The New Thermodynamics and Life Energy

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Abstract

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 entropy is a law. Nevertheless, life seems to contradict the law of entropy: living systems evolve towards order, towards higher forms of organization, diversification and complexity, and can keep away from heat death. In 1905 the dual solution of the energy/momentum/mass equation of Einstein's Special Relativity offered a solution to the paradox of life, but it requires the extension of thermodynamics to a new law.

Introduction

Modern science has not yet explained what energy is. Richard Feynman, Nobel Prize for physics in 1965, said:

> "*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*

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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... "

Energy exists in many different forms, and it is measured with many different units. Some of the different forms are: heat; kinetic, potential, nuclear, chemical, mass, and electromagnetic. 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 study of the transformations of heat into work lead to the discovery of three laws:

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, in which it has been dissipated in the environment. 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 the dissipation of energy is an irreversible process, since dissipated energy cannot be recaptured and used again, and that the entropy of an isolated system (which cannot receive energy or information from outside) can only increase until a state of equilibrium is reached (heat death). This law implies that it is not possible to reach absolute zero (-273,15° Celsius) since when transforming energy a part is always lost to the environment.

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 a situation of high potentials to one of low potentials, 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 and heat death: 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, the law of entropy seems to be contradicted by life: 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 the paradox of life:

- Schrödinger (1933 Nobel Prize for physics), answering the question of what allows life to counter entropy, responded that life feeds on negative entropy. In this way Schrödinger stated the need for a tendency 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."

  Gyorgyi suggested the existence of a law symmetric to entropy:

  "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 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 dissolution of any form of organization, life demonstrates the existence of another law. 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 you enter the living systems. The law of entropy does not govern living systems."

The dual time solution of the fundamental equations

In 1905 Albert Einstein solved the paradox of the constant speed of light with his Special Relativity. However few people are aware that $E = mc^2$ is actually a simplification of a more complex equation that was considered unacceptable at the time. The famous $E = mc^2$ commonly associated with Albert Einstein was actually derived by several others before, including the Englishman Oliver Heaviside in 1890, the Frenchman Henri Poincaré in 1900, and the Italian Olinto De Pretto in 1903. But in deriving the 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 to the energy/mass equation:

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

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

But since this equation is quadratic, it must always have two solutions: 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 quantum mechanics this simplification is not possible, since the spin of particles nears the speed of light; therefore the full energy/momentum/mass equation is required. In 1925 the physicists Oskar Klein and Walter Gordon formulated the first equation that combined quantum mechanics with Einstein's special relativity. But since the negative time solution was considered unacceptable, it too was rejected. Werner Heisenberg, one of the most influential physicists of the 20th century, wrote to Wolfgang Pauli: "*I regard the backward in time solution ... as learned trash which no one can take seriously.*" In 1926 Erwin Schrödinger removed Einstein's equation from Klein-Gordon's 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. Consequently, Bohr and Heisenberg met in Copenhagen and suggested an interpretation of quantum mechanics in which matter propagates as waves that collapse into particles when observed. This interpretation, in which the act of observation creates reality, was well accepted by the Nazi establishment of the time since it supported the idea that men are endowed with God-like powers of creation. Einstein's formula was rejected because he was a Jew and because it was felt that Jewish science undermined the power of the Third Reich. But when Schrödinger discovered how Heisenberg and Bohr had used his equation with its ideological implications, he commented: "*I do not like it, and I am sorry I ever had anything to do with it.*"

Life is caused by the future

In 1941 the mathematician Luigi Fantappiè (1901-1956), while working on the properties of the equations that combine quantum mechanics with special relativity, realized that the forward-in-time solution describes energy and matter that tends towards a homogeneous and random distribution. When heat radiates from a heater, it tends to spread out homogeneously in the environment; 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 (from the Greek *en* = diverging, *tropos* = tendency), the backward-in-time solution is governed by a symmetric law that Fantappiè named syntropy (from the Greek *syn* = converging, *tropos* = tendency). The forward-in-time solution describes energy that diverges from a cause, and requires that causes be in the past. But the backward-in-time solution looks—to us moving forward in time—like the energy is concentrating, rather than dissipating. 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 and information. 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 suggest in *The Unitary Theory of the Physical and Biological World*, published in 1942, that *life is caused by the future.*

A full professor at the age of 27 and one of the foremost mathematicians of the last century, Fantappiè was invited by Oppenheimer to become a member of the Institute of Advance Study, but he failed to devise experiments that could test his retrocausal hypothesis. Then in 2007 Antonella Vannini formulated the following testable hypothesis: "*if life is sustained by syntropy, the parameters of the autonomic nervous systems that supports vital functions should react in advance to stimuli.*" And indeed an impressive number of studies have now shown that the autonomic nervous system (as measured by skin conductance and heart rate) can react *before* a stimuli is shown. The first experimental study of this kind was conducted by Dean Radin and monitored heart rate, skin conductance, and fingertip blood volume in subjects who were shown a blank screen for five seconds followed by a randomly selected calm or emotional picture for three seconds. Radin found significant differences in the autonomic parameters *preceding* the exposure to emotional pictures versus the calm pictures. A review of the experiments and the description of four experiments conducted by the authors can be found in "*Retrocausality: experiments and theory*" (Vannini and Di Corpo, 2011).

The new thermodynamics

The negative solution of the energy/momentum/mass equation of Einstein's Special Relativity provides the description of a new law, symmetrical to entropy. But, since this law implies retrocausality it was rejected. When this new law is accepted thermodynamics needs to be reformulated in the following way:

1. *Principle of Energy Conservation*: energy can neither be created nor destroyed, but can only be transformed.
2. *Law of Entropy*: in diverging systems (such as our expanding universe) in each transformation of energy a part of energy is released in the environment. Entropy is the magnitude by which we measure the amount of energy that is released into the environment.
    a. *Principle of death*: in diverging systems entropy is irreversible and time flows forward (Eddington's arrow of time).
3. *Law of Syntropy* (from Greek *syn*=converging, *tropos*= tendency): in converging systems energy is absorbed and concentrated leading to the increase in differentiation and complexity. Syntropy is the magnitude by which we measure the concentration of energy, differentiation and complexity.
    a. *Principle of life*: in converging systems entropy is reversible and time flows backward.

A new perspective on time and life

In order to better understand the implications of the new thermodynamics it is important to note the three typologies of time which the fundamental equations of the universe predict:

1. *Causal time*, is expected in diverging systems, such as our expanding universe, and it is governed by the properties of the positive solution of the equations. In diverging systems entropy prevails, causes always precede effects and time moves 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 negative 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 would coexist and time would be unitary: past, present and future would coexist.

This classification of time recalls the ancient Greek division in: *Kronos*, *Kairos* and *Aion*.

1. *Kronos* describes the sequential causal time, which is familiar to us, made of absolute moments which flow from the past to the future.
2. *Kairos* describes the retrocausal time. According to Pitagora *kairos* is at the basis of intuition, the ability to feel the future and to choose the most advantageous options.
3. *Aion* describes the supercausal time, in which past, present and future coexist. The time of quantum mechanics, of the sub-atomic world.

According to this classification of time, syntropy and entropy coexist at the quantum level of matter, i.e. the Aion level, and at this level life can originate. A question naturally arises: how do the properties of syntropy pass from the quantum level of matter to the macroscopic level of our physical reality, 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 it freezes water expands and becomes less dense. Other liquid's molecules, when they are cooled, vibrate more slowly, 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 bridges. Also ammonia and fluoride acid form hydrogen bridges and these molecules show anomalous properties similar to water. However, water produces a higher number of hydrogen bridges 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 bond makes 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.

Life and the conflict between entropy and syntropy

According to the theory of syntropy the properties of life are available in the quantum level of matter and water molecules allows the flow of these properties in the macroscopic level. But, since the macroscopic level is governed by the law of entropy, which tends to destroy any form of organization, living systems are constantly struggling for survival. For example, material needs must be met such as acquiring water, food and a shelter. However, the theory of syntropy also identifies a series of intangible needs, just as vital and important as material needs, such as the need for meaning and the need for cohesion and love. When a vital need is met only partially an alarm bell is triggered. For example, if we need water thirst is triggered, if we need food hunger is triggered, if we need to provide a meaning to our life depression is triggered, if we need syntropy anguish is triggered. Depression and anguish are alarm bells, similarly to thirst and hunger, and inform us that the vital needs for meaning and syntropy are unsatisfied. Now let us describe the vital needs which arise from the conflict between syntropy and entropy:

1. *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:
    a. Combating the dissipative effects of entropy, for example, acquiring energy from the outside world through food and reducing the dissipation of energy with a shelter (a house), and clothing.
    b. Disposing of the production of wastes caused by entropy, i.e. hygiene and sanitation.

    The total satisfaction of these needs leads to a state characterized by the absence of suffering. The partial satisfaction, however, leads to experience hunger, thirst and diseases. The total dissatisfaction of these needs leads to death.
2. *Acquiring syntropy from the microcosm.* 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 organization levels. They must, therefore, acquire syntropy. In human beings 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:

a. the acquisition of syntropy is felt as sensations of heat associated with feelings of wellbeing, in the area of the solar plexus, just under the lower part of the sternum. These feelings of warmth and wellbeing coincide with the experiences usually named *love*;
b. the lack of syntropy is felt as a sensation of void in the solar plexus 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 void and pain, usually associated to a feeling of death are felt. 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.

3. *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.

$$\frac{\text{I}}{\text{Universe}} = 0$$

Figure 1 – Identity conflict equation

Which reads in the following way "*When I confront myself with the universe I am equal to nothing, to zero*".

Since the universe corresponds to entropy whereas I corresponds to syntropy the identity conflict equation can also be written as:

$$\frac{\text{Syntropy}}{\text{Entropy}} = 0$$

Figure 2 – Identity conflict equation using Syntropy and Entropy

To be equal to zero is equivalent to death, which is the *principle of death* of the second law of the *New Thermodynamics*. This principle is incompatible with life and with the fact that we feel to be alive. The identity conflict is characterized by being meaninglessness, by lack of energy, existential crises and depression. This conflict is generally perceived in the form of tension in the head, comes together with feelings of anxiety and anguish, and is perceived as the ***need of acquiring a meaning***. The strategies implemented in order to acquire a meaning can very: we might try to increase our value through wealth and power and we might find a meaning to our life through ideologies and religions. Strategies mainly focus on increasing the numerator, the top part of the fraction of the identity conflict equation, and / or reducing the denominator, the part below the fraction. Some examples:

Increasing the value of the numerator. One of the most common strategies used, in order to reduce depression and to provide our existence with a meaning, is to increase the value of the numerator in the equation of the identity conflict:

$$\frac{I + judgment + \ wealth + popularity + power + \ meaning \ldots}{Universe} = 0$$

Figure 3 – By increasing the value of the numerator in the equation of the identity conflict people find temporary relief from depression, but the identity conflict is not solved, we are always equal to zero

Decreasing the value of the denominator. Another strategy commonly used in order to try to resolve the identity conflict is to decrease the value of the denominator of the equation, for example:

$$\frac{I\ x\ Community}{Community} = I$$

Figure 7 - In this strategy, people seek to resolve their identity conflict limiting the outside world to a community without contact with the outside world. When the universe is replaced by the community and everything revolves around it the identity conflict is reduced.

Rather than comparing ourselves with the universe, we reduce our interactions by limiting our universe to the community to which we belong, which is finite. However, this strategy changes the need for meaning into the need to belong to a group, to a community. It becomes vital to be accepted and to be part of the group.

Removing the outside world. Another strategy commonly used to try to resolve the identity conflict is to cancel the external world. In these cases the formula is transformed into:

$$\frac{I\ x\ I}{I} = I$$

Figure 8 - In this strategy, individuals seek to resolve the identity conflict by excluding the outside world, replacing the universe with their ego.

This strategy can explain some of the main psychiatric disorders. For example, when the (I x I) multiplication is prevalent people can develop a narcissistic personality disorder. When the (I / I) fraction is prevalent there may be a paranoid personality disorder, and finally, when the (I / I) fraction and the (I x I) multiplication have similar weights, the person may be faced with a spectrum of psychotic disorders. A trait common to these disorders is the closure in oneself, and the perception of the outside world as threatening or inappropriate in relation to ones expectations.

None of the strategies which have been just described succeed in solving the identity conflict. According to simple mathematics the only way in which this conflict can be solved is the following:

$$\frac{\text{I x Universe}}{\text{Universe}} = \text{I}$$

Figure 9 – Theorem of love

Which reads in the following way: "*When I unite with the universe, compared with the universe, I am always I"*. The multiplication "x" corresponds to the cohesive properties of love and a fraction can be simplified when the numerator and denominator have common factors. In the theorem of love the common factor which can be removed is "Universe" and the equation simplifies to I = I.

This equation can also be written in the following way:

$$\frac{\text{Syntropy x Entropy}}{\text{Entropy}} = \text{Syntropy}$$

Figure 10 – Theorem of love using syntropy and Entropy

This equation demonstrates that when we unite syntropy and entropy the identity conflict disappears, but we also enhance the *law of life* of the third law of the *New thermodynamics*. In other words, love solves the duality between syntropy and entropy and allows to evolve in the direction of life.

Final considerations

Science is now based on the assumption that causes must always precede effects and this assumption is at the basis of the duality between entropy and syntropy and neglects the role of syntropy and the evolution of life towards love. The association between syntropy and love was underlined by Fantappiè as follows:

> *"Today we see printed in the great book of nature - that Galileo said, is written in mathematical characters - the same law of love that is found in the sacred texts of major religions. (…) The law of life does not move towards leveling and conforming, but towards higher forms of differentiation. (…) The law of life is not the law of hate, the law of force, or the law of mechanical causes; this is the law of non-life, the law of death, the law of entropy. The law which dominates life is the law of cooperation towards goals which are always higher, and this is true also for the lowest forms of life. In humans this law takes the form of love."*

The law of love and syntropy do not imply a new type of energy. It is always the same energy, but with a tendency which is symmetrical to entropy. Entropy is incompatible with life, since it leads to death. Consequently the cause and effect assumption on which science is now based is misleading and it is probably the main cause of the increase of entropy and crises which we are now observing. Consequently, in order to overcome the present situation of crisis and suffering the theory of syntropy shows that humanity should shift from the cause and effect paradigm to a new supercausal paradigm which can encompass the *New Thermodynamics*: the law of syntropy and entropy together.

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