SYNTROPY AND SUSTAINABILITY

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ABSTRACT

In the 1920s the backward-in-time solutions of the fundamental equations of the universe were rejected as non-physical, since retrocausality was considered to be impossible. Then, in 1941, the mathematician Luigi Fantappiè noticed that the properties of these solutions are: energy concentration, the increase in differentiation and complexity, the reduction of entropy, the increase in cohesion and unity, the formation of structures and the increase in order. Listing these properties he remarked that they coincide with the properties of life, which the classical (time forward) approach is unable to explain. In 1942 Fantappiè published a small book titled: "*The Unitary Theory of the Physical and Biological World*" in which he suggests that the physical/mechanical world is governed by the forward-in-time solution and by the law of entropy, whereas life is governed by the backward-in-time solution and by a law symmetric to entropy which Fantappiè named syntropy (from the Greek words *syn* = converging and *tropos* = tendency).

The entropy/syntropy theory deals with energy and states that two transformations can effect energy: a forward-in-time transformation governed by the law of entropy and a backward-in-time transformation governed by the law of syntropy. Since energy is a fixed quantity which cannot be created or destroyed, but only transformed, the total amount of energy can be represented as the sum of energy in the syntropic state (concentrated) and energy in the entropic state (dispersed):

$$Total\ Energy = Syntropic\ Energy + Entropic\ Energy$$

Furthermore, because Energy is a constant value it can be replaced with the number 1 and the equation changes into:

$$1 = Syntropy + Entropy$$

which shows that entropy and syntropy are complementary polarities of the same unity:

$$Syntropy = 1 - Entropy \qquad Entropy = 1 - Syntropy$$

Syntropy and Sustainability

Entropic energy is governed by causality (causes that precede their effects) and it is for us visible, whereas syntropic energy is governed by retrocausality (effects that precede their causes) and it is for us invisible. The existence of two complementary forces, one diverging and one converging, one visible and one invisible, would be constantly at play in living systems and in its numerous forms of organization.

Since entropy is the tendency towards death, whereas syntropy is the tendency towards life, living systems in order to sustain themselves need to minimize entropy and to maximize syntropy. When entropy is high crises are experienced. When entropy is low crises diminish and wellbeing is experienced. According to this view, sustainability follows the syntropic rules which govern the invisible plane of reality and which Jung and Pauli named synchronicities.

Keywords: Essence of life, Sustainable futures, Laws of thermodynamics, Entropy & syntropy, Visible and Invisible.

INTRODUCTION

Energy exists in many different forms: heat; kinetic, potential, nuclear, chemical, mass, and electromagnetic. However, modern science has not yet explained what energy is:

> "*It is important to realize that in physics today, we have no knowledge of what energy is… There is a fact, or if you wish, a law, governing all natural phenomena that are known to date. There is no known exception to this law–it is exact so far as we know. The law is called the conservation of energy. It states that there is a certain quantity, which we call energy, that does not change in the manifold changes which nature undergoes. That is an abstract idea, because it is a mathematical principle; it says there is a numerical quantity which does not change when something happens. It is not a description of a mechanism, or anything concrete; it is just a strange fact that we can calculate some number and when we finish watching nature go through her tricks and calculate the number again, it is the same...* " (Richard Feynman).

During the nineteenth century, the study and description of heat lead to a new discipline: thermodynamics. This discipline, which can be traced back to the works of Boyle, Boltzmann, Clausius and Carnot, studies the behavior of energy, of which heat is a form. The laws of thermodynamics are the following:

1. *The law of conservation of energy*, which states that energy cannot be created or destroyed, but only transformed.
2. *The law of entropy*, which states that energy always moves from a state of availability to a state of unavailability. When transforming energy (for example from heat to work) part is lost to the environment. Entropy is a measure of the quantity of energy which is lost to the environment. When energy lost to the environment is distributed in a uniform way, a state of equilibrium is reached and it is no longer possible to

transform energy into work. Entropy measures how close a system is to this state of equilibrium.

3. *The law of heat death*, which states that dissipated energy cannot be recaptured and used again, and that the entropy of an isolated system (which cannot receive energy from outside) can only increase until a state of equilibrium is reached (heat death).

Entropy is of great importance as it introduces in physics the idea of irreversible processes, such as that energy always moves from a state of high potential to a state of low potential, tending to a state of equilibrium. In this regard, the eminent physicist Sir Arthur Eddington (1882-1944) stated that "*entropy is the arrow of time*" in the sense that it forces physical events to move in a particular time direction: from the past to the future. Our experience continually informs us about entropy variations, and about the irreversible process that leads to the dissipation of energy: we see our friends becoming old and die; we see a fire losing intensity and turning into cold ashes; we see the world increasing in entropy, pollution, depleted energy, desertification. The term irreversibility entails a tendency from order to disorder. For example if we mix together hot and cold water we get tepid water, but we will never see the two liquids separate spontaneously.

The term "entropy" was first used in the middle of the eighteenth century by Rudolf Clausius, who was searching for a mathematical equation to describe the increase of entropy. Entropy is a quantity which is used to measure the level of evolution of a physical system, but in the meantime it can be used to measure the "disorder" of a system. Entropy is always associated with an increasing level of disorder. Nevertheless, Life defies entropy. Life becomes more complex over time, through growth and reproduction, turning more of the physical universe from disordered atoms into very highly ordered molecules. Living systems evolve towards order, towards higher forms of organization, diversification and complexity, and can keep away from heat death.

Biologists and physicists have been debating this paradox. Schrödinger, answering the question of what allows life to counter entropy, responded that:

> "*Life feeds on negative entropy. It is by avoiding the rapid decay into the inert state of 'equilibrium' that an organism appears so enigmatic; so much so, that from the earliest times of human thought some special non-physical or supernatural force (vis viva, entelechy) was claimed to be operative in the organism, and in some quarters is still claimed.*"

Schrödinger believed in a law symmetrical to that of entropy. The same conclusion was reached by Albert Szent-Györgyi (1937 Nobel Prize in Physiology and discoverer of vitamin C):

> *"It is impossible to explain the qualities of organization and order of living systems starting from the entropic laws of the macrocosm. This is one of the paradoxes of modern biology: the properties of living systems are opposed to the law of entropy that governs the macrocosm."*

The discovery of the energy-mass relation $E = mc^2$ gave strength to the three laws of thermodynamics. However, this equation, that we all associate to Albert Einstein, cannot properly be attributed to Albert Einstein, since it had been published by several other authors before, including the Englishman Oliver Heaviside in 1890 in his Electromagnetic Theory vol. 3, the Frenchman Henri Poincaré in 1900, and the Italian Olinto De Pretto in 1903 in the scientific journal "Atte" and registered at the "Regio Istituto di Scienze".

In deriving this equation, Einstein's predecessors made assumptions that led to problems when dealing with different frames of reference. Einstein succeeded where others had failed by deriving the formula in a way that was consistent in all frames of reference. He did so in 1905 with his equation for Special Relativity, which adds momentum (p) to the energy-mass ($E = mc^2$) equation:

$$E^2 = m^2c^4 + p^2c^2$$

where ***E*** is energy, ***m*** is mass, ***p*** momentum and ***c*** the constant of the speed of light

This equation is known as energy/momentum/mass, but since it is quadratic, it must always have two solutions for energy: one positive and one negative.

The positive or forward-in-time solution describes energy that diverges from a cause, for example light diverging from a light bulb or heat spreading out from a heater. But in the negative solution, the energy diverges backward-in-time from a future cause; imagine beginning with diffuse light energy that concentrates into a light bulb. This, quite understandably, was considered an unacceptable solution since it implies retrocausality, which means that an effect occurs before its cause. Einstein solved this problem by assuming that the momentum is always equal to zero; he could do this because the speed of physical bodies is extremely small when compared to the speed of light. And so, in this way, Einstein's complex energy/momentum/mass equation simplified into the now famous $E = mc^2$ equation, which always has positive solution.

But in 1925 Wolfgang Pauli (Austrian physicist, Nobel Prize 1935) discovered that electrons have a spin which nears the speed of light. Soon after the Swedish physicists Oskar Klein and the German physicist Walter Gordon proposed the Klein-Gordon equation in order to describe quantum particles in the framework of Einstein's relativity. This equation uses the full energy/momentum/mass equation of Special Relativity and yields two solutions: a forward-in-time and a backward-in-time solution. But since the negative time solution was considered unacceptable, it too was rejected. Werner Heisenberg (German physicist, Nobel Prize 1932) wrote to Wolfgang Pauli: "*I regard the backward in time solution ... as learned trash which no one can take seriously*" and in 1926 Erwin Schrödinger (Austrian physicist, Nobel Prize 1933) removed Einstein's equation from the Klein-Gordon equation and suggested that time be treated in essentially the classical way, as only moving forward. But whereas the Klein-Gordon equation could explain the dual nature of matter (particle/wave) as a consequence of the dual causality (forward and backward-in-time causality), Schrödinger's equation was not able to explain the wave/particle nature of matter.

While working on the properties of the equations that combine Quantum Mechanics with Special Relativity, the mathematician Luigi Fantappiè (a full professor at the age of 27 and one of the foremost mathematicians of the last century) realized that the forward-in-time solution describes energy and matter that tend towards a homogeneous and random distribution; this is the law of entropy, which is also known as heat death. Fantappiè showed that whereas the forward-in-time solution is governed by the law of entropy, the backward-in-time solution is governed by a symmetric law that Fantappiè named syntropy (from the Greek words *syn* = converging and *tropos* = tendency). The forward-in-time solution describes energy that diverges from a cause, and requires that causes be in the past and the backward-in-time solution describes energy that converges towards an attractor, a future cause. The mathematical properties of syntropy are energy concentration, an increase in differentiation and complexity, a reduction of entropy, the formation of structures, and an increase in order. These are also the main properties that biologists observe in life and which cannot be explained in the classical (time forward) way. This realization led Fantappiè to formulate "*The Unitary Theory of the Physical and Biological World*", first published in 1942, where he suggests that the cause of *life is in the future*.

In order to better understand the implications of the law of syntropy it is important to note the three types of time which the fundamental equations predict:

1. *Causal time*, is expected in diverging systems, such as our expanding universe, and it is governed by the properties of the forward-in-time solution of the equations. In diverging systems entropy prevails, causes always precede effects and time move forwards, from the past to the future. Since entropy prevails, no advanced effects are possible, such as light waves moving backwards-in-time or radio signals being received before they are broadcasted.
2. *Retrocausal time*, is expected in converging systems, such as black-holes, and it is governed by the properties of the backward-in-time solution of the equations. In converging systems retrocausality prevails, effects always precede causes and time moves backwards, from the future to the past. In these systems no retarded effects are possible and this is the reason why no light is emitted by black-holes.
3. *Supercausal time* would characterize systems in which diverging and converging forces are balanced. An example is offered by atoms and quantum mechanics. In these systems causality and retrocausality coexist and time is unitary: past, present and future coexist.

According to this classification of time, syntropy and entropy coexist at the quantum level of matter, i.e. the Supercausal level, and at this level life can originate. This statement is now supported by the fact that the functioning of living systems is heavily influenced by quantum events: the length and strength of hydrogen bonds, the transmission of electrical signals in the microtubules, the action of DNA, the folding of proteins.

A question naturally arises: how do the properties of syntropy arise from the quantum level of matter to the macroscopic level which is governed by the law of entropy, transforming inorganic matter into organic matter? In 1925 the physicist Wolfgang Pauli discovered in water molecules the hydrogen bridge (or hydrogen bonding). Hydrogen atoms in water molecules share an intermediate position between the sub-atomic level (quantum) and the molecular level (macrocosm), and provide a bridge that allows syntropy (cohesive forces) to flow from the quantum level to the macroscopic level. The hydrogen bridge makes water different from all other liquids, increasing its cohesive forces (syntropy), with attractive forces ten times more powerful than the van der Waals forces that hold together other liquids and with behaviors that are in fact symmetrical to those of other liquid molecules.

For example:

- When water freezes it expands and becomes less dense. Other liquid's molecules, when they are cooled concentrate, solidify, become more dense and heavy and sink. With water exactly the opposite is observed.
- In liquids the process of solidification starts from the bottom, since hot molecules move towards the top, whereas cold molecules move towards the bottom. The liquid in the lower part is therefore the first which reaches the solidification temperature; for this reason liquids solidify starting from the bottom. In the case of water exactly the opposite happens: water solidifies starting from the top.
- Water shows a heat capacity by far greater than other liquids. Water can absorb large quantities of heat, which is then released slowly. The quantity of heat which is necessary to change the temperature of water is by far greater than what it is needed for other liquids.
- When compressed cold water becomes more fluid; in other liquids, viscosity increases with pressure.
- Friction among surfaces of solids is usually high, whereas with ice friction is low and ice surfaces result to be slippery.
- At near to freezing temperatures the surfaces of ice adhere when they come into contact. This mechanism allows snow to compact in snow balls, whereas it is impossible to produce balls of flour, sugar or other solid materials, if no water is used.
- Compared to other liquids, in water the distance between melting and boiling temperatures is very high. Water molecules have high cohesive properties which increase the temperature which is needed to change water from liquid to gas.

Water is not the only molecule with hydrogen bonds. Also ammonia and fluoride acid form hydrogen bonds and these molecules show anomalous properties similar to water. However, water produces a higher number of hydrogen bonds and this determines the high cohesive properties of water which link molecules in wide dynamic labyrinths. Other molecules that form hydrogen bonds do not reach the point of being able to build networks and broad structures in space. Hydrogen bonds impose structural constraints extremely unusual for a liquid. One example of these structural constraints is provided by crystals of snow. However, when water freezes the hydrogen bonds mechanism stops and also the flow of syntropy between micro and the macrocosm stops, bringing life to death. Hydrogen bonds make water essential for life: water is ultimately the lymph of life which provides living systems with syntropy. If life were ever to start on another planet, it would certainly require water.

Following these premises thermodynamics should be reformulated according to the following laws:

1. *Law of Energy Conservation*: energy can neither be created nor destroyed, but can only be transformed.

2. *Law of Entropy*: in an expanding universe energy is constantly released in the environment. Entropy is the magnitude by which we measure the amount of energy that is released into the environment.
   a) The increase of entropy is irreversible.
   b) Time flows forward.
   c) The system tends towards a state of thermodynamic death.

3. *Law of Syntropy:* in a converging universe energy is constantly absorbed from the environment. Syntropy is the magnitude by which we measure the concentration of energy.
   a) The increase of syntropy is irreversible.
   b) Time flows backward.
   c) The system tends towards a state of thermodynamic potentiality.

4. *Law of Supercausality:* in a system balanced between diverging and converging forces energy is constantly transformed.
   a) Differentiation and complexity increase.
   b) Time is unitary.
   c) Processes can be reversed.

According to the entropy/syntropy theory life follows the Law of Supercausality.

SUPERCAUSALITY AND COMPLEMENTARITY

Since energy is a fixed quantity which cannot be created or destroyed, but only transformed, the total amount of energy can be expressed as the sum of energy in the syntropic state (concentrated) and energy in the entropic state (dispersed):

$$\textit{Total Energy} = \textit{Syntropic Energy} + \textit{Entropic Energy}$$

Furthermore, because *Energy* is a constant value it can be replaced with the number 1 and the equation changes into:

$$1 = \textit{Syntropy} + \textit{Entropy}$$

which shows that entropy and syntropy are complementary polarities of the same unity:

$$\textit{Syntropy} = 1 - \textit{Entropy}$$

$$\textit{Entropy} = 1 - \textit{Syntropy}$$

In "*Syntropy: definition and use*" Mario Ludovico states that: "*I deem it impossible to grasp the concept of syntropy without having assimilated the concept of entropy, since not* *only are the two concepts in a strict mutual connection but entropy and syntropy are also complementary concepts. In other words, where it is possible to measure a level of entropy there is a complementary level of syntropy*."

The entropy/syntropy theory states that forward-in-time causality is visible, since we can see its causes, whereas backward-in-time causality is invisible, since we cannot see future causes. This would be the reason why we experience forces and entities that we cannot observe directly but which exist objectively, independently of any human perception. One such force is gravity. Let us look at a very simple example. Suppose we hold a small object like a pencil between our thumb and forefinger and then release it. We observe that it falls to the floor and we say that the force of gravity causes it to fall. But, do we actually see any downward force acting upon the pencil, something pulling or pushing it? Clearly not. We do not observe the force of gravity at all. Rather we deduce the existence of some unseen force (called gravity) acting upon unsupported objects in order to explain their otherwise inexplicable downward movement. According to the energy/momentum/mass equation half of the forces acting in the universe are entropic (diverging) and visible and half are syntropic (converging) and invisible. Furthermore, nothing takes place without the interplay of both these forces: visible and invisible. We constantly experience observable effects that have unobservable causes, behaviors that cannot be explained observably and phenomena in the visible reality that arise from the invisible reality.

The description of two complementary forces, one diverging and one converging, one visible and one invisible, one destructive and one constructive, can be found in many philosophies and religions:

In the *Taoist philosophy* all aspects of the universe are described as the interplay of two complementary and fundamental forces that constantly interact between themselves: the *yang* principle which is diverging, and the *yin* principle which is converging. These two forces are part of a unity. In the visible side of reality, when one increases the other decreases, but as a whole their balance remains unchanged. This law is masterfully represented in the Taijitu symbol, that is the union of these opposite forces, the yin and the yang, the diverging and converging forces whose combined action moves the universe in all its aspects: the sexes, seasons, day and night, life and death, full and empty, movement and repose, push and pull, dry and wet, etc.

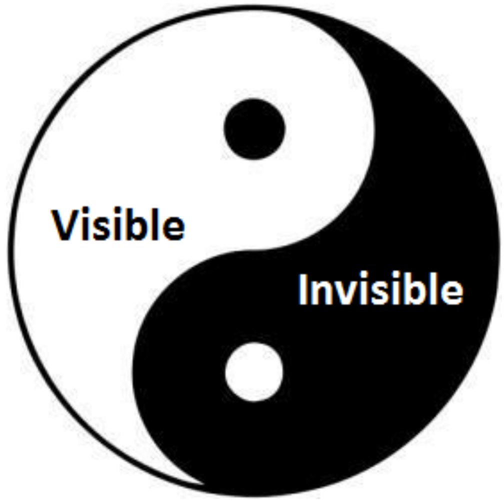

Figure 1 – Taijitu symbol: black is yin and has syntropic properties, whereas white is yang and has entropic properties.

In the Taijitu the yang principle is represented by the white color and coincides with the law of entropy, whereas the yin principle is represented by the black color and coincides with the law of syntropy. The Taijitu is a wheel that rotates constantly, changing the proportion of yin and yang (syntropy and entropy) in the visible and the invisible sides of reality. The Taijitu shows that a property of the law of complementarity is that *opposites attract each other*. This law is well known in physics, but it is also true at the human level where people on opposite polarities are attracted to each other. Since the balance of these opposite forces remains unchanged the Taoist philosophy suggests that *the aim is to harmonize the opposites*, thus creating unity.

In *Hinduism* the law of complementarity is described by the dance of Shiva and Shakti, where Shakti is the personification of the female principle and Shiva of the male principle. They represent the primordial cosmic energy and the dynamic forces that are thought to move through the entire universe. Shiva has the properties of the law of syntropy, whereas Shakti has the properties of the law of entropy and they are constantly combined together in an endless cosmic dance.

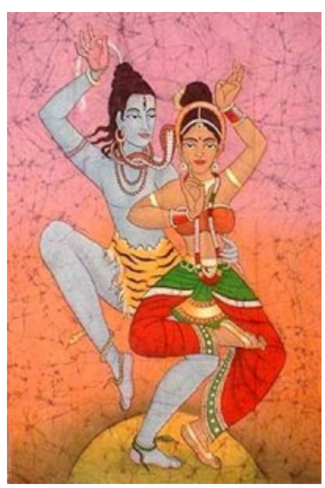

Figure 5 - Endless cosmic dance between Shiva and Shakti

Shakti can never exist apart from Shiva or act independently of him, just as Shiva remains a mere corpse without Shakti. All the matter and energy of the universe results from the dance of the two opposite forces of Shiva and Shakti. Shiva absorbs Shakti (energy) turning it into a body and absolute pure consciousness, the light of knowledge. According to Hinduism knowledge, intelligence and consciousness would come from the future (Shiva), whereas fearsome, ferocity and aggressiveness would come from the past (Shakti). Shakti is the energy of the physical and visible world whereas Shiva is the consciousness which transcends the visible world. However, each aspect of Shiva has a Shakti component, linked to the physical world. The evolution of this endless dance between Shakti and Shiva has the function to bring life towards Unity.

In the psychological literature of the 20th century *Carl Gustav Jung* used to add synchronicities (i.e. syntropy) to causality (i.e. entropy). According to Jung, *synchronicities* are the experience of two or more events that are apparently causally unrelated or unlikely to occur together by chance, yet they are experienced as occurring together in a meaningful manner. The concept of synchronicity was first described in this terminology by Carl Gustav Jung in the 1920s. The concept does not question, or compete with, the notion of causality. Instead, it maintains that just as events may be grouped by causes, they may also be grouped by finalities, a meaningful principle. Jung coined the word synchronicities to describe what he called "*temporally coincident occurrences of acausal events*." He variously described synchronicity as an "*acausal connecting principle*", "*meaningful coincidence*" and "*acausal parallelism.*" Jung gave a full statement of this concept in 1951 when he published the paper *Synchronicity - An Acausal Connecting Principle*, jointly with a related study by the physicist Wolfgang Pauli. In Jung's and Pauli's description causality acts from the past, whereas synchronicity from the future. Synchronicities would be meaningful since they lead towards a finality, providing in this way a direction to events correlated in an apparently acausal ways. Jung and Pauli believed that causality and synchronicity both act on the same indestructible energy. They are united by this energy, but at the same time they are complementary.

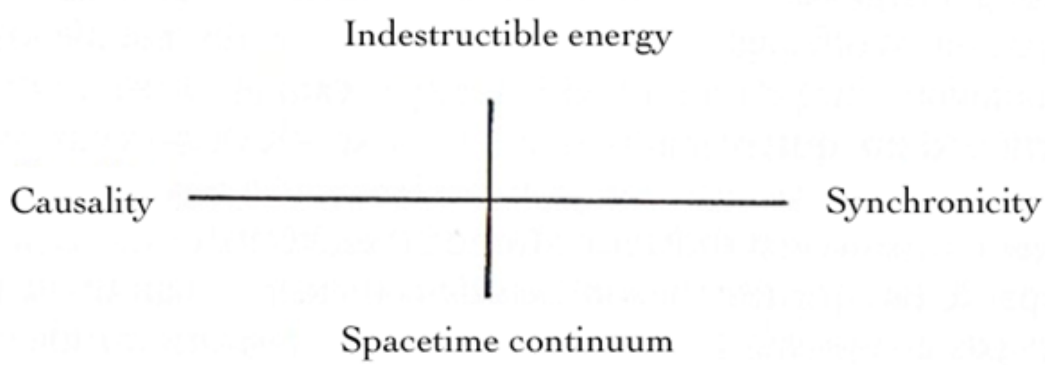

Figure 3 - Jung and Pauli representation of causality and synchronicity

In the entropy/syntropy theory the principle of complementarity can be described also using a see-saw with entropy and syntropy playing at the opposite sides. This representation shows that when entropy goes down syntropy rises and when entropy rises syntropy goes down.

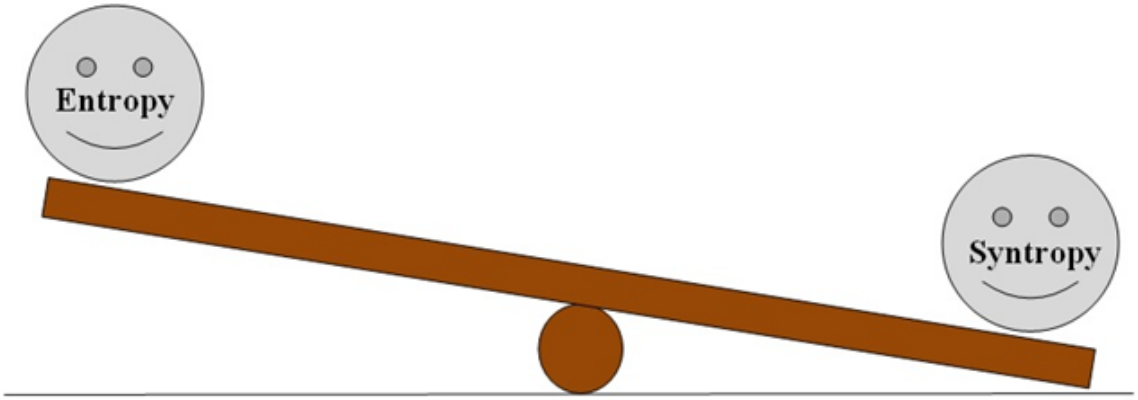

Figure 4 - Entropy and Syntropy constantly playing, transforming energy

The see-saw mechanism is well represented in metabolism. Where ***Entropy*** corresponds to ***Catabolic*** processes which transform higher level structures into lower level structures, with the release of energy in the form of chemical energy (ATP) and thermal energy and ***Syntropy*** corresponds to ***Anabolic*** processes which transform simple structures into complex structures, for example nutritive elements into bio-molecules, with the absorption of energy.

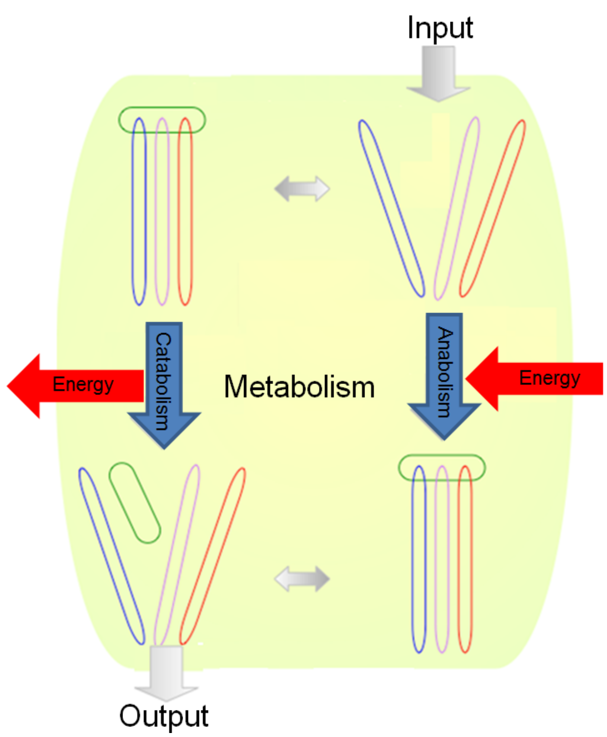

Figure 5 – Schematic representation of Metabolism.

Syntropy concentrates energy in ever smaller spaces increasing order and organization, but since the concentration of energy cannot increase indefinitely, at some point, the system releases energy and matter, thus activating the opposite process of entropy and an exchange of energy and matter with the environment. Exchange is a fundamental property of life and can be found in all its levels of organization, from the organic/biological level to economics. On one side syntropy concentrates energy, on the other side entropy disperses energy. This continuous interplay between entropy and syntropy produces peaks of entropy and peaks of syntropy.

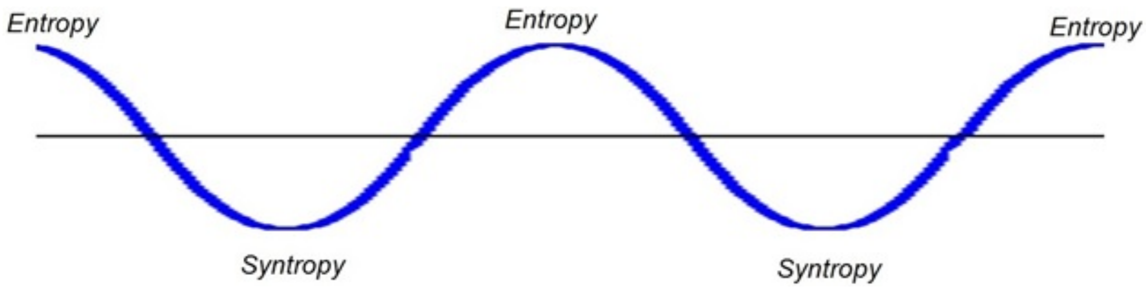

Figure 6 – Entropy and Syntropy cycles.

The entropy/syntropy theory maintains that any system physical, living or organization vibrates between peaks of entropy and syntropy acquiring in time specific resonances. This theory also suggests a continuous interplay between the visible reality of entropy and the invisible reality of syntropy, since by reducing entropy we inevitably increase the invisible properties of syntropy (i.e. Jung's synchronicities) and vice versa.

THE VITAL NEEDS THEORY

According to the entropy/syntropy theory, life stems from the quantum world where time is unitary and syntropy and entropy play together. However when life enters the macroscopic level, which follows forward-in-time causality, it starts conflicting with entropy, which tends to destroy any form of order and organization. The contrast between life (syntropy) and entropy has been described by several authors. Albert Szent-Gyorgyi (Nobel Prize in Physiology and discoverer of vitamin C) stated that:

> *"A major difference between amoebas and humans is the increase of complexity that requires the existence of a mechanism that is able to counteract the law of entropy. In other words, there must be a force that is able to counter the universal tendency of matter towards chaos and of energy towards dissipation. Life always shows a decrease in entropy and an increase in complexity, in direct conflict with the law of entropy."*

While entropy is a universal law that leads to the disintegration of any form of organization, Szent-Gyorgyi stated that a symmetrical law must exist as a universal law.

For Gyorgyi this symmetrical law to entropy leads living systems towards more complex and harmonious forms of organization. The main problem, according to Gyorgyi, is that:

> *"We see a profound difference between organic and inorganic systems ... as a scientist I cannot believe that the laws of physics become invalid as soon as we enter living systems. The law of entropy does not govern living systems."*

The biologist Jacques Monod (1910-1976) uses the following words in order to describe the vision of life that emerges when we take into account only the tendency of entropy towards disorder, disorganization and death:

> *"Man must at last finally awake from his millenary dream; and in doing so, awake to his total solitude, to his fundamental isolation. Now does he at last realize that, like a gypsy, he lives on the boundary of an alien world deaf to his music, indifferent to his hopes, his sufferings, his crimes."* (Monod, 1971)

Entropic Science, based only on forward-in-time causation, has brought to a vision of the universe in which life is a highly improbable episode, which does not stem from the laws of the universe. In contrast, the entropy/syntropy approach explains life as the manifestation of physical laws which arise from the backward-in-time solutions of the fundamental equations of the universe. But, in order to survive, life must continuously reduce entropy and increase syntropy. This is one of the fundamental laws of life, which implies a series of conditions that must constantly be met in order to survive. From these conditions stems the theory of vital needs which can be grouped in three main categories of needs: material needs, which are visible, and needs for cohesion and meaning, which are invisible.

Material needs: combating the dissipative effects of entropy.

In order to combat the dissipative effects of entropy, living systems must acquire energy from the outside world, protect themselves from the dissipative effects of entropy and eliminate the remnants of the destruction of structures by entropy. These conditions are generally referred to as material needs, or basic needs, and include:

- acquiring energy from the outside world through food and reducing the dissipation of energy with a shelter (a house), and clothing;
- disposing of the production of wastes caused by the law of entropy, i.e. hygiene and sanitation.

The partial satisfaction of these needs is signaled by hunger, thirst and diseases. The total dissatisfaction of these needs leads to death.

Material needs are "visible".

The need for cohesion and love

The satisfaction of material needs does not stop entropy from destroying the structures of living systems. For example, cells die and must be replaced. To repair the damages caused by entropy, living systems must draw on the regenerative properties of syntropy that allow to create order, regenerate structures and increase the levels of organization. They must, therefore, acquire syntropy. Vannini and Di Corpo's experiments on retrocausality show that this function is performed by the autonomic nervous system that supports the vital functions, such as the heart beat and digestion.

Since syntropy acts as an absorber and concentrator of energy:

- the acquisition of syntropy is felt as sensations of warmth associated with feelings of wellbeing, in the area where the autonomic nervous system is located (heart/lungs/thorax). These feelings of warmth and wellbeing coincide with the experiences usually named *happiness and love*;
- the lack of syntropy is felt as a sensation of void and emptiness in the thorax area associated with feelings of discomfort and distress. These feelings coincide with the experience usually named *anxiety and anguish* and may come with symptoms of the autonomic nervous system such as nausea, dizziness and feelings of suffocation.

Consequently, the need to acquire syntropy is experienced as need for love and cohesion. When this need is not satisfied, feelings of emptiness, chill and pain, usually named anxiety and anguish, are felt in the thorax area. When this need is totally dissatisfied living systems are not capable of feeding the regenerative processes and entropy takes over, leading the system to death.

The need for cohesion and love is an "invisible" need.

The need for meaning: solving the conflict between entropy and syntropy.

In order to meet material needs, living systems have developed cortical structures that show the highest development in humans. These cortical systems produce representations of the world that allow to deal with the environment, but give rise to the paradox of the opposition between entropy and syntropy. Entropy has expanded the universe towards the infinite (diverging forces), whereas syntropy concentrates life, the feeling of life, in extremely limited spaces. Consequently, when we compare ourselves with the infinity of the universe, we discover to be equal to zero. On one side we feel we exist, on the other side we are aware to be equal to zero. These two opposite considerations generate the identity conflict which was described by Shakespeare with the words: *to be, or not to be: that is the question*. The identity conflict can be represented using the following equation.

$$\textit{Identity conflict:} \quad \frac{I}{Universe} = 0$$

Figure 7 - When confronted to the universe I am equal to nothing, zero

To be equal to zero is equivalent to death, which is incompatible with our feelings of being alive. We must therefore solve the conflict between "*to be or not to be*" which is felt as the need to give a meaning to our life. The strategies implemented to meet this need may differ. For example, we might try to increase our value through wealth, power, achievement, judgment of others or we might try to find a meaning in life, a purpose, through ideologies and religions.

The identity conflict is characterized by feelings of nothingness and of being meaninglessness, by lack of energy, existential crises and depression. These feelings generally come together with anxiety and anguish.

From a mathematical point of view, the identity conflict can be solved in the following way:

$$\text{Theorem of love:} \quad \frac{I \; x \; Universe}{Universe} = I$$

Figure 8 - When I unite with the universe, compared with the universe, I am always I

A fraction can be simplified when the numerator and denominator have common factors. In the case of the theorem of love the common factor is "Universe" and removing it the equation becomes:

$$I = I$$

The multiplication "x" corresponds to the cohesive properties of syntropy, that is converging forces and cohesion. The theorem of love shows that when we unite ourselves with the outside world through love, the identity conflict (I = 0) between being and non-being vanishes and turns into a confirmation of the identity (I = I). In other words, it shows that we find our identity in unity and that love solves the conflict between entropy and syntropy providing meaning to existence.

ENTROPY, SYNTROPY AND SUSTAINABILITY

The entropy/syntropy theory suggests that a system, in order to be sustainable, needs to take into account also the invisible needs. This statement leads towards solutions and forms of organization which at first might seem counterintuitive. In this paragraph we provide an example taken from the provision of health care services to DMD patients,

Approximately 1% of the population is affected by neuromuscular diseases and the most common forms are Duchenne and Becker muscular dystrophy. Duchenne muscular dystrophy (DMD) is usually diagnosed in the third year of life and half of patients show signs of this disease before starting to walk. The first signs are the delay to walk and how easily these children fall. Muscles are usually hypotonic and flaccid and during the progression of the disease contractions due to the reduced muscle mass are observed. Gradually all the muscle mass disappears and the death occurs between 20 and 30 years of age because of respiratory or heart failure. Since this is a genetic disease, that has its origins in a defect of the X chromosome, the disease primarily affects males.

European countries provide health care to DMD patients following direct or indirect spending policies. In indirect spending the Government provides money to the local health authorities which in turn fund local health care systems, which pay hospitals, clinics, associations and health facilities that provide services to DMD patients. This process is controlled and optimized thanks to cost-benefit analyses which focus on the costs of services and use quantitative and objective indicators. In countries which have opted for direct spending the DMD patient chooses how to spend the allocated money. The direct spending model shifts the evaluation processes from what is visible and objective to what is invisible and subjective which can be assessed only by the patient.

Classical logic suggests that the direct system would be more expensive and less effective and efficient, thereby increasing the costs of the welfare system and the dissatisfaction of the patient.

But when we compare the two systems we discover exactly the opposite. Why? If we consider a per capita monthly expenditure of 10 thousand Euros for each DMD patient, in countries that follow the direct spending approach this amount of money is given directly to DMD patients who usually uses it to employ 6 care givers at full time. On the contrary in countries that follow the indirect spending approach, these funds are lost in the various steps through which money flows from the central to the peripheral level. The DMD patient receives, at the end, minimal assistance, poorly motivated and often not well trained staff.

The paradox is this: indirect spending systems are considered to be more scientific since they are based on cost-benefit analyses, objective data and highly scientific medical research, but life conditions for DMD patients are often dreadful and life expectancy still remains between 20 and 30 years of age. In contrast, in direct spending systems, which focus primarily on qualitative and social aspects, which are generally not considered scientific, DMD patients live a good quality life, receive high-standard care and the life expectancy is about 10 years longer. The paradox is that highly scientific spending systems lead to ineffective and costly policies, whereas the non-scientific direct spending system results in effective and efficient policies that generate wellbeing, distributed wealth and sustainable practices.

Why? Mainly because direct spending takes into account what is invisible to the highly scientific approach. In direct systems end users produce the assessment and choose according to their material and immaterial needs. End users are capable of integrating what is visible and what is invisible and to perform assessments that cost-benefit analyses cannot do.

Direct spending has also several other advantages:

- Since the end user is buying services on the free market, competition is promoted between different providers of services.
- Competition creates a market for training schools and high quality services.
- Taxation applied to this market allows to recover almost all the public money which was spent. So, at no cost, direct spending creates a virtuous cycle that generates distributed wealth, well-being and high quality services.
- Direct spending does not only replace cost-benefit analyses, but it becomes a way to guarantee high quality standards, increase job opportunities, training and reduce the costs of the health and welfare system.
- In direct spending systems all the steps from the central to the local level are missing and immaterial needs are taken into account, contributing in this way to a sharp reduction of costs and of the inner states of suffering, such as depression and anxiety.

In Western countries public spending rose from 12% of GDP (Gross Domestic Product) in 1913 to 24% in 1937, 40% in 1980 and it now exceeds 50% of GDP. Between 1960 and 2008 the increase was annually of 4.9% compared to an average growth of GDP of 2.1%. The steady increase in public debt and the steady increase in individual and social suffering and dissatisfaction are indicators of the crisis in which Western societies are moving in. According to the entropy/syntropy theory the causes of this crisis can be traced back to the fact that policy makers consider only the visible/objective needs.

FINAL CONSIDERATIONS

On 23 January 2012 George Soros, in a noteworthy Newsweek article, stated that "*The situation is about as serious and difficult as I've experienced in my career… the world faces one of the most dangerous periods of modern history, a period of evil.*" Soros forecast is that the global economic system could collapse altogether: "*the international financial crisis and the risk of default of public debts are unprecedented.*" Elido Fazi in a book titled "*The Third World War?*" published in February 2012 states that: "*the third world war is now only financial, but it could soon be a real war, the most destructive of all, a war that would dwarf the conflicts of the twentieth century, which also were the most violent since the beginning of history*." On 28 January 2012, in Davos, in a riveting address, Hong Kong's leader Donald Tsang recalled his place at the epicenter of the Asian financial crisis in the late 1990s, and the experience of the 2008 global credit pullback, asserting that the current situation is worse: "*I've never been as scared as now about the World and what is happening in Europe*", he said. Faced with this scenario, economists and politicians seem to have no real answers and are trying to postpone the deflagration of the financial system.

The entropy/syntropy theory suggests that a way out exists. This way out requires the shift from the mechanistic cause and effect paradigm, which considers only the visible components of a system, to the supercausal paradigm which considers also the invisible components.

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