between them (chaos and order co-existence). The title of this paper 'shrinking and expanding time' metaphorically represents the nature of these opposites, such as being reactionary and reflective, objective and subjective; rational and intuitive/creative; analytic and synthetic, etc. The third, *the bridge*, represents the magic wand, which carries the past to future through the time's arrow with examples. There, the specific roles of 'matter' and 'form' in maintaining the interaction and co-organization of relationships within the flow of pastpresent-future are demonstrated. Healing, restoration, regeneration and rejuvenation are among the processes where past-present-future are unified within the nonlinear and dynamic flow of time.[2]

Premise – a plunge into the past

The time is out of joint. O cursed spite,
That ever I was born to set it right!
Shakespeare, Hamlet

The history of philosophy and science teaches us that our understanding of life and the reality is ever growing and widening owing to the work of deep-thinkers who lived before us. The pertinent enquiries made and work done by them resulted in a vast and diverse knowledge that are accumulated, confronted, assimilated and passed from generation to generation for further deepening with an ultimate aim of reaching the reality about the cosmos and the life. In this process the arrow of time had been free to move in any direction with ups and downs, oscillating from one side to the other and with back and forth in time and space. In this multi-directional time context, images, thoughts, art-works as well as spiritual experiences have played a major role and made

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[2] Acknowledgement: The first section of the paper, 'premise', as a foundational-epistemological support system of this paper is prepared by purposefully selecting and enmeshing the facts and ideas presented by a number of authors, as listed in the list of references at the end of the paper. It is also benefited from other sources such as book reviews, articles, my own papers prepared for other occasions, continuing dialogue on the Rosen list in the internet, exchange of views with individuals, research in internet, notes taken during conferences, radio transmissions etc. as fitting and interpreted to meet the purpose of this paper. In particular, the continuing support provided by Judith Rosen personally and through her archives, which enabled me to relate this paper to its purpose, is acknowledged.

pastpresent-future a multi-directionally flowing entity folding around the present moment. With St. Augustine's words, the past has become something sensed at the present in the form of thought and dream, the present something actually experienced at the present moment and finally the future also sensed at the present in the form of anticipation and hope.

Time is something elusive and relative. It makes different sense to different people, different society and culture. It is sensitive to location. It requires an event and/or a change to occur to bring the time-measure into existence to report an instant happening or a long history. When all is silent and no change occurs, the concept of time has no meaning. Its flow is not noticed. This conceptual framework implies that time could function both in the existential and the experiential realms. In the first, its arrow is one directional. Whereas in the imaginary-experiential realm it is free to move into any direction, as in the dream and the reflection worlds. Our present task is also carried out within a dynamic time sphere.

With a purposeful aim of tracing the thread of the seminal ideas which gave birth to the 'Rosennean Complexity Theory', a quick travel into the deep history of thought process of the western vision is made below. This carries us to the era of Pre-Socratic thinkers, a group of Milesian philosophers of the Asia-Minor to start with, who, in turn, is the repository of the ancient eastern philosophies, in-built in their thinking process. On the way some reflections are made to organize the relationships among differing thoughts and ideas in time and space in the light of our objective.

Among a few related to our task in hand, the ancient Greek Philosopher Heraclitus, who lived c.500 BC, amongst his ideas regarded the unity of the universe as the most important thing and considered that the unity arises from the combination of opposites and subsists through perpetual change. He was interested, however, more in the way the world actually functions than in its origin. He is the maker of the timeless aphorism: "*Pãnta rhèi*"- everything flows- 'continuing becoming', a precursor of the Rosennean complexity theory. It is thus the primary mover of this paper. Heraclitus' philosophy for the reality is being something dynamic and resulting from the unison of the perpetually becoming opposites with the essence of the world as their eternally regenerating secret harmony and balance. Similarly, Yin–Yang opposites can only exist as 'opposites' because of the existence of each. This is the Paper's operating ground, around its specific objective of enlivening –one of the 20th century philosophers and the forerunners of the new science- Robert Rosen's theory of life and living. It is a huge jump to arrive from that era to our present time, which in the process had many back and forth movements within the arrow of time. It, thus, requires a hard climb up with many negotiations on the way to move from the bottom of the deep well to the surface. Here below it begins the long trip in a condensed form starting, in effect, from the seminal work of Heraclitus.

Next Parmenides is also an ancient Greek philosopher and a contemporary of Heraclitus. He is the supporter of the idea that our senses deceive us, 'what is' or 'being' must be indivisible and unchanging, without a beginning or an end. This distinction later played a crucial role in Plato's theory of 'ideas' and of 'what constitutes true knowledge'. Zeno of Elea, a disciple of Parmenides, best known with his paradoxes of the arrow and of Achilles and the tortoise, indicated that the reality must be a continuous whole. He also argued in favor of the illusory nature of change and movement. These first two philosophers are the forerunners of two opposites of 'becoming' and 'being' and later the ideas and approaches of Aristotle and Plato in furthering the philosophy and science. They are, however, two inseparable sides of the same medallion. Pythagoreans (6th –5th centuries B.C.) made important contributions to mathematics and science. They took the mathematics and geometry beyond their practical stage and developed them theoretically. They

were the first to think about the relationship between mathematics and nature, investigating numerical relationships in acoustics and musical theory. Describing the world by numbers was their most important legacy. Ages later, in the 17th century, Galileo declared: "*Philosophy is written in a huge book, which stands open before our eyes, that is the universe. It cannot be read until we have learnt the language and become accustomed to the symbols in which it is written. It is in a mathematical language, and the letters are triangles, circles and other geometrical figures, without which it is not possible to understand a word.*" This is also the belief of most of the scientists today. Pythagoreans distinguished 'number', or 'pattern' from 'substance', or 'matter', viewing it something that limits matter and gives it a shape. They stood for enquiring into pattern rather than inquiring into substance. Recent studies on complex systems in many ways find their roots within the Pythagorean work. It was also the belief of the Jewish mystics who generated the Kabbalah - that mathematics was God's own language, which was why mathematics is so applicable to musical notes and wavelengths of light, etc.

Later Euclid (c. 300 B.C.) furthered their work, especially, to give to geometry stable foundations and a thorough structure. He also managed to solve many complex problems with the help of geometry. There was, though, a subtle assumption about the nature of space involved in Euclidean geometry, such as the assumption of a flat space, we are familiar with, as its base. Until the 19th century and in the early 20th century such dimensional subtleties were not questioned. Even existing alternative theories of geometry were of only philosophical interest until Einstein introduced his special and general relativity theories in 1905 and in 1915. Then it was realized that space has a positive and negative curvature. However, Euclidean geometry still remains valid for flat space and provides a solid starting point for the conventional science. As was understood later that application of this assumption to models generated by physics for describing the universe was not adequate. It is observed that the more complex a system's organization is, the more deficient physics-based models become. This is certainly the case for all living systems.

Aristotle (384-322 B.C.) is a philosopher with a great breadth of thought, with an internal coherence and consistency and a polyvalent scientist of his time, was the inventor of the formal logic. Besides logic, he dealt with a variety of subjects, including physics, biology, metaphysics, ethics, politics, sociology, meteorology and other subjects concerning life and living and the world. He was a great synthesizer. He developed his theories in systematic treatises. He believed that form/pattern had no separate existence, but it was immanent in matter. For him, the matter did not exist separately from the form. Matter, however, contains the essential nature of all things, but in the form of potentiality. By means of form this essence becomes real, or actual (self-completion/entelechy). Thus the matter and form are the two sides of the process, separable only through abstraction. This is also one of the deep roots of the new science now appearing as an iceberg for discovering what is underneath.

Aristotle's treatise concerning physics, contains four hard-to-grasp and at times ambiguous causes: material, efficient, formal and final, which had, beyond his time, played a significant role with its varying interpretations, in due course, to suit the purpose at hand, both in scientific and theological philosophies.

These are (from J.Kinneman's lecture):

- *Material cause*: "that out of which a thing comes to be, and which persists", e.g., bronze, silver, and the genus of these (*made out of metal/ matter*);
- *Formal cause*: "the statement of essence" "the account of what it-is-to-be, and the parts of account" (*is to be*);

- *Efficient cause*: "the primary source of change", e.g., the man who gives advice, the father (of the child) – (*produces*);
- *Final Cause*: "the end (telos), that for the sake of which a thing is done," e.g., health (is the cause of exercise) – (*for*).

For our purpose we can interpret these causes within its most essential causes as formal and final which seem to be alike in essence. They are static. Efficient cause is then the process to actuate the change, to produce the form out of matter. It is dynamic. In the end the form, consisting of its purpose of being so, contains all causes in one. It has thus supremacy over the matter, an important point demonstrating the difference between reductionistic/simplicity (matter related) and holistic/complexity (form related) systems.

Aristotle saw the terrestrial realm as a place of change within four essential qualities interacting with contrary qualities as shown in Figure 1. According to him the unchanging heavens must be made of some other substance, not subject to change.

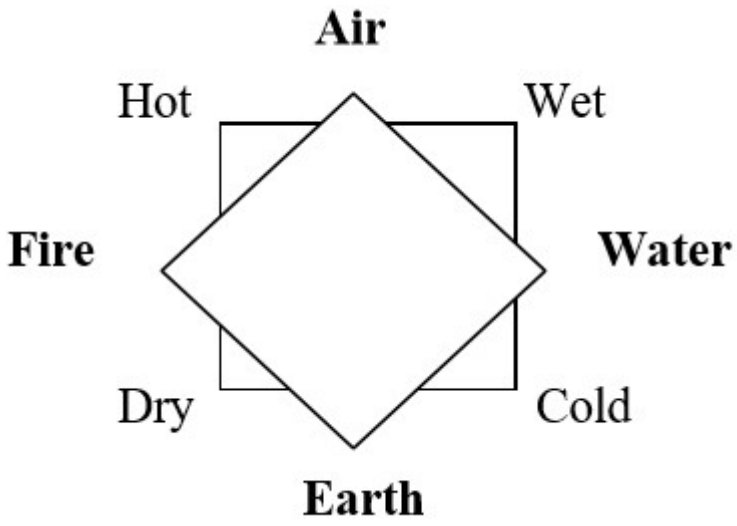

Figure 1

Aristotle's view of matter was essentially a qualitative. For him these qualities cannot be broken down or analyzed further. They should be considered as the ultimate constituents of the world. As such his view of the world was a qualitative one, thus making the actual very different from the ideal. While mathematics can describe some of these qualities, it cannot do the same for all of them and in all situations. He thought that everything had a potential to be something or somewhere else, which it might actualize, unless hindered from doing so. Matter for him contained the essential nature of all things but only as potentiality. By means of form this essence becomes real or actual. All these views seem very supporting for biological theories, though he used them also for physics.
The understanding of form is inextricably linked to the understanding of the development process. He thus explained the world as something mechanical, working like a clock on the physical ground and or something organic, which works like an animal on the biological ground. On the other hand, owing to some difficulties in explaining the life in mechanical terms many ancient scientists tended to use organic explanations also in physics. The tension between mechanism and holism has remained an ever-recurring theme throughout the history of biology: a dichotomy between substance (matter, structure, quantity) and form (pattern, function, quality).

Aristotle's ideas reshaped the western thought and the belief systems during the 12th/13th centuries. It had been also a useful tool for the church. This especially owes to the interpretation of Aristotle's metaphysics by theologian Thomas Aquinas (13th century), in terms of ethics and human behavior. In that period in the Latin world, translations from Greek to Latin were not yet available. His work was, therefore, based on the translations and interpretations made in Arabic from the philosophical works of Aristotle in Greek by Averroe (Ibn Rochd, a 12th century Islamic philosopher who then lived in Granada/Spain).

Averroe's own ideas were very much in line with those of Aristotle. Thus his own interpretations later used by Thomas Aquinas should not have been too different from the authentic views of Aristotle. But they were still second hand opinions. Also in their next translation into Latin and re-interpretation in due course they were likely modified. Then, Thomas Aquinas uses the final Latin text in creating his famous book: 'The Summa of Theology'. This philosophical/theological literature greatly influenced the Christian doctrine that in turn influenced the western thought in general during the medieval era of which echoes had even lasted beyond the Renaissance and the Humanism movements born later in Italy.

The Renaissance and the Humanism movements from 14th through 16th centuries were, however, influenced directly by the ancient Greek philosophy and science through the direct translations made from the Greek literature to Latin by Greco-Roman thinkers and philosophers. Among others, Aristotle's polyvalent works had continuously been the main pillars of the birth of the new vision, to last until the seventeenth century, when Galileo, Newton, Descartes entered the scene and introduced yet another new thought system and science and became its main architects. Aristotle's views and scientific theories were consigned to oblivion.

Aristotle is, however, now re-entering the western thought and making an apposite contribution to shaping the new world-view of reality. His works remain as a rich and inexhaustible source of wisdom to extract and to suitably interpret in the light of today's needs and existing contrasting ideas. In understanding Aristotle's mind and interpreting his ideas one needs to remember Averroe's words: "*in Aristotle's works every virgule has its specific function in conveying the essence of his ideas*". In the antiquity, while it was Roman physician Galen's work (2nd century A.D.) on the human body that is known as the beginning of biology, in reality it was Aristotle and his disciples, five centuries before Galen, who paved the way, for biology. He, however, had great difficulties, during his time, to get biology to be accepted as a proper field of study, as it concerned some delicate matters such as human beings and heavens.

Revolutionary thinking in the 16th and 17th centuries, however, radically changed the medieval world-view, sweeping away with it both Aristotelian philosophy and Christian theology and replacing all with precise mechanistic thinking, namely, the world as a machine. Mathematically quantifiable properties replaced qualities and heliocentrism replaced geocentrism. The distinction between the celestial and terrestrial realms was abandoned, since gravity could now explain both the motion of the planets and the falling of objects dropped on earth. They followed more of the atomistic line of the ancient thinking.

This paradigm shift, so-called Scientific Revolution, had resulted from the new discoveries in physics, astronomy and mathematics during this period and associated with Copernicus, Galileo, Descartes, and Newton, a few of the prominent scientists of their time. Galileo, who was the first to discover the gravity, pushed away the quality from science into oblivion, limiting it to the study of phenomena, which could be measured and quantified. This has dominated throughout the modernity

affecting not only the physics but also touching deeply all life-matters and day-to-day living. The world thus lost its soul and become a solid matter to think and function as a machine. Descartes, on the other hand, in line with this new paradigm, created the method of analytic thinking. According to him, the material universe, including living organisms, was a machine, which could in principle be understood completely by analyzing it in terms of its smallest parts. Following on their views of the world as a perfect machine governed by exact mathematical laws, Newton made a synthesis in the form of the well-known 'Newtonian Science'. From thereon, his framework had been the guru of all scientific studies and advancements. It is still dominating the scene, rightly, but sometimes wrongly depending where and how it is used, though together with newly emerging alternatives. For example, in the light of the new science of chemistry, the simplistic mechanical models of living organisms were largely abandoned, but the essence of the Cartesian idea survived in that the laws of biology can ultimately be reduced to those of physics and chemistry. With this baggage of epistemology we have arrived in the 19th and 20th centuries when new thoughts started to emerge and to question the validity of the old.

The first opposition to Newton-Cartesian framework came from the field of art, literature and philosophy towards the close of the 18th and thereafter during the 19th centuries. Several poets and philosophers returned to the Aristotelian world-view concentrating on the nature of organic form. Goethe (1750-1832), for example, was the first to use the term 'morphology' for the study of biological form. He conceived of form as a pattern of relationships within an organized whole: a forerunner of the systems thinking. He and all artists of his time concerned mainly with a qualitative understanding of patterns and they thus placed great emphasis on explaining the basic properties of life in terms of visualized forms. He, in particular, felt that visual perception was the door to understanding organic form. This understanding also played an important role in the philosophy of Kant.

Kant (1724-1804) in his studies placed the process of knowing as his central concern. He thought 'every event has a cause', that cannot be fully established through experience. He set out to show that our knowledge derives partly from our direct perception of external objects and partly from our own manner of perceiving them. His greatest insight was that instead of thinking of our knowledge as necessarily having to conform to objects, we must view objects as conforming to our way of knowing them. He argued that we cannot comprehend the truth about an object 'as it is', for our understanding of that object is always dependent on the structure of our minds. We cannot find an independent truth about an object, since our knowledge of that object is structured by space and time (what he called 'the pure form of intuition'), as well as by the categories that are inherent to our way of thinking (e.g. causality). He called them *a priori* concepts.

Though these thoughts do not reflect the way we know the world but they direct the way we behave in the world. He made an attempt to reconcile Descartes' rationalism and Hume's empiricism and sought a way out of the difficulties in which both found themselves entangled. His view was that our representations require both the trigger of external reality and concepts that do not derive from that reality has, directly and indirectly influenced most thinkers who have addressed themselves to the problem of knowledge and the scope and limits of reason. He believed that science could offer only mechanical explanations. Though he affirmed that in areas where such explanations were inadequate, scientific knowledge would need to be supplemented by other methods, considering nature being teleological. According to him the most enquiry in this sense is related to 'the understanding of life'.

Schopenhaur (1788-1860) considered the Will as the fundamental reality behind the phenomena we perceive. The Will, for him is one and timeless. It shows itself in the whole of nature, both animate and inanimate. He was the first western philosopher to explore Hindu and Buddhist ideas and to incorporate them into his system. The idea of the primacy of the will opposed to the primacy of knowledge has since been advocated by a number of modern philosophers such as Nietzsche.

At the end of the 18th and the beginning of the 19th centuries this opposition to mechanistic-materialistic view was so strong that the primary concern of biologists was the problem of biological form, and questions of material composition were secondary. Later in the 19th century the emphasis shifted, though, again back to mechanism, when the newly perfected microscope led to important advancements in biology. Biological functions were now seen as the results of interactions among the cellular building blocks, rather than reflecting the organization of the organism as a whole. Among others, for example, Pasteur's discoveries led to simplistic 'germ theory of disease', in which bacteria were seen as the only cause of disease. This reductionist view over-shadowed an earlier alternative theory of Claude Bernard, the founder of the modern experimental medicine. In his theory Bernard had observed that in a healthy organism this internal environment remains constant, even when the external environment fluctuates considerably. This concept was the harbinger of the notion of homeostasis of Walter Cannon in the1920s. Similarly many other theories of the 19th century such as cell theory, embryology, and microbiology developed based on mechanistic conception of life as a firm dogma among biologists paved the way for the next wave of opposition, so-called 'organicism movement'. The limitations of the reductionist model were shown even more dramatically by the problems of cell development and differentiation.

At the turn of the 20th century Poincaré, re-introduced the originally Pythagoreans' concept on the visual imagery into mathematics of the dynamical systems, that is a shift to geometry, the mathematics of visual shapes, from algebra, the mathematics of formulas. His geometry is however not Euclidean, but a new kind of geometry- mathematics of patterns and relationships, known as topology with the ability to transform patterns from one form into topologically equivalent another, by continuous bending, stretching and twisting, without changing the properties of geometric figures in the process. Topology is, then, really the mathematics of relationships of unchangeable or 'invariant' 'patterns'. Poincaré used topological concepts to analyze the qualitative features of complex dynamical problems and in doing so laid the foundations for mathematics of complexity that would emerge a century later. His concepts had, however, been sent to a deep background with the appearance in a few years' time of Max Planck's energy quanta and Albert Einstein's special relativity theory. Then in the next half a century physicists and mathematicians were overwhelmed with these new revolutionary developments such as 'quantum physics' and 'relativity theory', only in 1960s to go back and dig out more of Poincaré's dusted archives in connection with the complexities of chaos. Scientists can now, with the help of high-speed computers, peep into the depths of complex trajectories of complexities. The solutions appear in the form of a curve or a set of curves or a graph, not a formula.

Another important shift has taken place concerning the space and time. These separate concepts have lost their dogmatic absolute positions as stipulated by Newton as invisible scaffolding that gave the universe a shape and structure and remained as the corner stones of the classical physics, which lasted more than two hundred years. Maxwell had added to it electrical and magnetic forces (1860), regarding the motion, which had opened the way to the theoretical physics. Then space and time have united under one roof and become one as a relative concept, meshed into 'Spacetime', as invented by Einstein, a concept changing only on the perception of its observer. Namely, it would

acquire a meaning only if it referred to a *function* taken place on a given location in a given moment: answering to 'where' and 'when' questions as one unit.

In shaping this new 'spacetime' concept Einstein, among other things, must have been inspired by the idea initiated, in the 1870s, by the Austrian physicist and philosopher Ernst Mach concerning the shape and the motion of a surface. Furthermore, his ideas suggested that there would be no conception of motion or acceleration if there were no benchmarks for comparison. With all these differing views Mach was the first significant challenge to Newton's work, before Einstein. Einstein, with his later works had further proved that Newton's physics could not describe the reality of our world, which is a relativistic reality. As this manifests only in extremes of speed and gravity Newton's physics will still continue providing the approximation acceptable in many circumstances as a utility not a reality.

During 1920s there has been another entry into the realm of physics, also contesting the Newtonian view namely, *quantum physics*. It is not, however, in line with the Einstein's general relativity theory, especially its uncertainty principle. Their gap is still to be closed perhaps with new theories to be discovered to function at higher realms to embrace both from above. The view in the quantum physics is that the solid material objects of classical physics dissolve at the subatomic level into wavelike probabilities. These patterns, moreover, do not represent probabilities of things, but rather probabilities of interconnections. Subatomic particles have no meaning as isolated entities but can be understood only as interconnections, or correlation, among various processes of observation and measurement. Quantum theory deals with interconnections and not with things *per se*. This theory also gave rise to the school of organismic biology cited above. Neither this theory nor the general relativity theory alone can explain the reality. They both meet the needs of different systems; the former successfully deals with microsystems and the latter with the macro-systems. Taken together, they clash. There is a gap to be closed to make them work together. This is the idea of a unified theory. Efforts are being made with this aim, mainly starting from the quantum theory to upgrade it by including the missing gravitational forces within its framework, namely launching a move towards meeting the general relativity theory. Without a successful union between general relativity and quantum mechanics the end of collapsing stars and the origin of the universe would remain forever mysterious. Leading contenders at the present are 'Superstring theory/M-theory' on the one side and the 'Loop Quantum Gravity theory' on the other side. There seem to be appearing promising results from both, but yet only experimental proofs. Even if these efforts successfully develop into a unified theory, but it may not satisfactorily meet the needs of living systems. Close observation on their progress will prove useful in developing theories of wider horizons and dealing with the questions of life.

Schrödinger, who for the first time posed the question "*what is life?*" in his book published in 1944. This brought the need into an open platform for a brand new science, beyond physics and even beyond biology to adequately deal with life and living. In his above-cited book he advanced clear and compelling hypotheses about the molecular structure of genes. These thoughts stimulated biologists to think about genetics in a new way. He further concluded that organisms were repositories of what he called new physics. Thus he paved the way towards a new science, molecular biology. It is remarkable that coming from a background fully immersed in the contemporary physics he has admitted the shortcomings of its laws in adequately dealing with living things. Einstein later more emphatically supported this argument. Late in the 20th century biophysicist Robert Rosen, in line with the findings of his predecessors mentioned above, further indicated the need for a thorough re-thinking of the capabilities of the contemporary science, in particular as far as its application to living systems were concerned. Hence, he proposed a bio-

theory as a new science capable of expanding the horizons of scientific enquiry much beyond the physics.

It is thought to be very appropriate to give here a passage from the introduction of the book of Ian Marshall & Danah Zohar, entitled 'Who's Afraid of Schrödinger's Cat?'. It may provoke reflection on the chances of the New Science and the New Thinking making a dent into the existing scientific struggle and conceptual crisis.

"*One of the founding fathers of quantum physics, Niels Bohr, was often asked to speak to lay audiences about the new science. He would begin by telling a story in which a young rabbinical student goes to three lectures by a very famous rabbi. Afterwards, he describes these to his friends. The first lecture, says the student, was very good – he understood everything. The second lecture was much better – student did not understand it, but the rabbi understood everything. The third lecture, however, was the best of all, very subtle and very deep – it was so good that even the rabbi did not understand it.*

Bohr, like the rabbi of his story, never understood the science he had helped to create. Nor did Albert Einstein, who didn't even like quantum physics. Even today, some seventy years after it was fully formulated and long since it was joined by the further 'bizarre' sciences of chaos and complexity, many scientists have trouble coming to terms with the central concepts of the new physics – its indeterminism, nonlinearity, and causality; its fractals and wave/particle duality, and its cats that are alive and dead at the same time. Laymen can be forgiven for being largely unaware of how profoundly different the science of the twentieth century really is from past science, and how this difference may bear on their own lives and thinking. Science is often the harbinger of great changes that overtake human thinking. It draws its inspiration from often vague and tentative but wider cultural shifts and transmutes them into highly focused, rigorous, clear language, and into powerful images and metaphors."

Conceptual Review

"*Every year getting shorter, never seem to find the time*
Plans that either come to naught or half a page of scribbled lines
Hanging on in quiet desperation is the English way
The time is gone the song is over, thought I'd something more to say."
Pink Floyd, from their song 'Time'

The concepts of objectivity versus subjectivity underlie the duality operating in all similar concepts representing the opposite sides of the same truth. Once Kant said: '*there is no objectivity, but there is a synthesis of many objectivities*'. In a way, objectivity- subjectivity is like the non-separable opposite sides of the same medallion. We have, in effect, reached a stage where we have separated and placed them into very distinctive positions in faraway quarters, giving a preference to the former, believing that only objective judgments give us a sound, rational, quantifiable and thus reliable base to establish all of our life matters.

This belief is the off-spring of the Scientific and thereafter Industrial Revolutions of the Modern Era. This understanding has gone too far to put human being at a distance from the self, thus treating the own body as an object apart from the subjective self. Similarly anything around the human environment is observed and treated as an object apart from the observer. In effect, a particular attention is given to not letting the subjectivity to interfere or even corrupt the process

objectively set in motion. This understanding prepared the ground for materialistic and mechanistic developments, which started in the seventeenth century with mechanistic theories breaking away from earlier beliefs considered to belong to medieval dark ages. This new paradigm reached its peak with the support of the industrial revolution during the first half of the nineteenth century as a religion-like ideology to support human happiness with materialistic means. The uniformity has become its supporting ally thus making things easy and reliable and controllable as long as they have a rational base. Since then most of developmental activities are designed and implemented within this concept. The modernity was born out of this revolution - reform.

Anthropologically and sociologically viewing, human being, with deep and lasting effects of mechanistic and simplistic approaches, has now evolved into a machine-like instrument to produce only material gains for his/her so-called happiness as well as for ensuring the wellbeing (!) of their societies. People have long started to use their body as a work-horse, without minding or realizing its potentially negative consequences on their true well-being. Only those, such as pure artists/scientists on the one extreme, able managers on the other extreme, were using their body as racehorses, with different formal/final causes though. They produce things of personalized nature in terms of art and grace-inspiring works on the one constructive side where the form prevails and in terms of prestige and material gains producing products on the other side where the matter/material reigns. Things, which they manage to produce, usually highlight their distinctive existence and their diversity representing at times diverse human values.

Such rare values, at times, could be exploited by those who see a potential material gain in them, rather than indicating them to others as models to help bring out their own diverse creative contributions into collectivity. Diversified inputs, if allowed, would then interact and through emerging synergetic relationships lead to healthy integration. The prevailing mechanistic approach has in effect created its own hard sub-concept of competition and conflict as against to the soft sub-concept of cooperation and conciliation of the humanistic approach in every field of human life.

Now we have reached an extreme level of separation between subjectivity and objectivity, between cooperation among creative subjects and competition among greedy objects, all leading to a visible polarization between the materially well-to-do and the marginalized, in every sense.

Some of the similar concepts at their extreme states are listed below:

Time shrinking limiting concept	**Time expanding relaxing Concept**
Objectivity	Subjectivity
Closed systems	Open systems
Simple/static systems	Complex/dynamic systems
Organization/top to bottom	Self-organization/bottom up
Tyranny/Oligarchy	Democracy
Guided democracy	Direct democracy
Revolution	Reform
Destructive	Constructive
Analytical/reductionistic	Systemic/relational
Linearity	Non-linearity
Predictable/known	Unpredictable/unknown
Ideological	Ideal

Project approach/deadlines	Process approach
Rigidity	Flexibility
Stressful	Relaxed
Rational	Inspirational/creational
Matter/materialistic	Formal/humanistic
Mechanistic	Quantistic/relational
Consumerism	Conservationism
Reactionary	Reflective
Uniformity	Unity in diversity
Competition	Cooperation
Conflictuality	Reconciliation
Information/knowledge	Wisdom/intuition
Epistemology	Ontology
Syntactic	Semantic
Experimental	Experiential
Tangible	Intangible
Quantitatively measurable	Qualitatively valuable

Most of these concepts are considered to be opposites and yet are similar within their groups. When one of them is detected in one situation, their "*opposite*" also tends to appear simultaneously. Within this framework 'being' and 'becoming' are not introduced as opposites to be calibrated and integrated in the process, because 'being' is the lighthouse of 'becoming' It is not its opposite.

Relatively speaking concepts listed above, in both sides, have their specific places, which can be safely and consciously referred to in day to day human-life and living at large. At extremes, they are the characteristics of strictly closed-impervious versus freely wide-open pervious systems. What is essential is to recognize their roles as counter-weights in achieving true balance. In this manner, we can consciously utilize them to help resolve problems and overcome stumbling blocks in human relations over time. In this process dialogue, negotiation and reconciliation in both practical and mental senses are the major facilitators. Equilibrium/Stability is the meaning of the game. In this process, it is not only a balanced use of concepts but also the ground to be created for the organization of balanced relationships to take place among the past, the present and the future by weaving their healthy threads. Being progressive and modern does not always mean being advanced in qualitative terms, if not functioning on the bridge by continuously observing and experiencing both sides of the flow. In the process these two sides of the truth get closer on the way to integration. The process, once in motion, continues. Stability and balance allow progress and peace.

Here below the 'process approach' is briefly described and the compatibility between the Rosennean complexity theory and such processes is examined, in particular in the next chapter, the bridge, with a view to demonstrate its potential for wider use.

'Process approach' is a natural way to work relationally towards a long-range objective. It has a continuing nature in which the *time* is never a constraint in that it never shrinks. On the contrary it relaxes as needed. In a way, it is doing things with no deadline to *per force* obliging them to reach completion within a fixed period, as the case in a project approach, which can be relaxed only in cases of *force major*. But the work, all the same, continues progressing towards a shared ultimate

goal. It may require temporary deviations and back and forth movements without losing the sight of the goal. It is a dynamic, non-linear, self-reinforcing, synergistic operation within the complex natural environment. Here, what counts is not so much weaving the texture of matter (by integrating the individual ingredients towards building a whole), instead it is letting the relationships between and among such ingredients interact harmoniously, entail, fold and organize themselves into a functional whole, as a continuing process.

A stable, effective, balanced process is much like what Robert Rosen described living organization to be. He said that organisms are open systems, meaning matter and energy flow through these systems, continuously, yet living organisms maintain their own organization. On the way, the process may become more and more complex and subtle owing to a continuing folding and resulting synergies, thus requiring equally subtle solution. Such things hard to quantify as implied also in Rosennean Complexity Theory. It is self-organizing, nonlinear-dynamic flow of functional (purpose directed) interactions and relationships, (Figure 2). The management in the process approach ideally occurs, also in a self-organizing manner, through an intelligent feedback system flowing as loops into the process in progress as an invisible parallel organization which fulfills a remedial function in a reverse order: a kind of self-correction and re-arrangement.

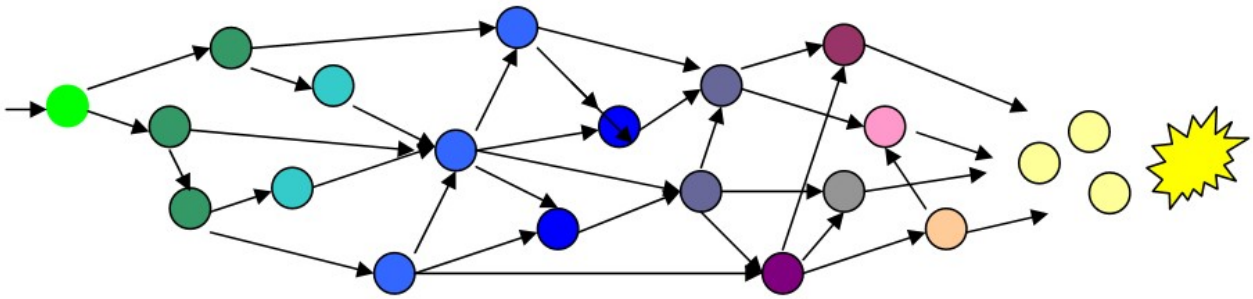

Figure 2- Self-organizing process: a non-linear and dynamic flow of purpose directed interactions

This kind of natural feedback and self-improvement/correction/re-arrangement in a process is also akin to metabolism and repair capabilities in a biological system.

While the existing scientific theories such as the gravitational relativistic theories are successfully dealing with macro-cosmos and the quantum theories (as the mother of many advanced technologies) with micro-cosmos, both by-pass the subtleties involved in living systems. Rosennean Complexity Theory offers a solution by addressing the issue from another point of view. Namely, it takes a relational view of a system, which addresses both the material structure and the larger organization of systems as a whole. In this view, the entire organization is given the higher priority because, as system complexity increases, organizational matters contribute for more causality in terms of the behavior of these systems than the material structure alone can account for. Living systems are extremely complex, as are systems composed of them. Human consciousness and social systems are particularly difficult to analyze using the current scientific paradigm. To approach them more usefully requires operating on a realm higher than that dealing with purely material, non-complex systems, although it must naturally encompass them as well.

While science is still struggling to understand what space and time actually are and where the reality now stands, the question becomes: Could Rosennean Complexity Theory, with its multi-

dimensional potential, present a sound base in the search for the wide-reaching general theory of a new dynamic scientific approach?

The Bridge-Magic Wand ?

"*Each time a geometrical form is produced,*
an expression of the universal oneness is made;
it is at once unique at time and space
and also timeless and transcendent,
representing the particular and the universal."
by Nigel Pennick 'Sacred Geometry', 1980

A drastic change from a life, conducted under the 'shrinking time' concept, namely mechanically and materialistically organized, to the one, which is experienced under the 'expanding time' concept, namely organically and holistically self-organized, is not easy. But it is possible. The will may play the role of the needed magic-wand to start the ball rolling and the grace to keep it going. Cultural world mirrors the behavioral changes occurring in human conduct and in nature's responses within the underlying also changing time and space. Human being has a lot to learn from these changes if s/he lives as an insider who is fully involved within happenings as a subject and a manager to keep the thread flowing from one state to the other with the help of a well-maintained bridge. In this process, memories, archives, archeological findings, historical buildings and monuments, literature and art of many kinds play an important role in keeping alive the essence of the past as the humanity's precious treasure. When this thread is broken, the humanity starts devolving, thus losing many steps so far taken in its struggled evolution.

Recovering follows a process approach. Living systems, as complex systems, are excellent candidates for such processes, involving growing, healing as needed, and maturing through natural dynamic changes with flexible deadlines or with no deadlines, like in the nature. In practical terms this process common to all living systems, which may also be applicable to physical and chemical systems, includes rehabilitation of land, water, air, societies and the humanity at large to be the custodians of an harmonious and sustainable life-environment. All depends on maintaining healthy relationships among parts involved and self-helping such relationships towards purposefully weaving and keeping a graceful texture as a common goal.

Here below, a few factual examples are given to demonstrate how the past can be revisited and its healthy essence could be carried into the future passing through the present. This can be humanly possible by relying on the ever-existing harmonious organization of relationships originally woven into the shape of the matter, which embodies the shape and its content. The latter always stays ready for abstraction as needed in due course.

- The simplest example is the organization of things in our daily living such as organizing the books-documents in a library or in a book- shop. They can be arranged by topic, by author, by language, by publisher, and by alphabetical or chronological order and so on. Similarly life is made up of different ways and may be viewed from a variety of angles keeping the secret of diversity as the seed of the dynamic harmony. One continuously needs to choose, to taste, to store, to arrange and rearrange things each time differently by the inspiration of the moment. Learning the art of composition of things out of many ingredients is the essential ability to acquire for living a life worth maintaining.

- Self-healing as the nature does, if it is left undisturbed, with its inherent ability to regenerate, to build its defense system–immunity, rejuvenate, re-produce and selfheal with a healthy interaction and cooperation with its environment to ensure a long life such as millenary trees found in jungles as examples. This is the area for an immediate application of the proposed bio-theory dealing with its subtleties to fill in the gaps of present scientific theories.
- Self-organized social systems, organized based on the natural strengths of areas and of their indigenous people or the similar, in line with the principles of complex systems applicable to all living systems. In this specific situation, the magic wand to make and keep a harmonious whole consists of each component's sense of equality and responsibility, be it an individual or a group, on the one hand and a mutual trust and respect among all components on the other hand. Without this collagen, societies are bound to degenerate, as the human history teaches us. During October 2004January 2005, an exhibition staged in antic Roman Trajan's Market (itself an archeological site) in Rome/Italy reporting on the findings of an ongoing archeological research of the University of Rome, carried out since 1960s in collaboration with the Turkish government. The work is carried out in the location of Arslantepe within the basin of the Euphrates River in Anatolia (present day Turkey). Findings of this research reveal extraordinary realities concerning societal rises and falls, going back to 10 000/9000 B.Cs. It recounts the history of power: its origins, development and ideological legitimization between the 9th and the 1st millenium B.C. through the origins of agriculture, the emergence of social classes, bureaucracy and the first forms of political and military control. It almost tells us what and where we are now. Without knowing the same pattern has continuously been simulated throughout the history up until our times, without realizing and learning from its repeated drastic failures. The information is now available in the form of literature, computer simulations, satellite images, drawings, photographs, architectural models and assonometric visions, etc. for transferring not the model but the hidden wisdom to the future. It is now a living repository of human history to revisit the past and learn from. A couple of images are shown in Figure 3.
- Architecture is a visible expression of how a specific historical-cultural era shapes its space and draws its boundaries between the inside and outside. Geometry plays a central role in architecture by giving life to its symbolism through a shape. Throughout the known universe the function of the geometry is an unchanging value in transitory existence. Artists-architects, especially holistic and organically minded ones, had recognized this transcendental quality upon which the fabric of culture is hung. They, by exercising their craft, had provided the inner matrix upon which the outward forms are based. This way the content embodied in their geometry-shape such as functions, ideas, conceptions, as unchanging values were being transferred to perfection from one period to another, even from one culture to another perhaps with some modification in contents, regardless of materials used as their shells. Restoration has, therefore, an irreplaceable function in transferring the healthy spirit from generation to generation. Throughout the history religions have used the geometry for disseminating and ensuring the continuity of their ideologies, in the form of temples, synagogues, churches and mosques among others with their profane versions as monuments erected to commemorate certain remarkable events in the history of man.

A few examples of restoration are given below to illustrate this point and the need for the employment of the process approach in their realizations as they deal with the transmission of insights involving complex subtleties to tackle, letting a self-arranging, self-managing method to work within a flexible time-span.

- One recent example, where in its realization art, science, and technology melted in the same pot, is the restoration of the 15th century frescoes made by Andrea Mantegna in the Heremitans Church and Ovetari Chapel in Padua, Italy. It was completely destroyed about 60 years ago during the 2nd World War. Within the debris, more than 80 000 pieces had since been collected by local people, representing only 10% of the whole. A mathematical model has now been developed by using these pieces, by also using the map image prepared by the technicians of the Church in 1920. In developing the model the circular harmonic technique, which helps attract pieces to their original places, trusting the natural harmony inherent in the original work. This model is being used for the restoration of this both culturally and artistically invaluable work. This example further supports the truthfulness of the ancient wisdom, as mentioned earlier in reviewing the theories of ancient thinkers, in particular that of Pythagoreans and much later Poincaré, among others.
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- Another example is the Chartres Cathedral in France built in the 13th century as the French Gothic expression. It was built by the medieval master-builders who inherited their craft from their peers, who in turn were involved in the construction of religious structures built in the Near East in earlier times. The Chartres Cathedral was, especially, built in the image of 12th-13th century Seljukean/Islamic architecture, which, in effect, made a significant influence in the emergence of the Gothic style in Europe, which reflected the ideas and sentiments of the time, perhaps carrying a similar expression to spread.
- Another example concerning the restoration activity is the recent work carried out in Turkey in support of the restoration of a 13th century Islamic historical work of art. It is an old hospital, which is built forming an integral part of the Divrigi-Ulucamii Mosque- a complex, historically and culturally unique of its kind- presently about to collapse and thus needing an immediate attention for restoration before it was totally lost. Within the auspices of the Faculty of History of Medicine of the University of Istanbul, a team of decorative-art and miniature artists, has worked for full two-years and produced the patterns of declining motifs and symbols on the walls and pillars of the building-complex. They, in many instances, extrapolated them from the fallen and broken pieces registering thus the expressions hidden therein as healing messages of the healing house, to be referred to, as needed, in the authentic restoration of the building. The center is, purposefully, organized to revive and update the historical decorative art without distancing it from its roots. Their work has been exhibited during the 7th National Congress on The History of Medicine, held in Divrigi- Sivas, in June 2004 and has been compiled in a book. An example (a real stone carving with its model in miniature) is presented in Figure 4.
- The last but not the least, especially owing to the importance of his dynamic art works in the introduction of aesthetics and plasticity into engineering is the 20th century American engineer/artist Alexander Calder. He introduced a time dimension into his work. While the shapes and forms in his works of art are of an abstract genre, their meaning involves a return to nature, that is to first principles, which seems to be an indispensable condition of any great work of art or movement in art. Calder had an eye for beauty, a sensibility to aesthetic meaning, which would usually escape the engineer. The result for us is an inter-dependent movement in a continuing motion and has a hidden organization of their relationships consisting of varieties of form balanced with delicate precision into experiencing the perfect union of nature and art.

Calder's suggestive work also alludes to the need of plasticity in material/matter used in creating the art piece to enhance the content of the work of art concerned. The plasticity being amenable to needs helps matter fold fully into the whole, thus joining the form, with function and purpose of the engineering or artistic construction. This new quality illustrates the basic difference between the rigid concrete and stone and the flexible and plastic steel, wood and the like as building materials.

This is in effect an important point for construction engineers, especially those erecting high buildings expected to be resistant to strong winds and earthquakes as well as to sea-quakes (tsunami) as recently experienced in the South-East Asia.

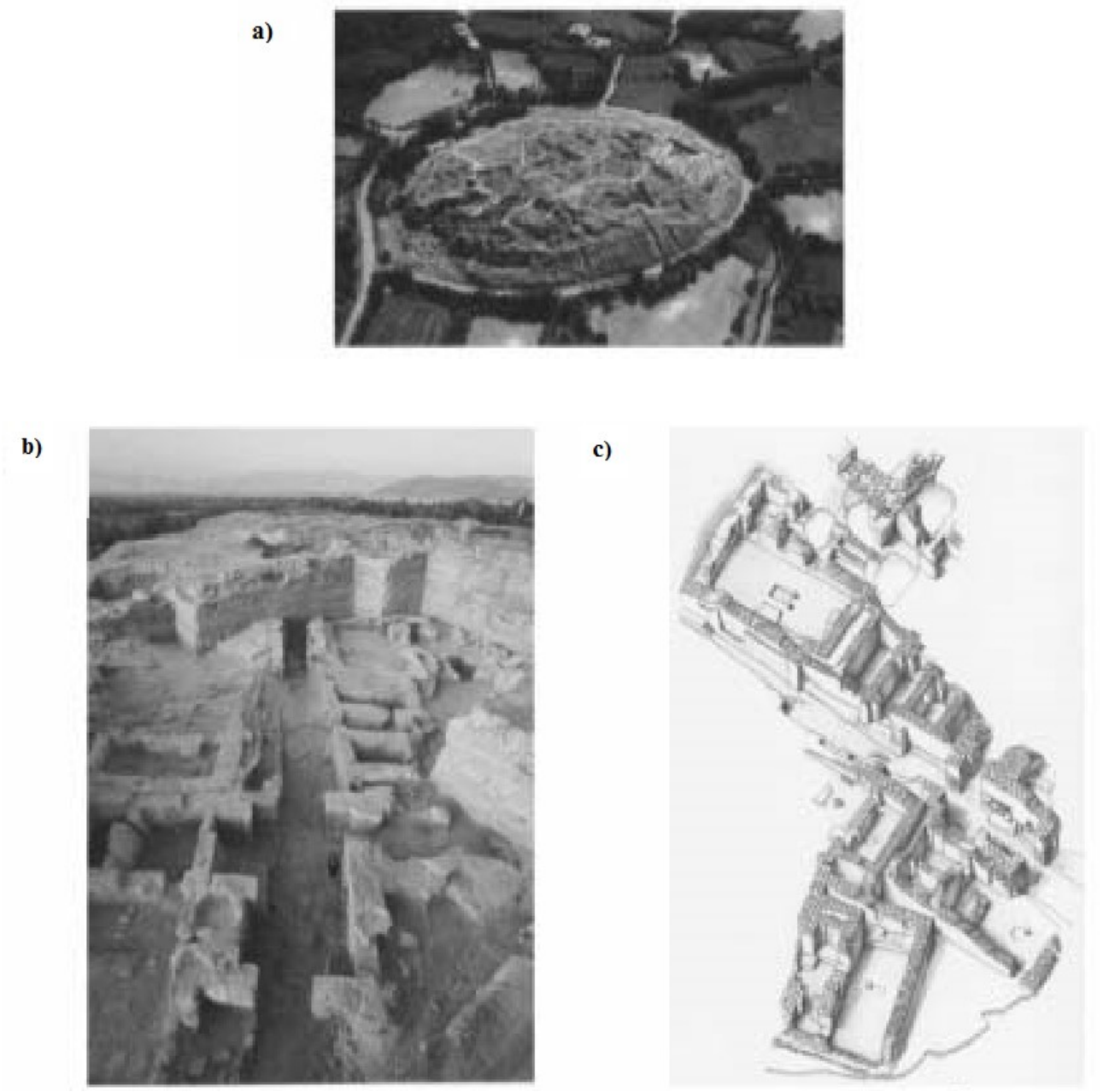

Figure 3 - Archeological site of Arslantepe, Anatolia:

a) General view of the hull of Arslantepe
b) 4th Millenium BC Imperial Palace
c) reconstruction design of the main hall of the Temple

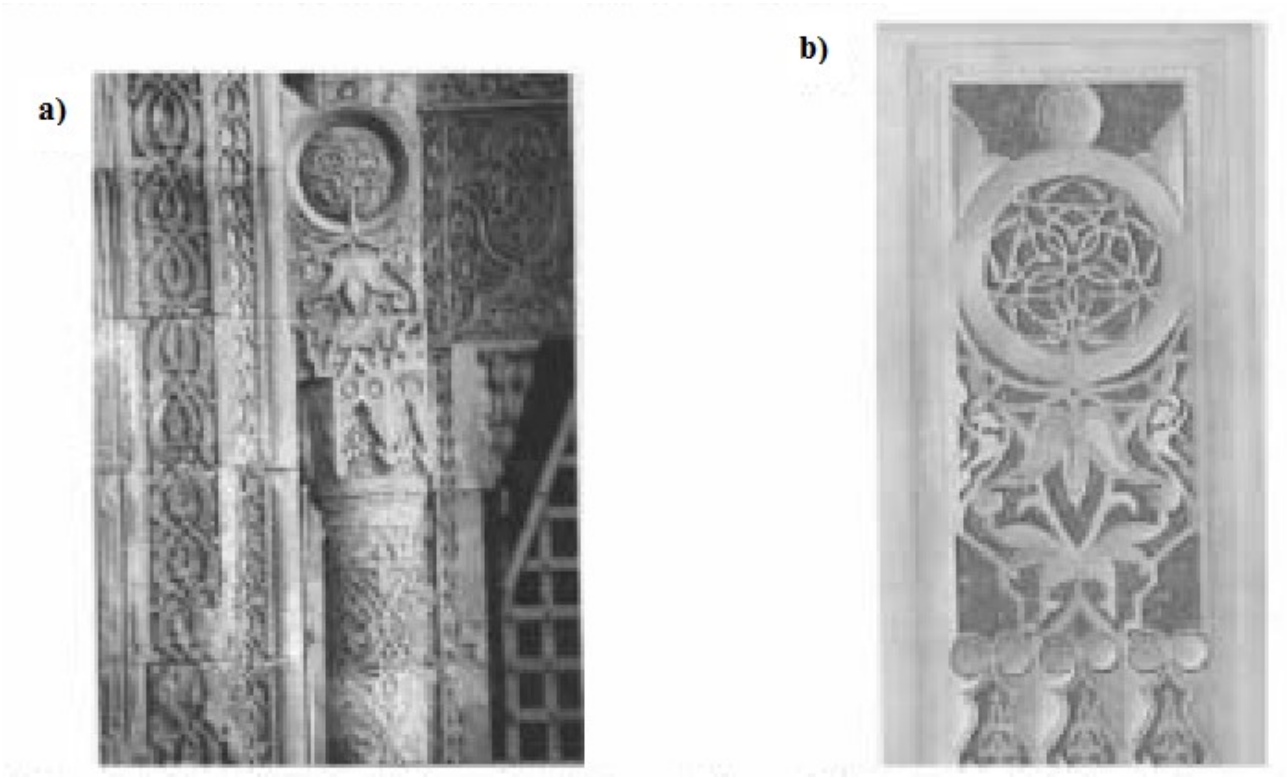

Figure 4: Divrigi Ulu Cami, Sivas, Anatolia - west door motifs a) photograph b) miniature

Conclusion

We need to acquire the ability to deal adequately with complex, dynamic-nonlinear, systems with all its subtleties in order to retreat back from the threshold of anxieties for the future of the planet and the humanity. In the field of science, especially those dealing with living systems, this may mean finding suitable methods to understand the organization of relations among parts integrated synergistically into an ever-emerging whole, also made up with similar wholes in themselves. It is peeping into the dynamic interconnections and understanding their messages, which are also dynamic in nature. While rational models fit well to simple/closed systems, they cannot deal with the subtleties of complex/open systems. What is needed are relational models. This takes us outside the sphere of rational mathematical functions to look for new mathematics of complexity with new type of functions and forms such as complex geometric patterns, which represent the systems' dynamic properties. Among them, function, purpose and pattern mesh and altogether they cooperate with matter. Our present work, also to be dynamic and nonlinear, has this goal as its objective.

The human being has lost its plasticity to re-adjust and re-generate itself. It has also lost its inherent ability for consciously experiencing and sharing both joy and pain. To regain these lost qualities it needs to re-arrange the dynamics of its inner-self by simply mimicking the nature and its grace.

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