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The Introduction of the Informatics Potential and the Kinetics of Informatics: The Spontaneous and Non-Spontaneous Enmorphy

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I. Introduction

Edgar Morin (1) in his book *The seven knowledge necessary for the education of the future* working with the notion complexity cited Claude Bastien (2) who said that *cognitive evolution does not lead to the establishment of increasingly abstract knowledge, but, instead, to its contextualization.* The physicist Stephen Hawking (3) answer to question: *Some say that while the twentieth century was the century of physics, we are now entering the century of biology. What do you think of this?* The answer of Hawking: *I think the next [21st] century will be the century of complexity. We have already discovered the basic laws that govern matter and understand all the normal situations. We don't know how the laws fit together, and what happens under extreme conditions. But I expect we will find a complete unified theory sometime this century. There is no limit to the complexity that we can build using those basic laws*.

Based on this and having in mind the complexity and contextualization and the expression of Hawking which said, *we don't know how the laws fit together*, this contribution aims to aggregate and elucidate the questions: what is the Informatics Potential, and how the unified kinetic theory of informatics works?

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In previous publications (4,5) the notion of enmorphy was introduced and defined as a function of the logarithmic expression of the disorder. Considering that the information corresponds to energy, and enmorphy corresponds to the entropy, thinking analogically, we introduced the temperature and the time as the variables of the integrating factor. Following the same logic, the information is directly related to order created through equation 1. In this equation, I is the information, c the proportionality factor, it achieves values between 0 and 1, and O is the order created.

$$I = c\,O \qquad [1]$$

Equation 2 was proposed verbally by Schrödinger (6) in his work *what is life*. In this equation, O is the order, and D is the disorder.

$$O.D = 1 \qquad [2]$$

Physical-chemistry, according to Blinder (7), considers that there are four energetic potentials, namely: dH the enthalpy, dA the Free energy of Helmholtz, dG the free energy of Gibbs and dE the internal energy. Chemistry, on the other hand, introduces the chemical potential, $d\mu i$, that depends on the chemical composition of the reaction and the state (pressure and temperature) of the matter before the start of the reaction. To perform a chemical reaction we need at least two components, excluding nuclear reactions. The materials of the reactions are transformed and take another form and the nature of the product very little resembles the nature of the components. The number of reactions known to man is very high. These transformations, according to the chemical potential, are always spontaneous, depending on the temperature and pressure conditions, and on the chemical equilibrium that establishes the relationship between the components and the reaction product. To accelerate or slow down the reaction rate, we need to increase or decrease the temperature or pressure.

We can even alter the chemical equilibrium, and for this, we need more knowledge about the reaction and the consequences of changing the pressure and temperature parameters. Knowledge equals to information. The reaction needs to be fed with additional information.

In Physical-chemistry, the part that refers to physicist is the part of the observer who tries to explain, with experiments and theories, the phenomena of nature; the part that refers to chemist is that the researcher studying the reactions creates information to be able to do intelligent or non-intelligent actions, in other words, to manipulate the chemical equilibrium.

The human being, through observation, experiment and theory, managed to overcome superstition, overcome magic and create physics as the first of science. Along with this path, great thinkers had the capacity for abstraction and sharp intelligence to replace magic with physical science. This process forces the thinker to be abstract from beliefs up to that moment valid as true.

Shannon [8-11] carried out the publication of computer mathematics in 1941. Between Szilard (12) and Shannon and after them, there are many other thinkers who have made important contributions in computer science. The researcher felt the weight of information in any area. That is why today we cannot exclude computing from any interdisciplinary research. Nowadays we cannot imagine interdisciplinary without the participation in computer science.

The history of science teaches us that physicists of the Renaissance could observe and did not interfere with nature. Physicists discovered the secrets of nature without interfering with nature or were observers and experimenters. This direction changed radically from the moment of Le Chatelier's (13, 14) formulation. This principle defined the chemical equilibrium between the products of the reaction and the materials before it, and is one among other principles of chemistry which received much attention from 19th-century researchers. On the other hand, early 20th-century, physicists with atomic science began using nuclear energy for peaceful and bellicose purposes, and biologists in recent years started working with mutagenesis of plants and animals, therefore assume an interference with nature.

At this moment we do feel the need to introduce the "Informatics Potential" presented as dI. Following the analogical method, we treated the Informatics Potential similarly to the Chemical Potential dμi. Then the Informatics Kinetics is presented alike to the Chemical Kinetics. However, in the case of chemistry and engineering, very small efforts have been applied to control the entropy produced, and the entropy corresponds to the enmorphy.

Then, for the case of chemistry we can write the general expression:

$$d\mu/dt = k1\ \mu_1^n\ \mu_2^m + k2\mu_3^l\mu_4^p, \qquad [3]$$

μ is the concentration of component μ during the reaction. k1 and k2 are the Arrhenius constant. n, m, l, and p are the orders or degrees of the reaction. μ_1, μ_2 μ_3, and μ_4 are the respective concentration of the components. Starting with this simple equation, it was possible to describe more complex systems of the reaction and finally the lows of Chemical Kinetics.

The mathematical description of the transformation of Information into the order and the deterioration of the order itself

The chemists and engineers do not care about the entropy created in the process of transformation. Do not care because the entropy it is an abstract notion, and in the words of John von Naumman *nobody knows what exactly is* [11]. Unlike entropy, enmorphy is a specific expression related to the disorder caused by the transformation to be performed.

The information existing before the transformation into order can be divided into two cases: a) continue existing. This effect is observed in DNA, plants of constructions of buildings, bridges and maps and others as patents and publications. The information can be used again and again with the same or similar purpose. The duplication of DNA reproduces the information included in DNA (15-18). However, the duplication of DNA is subject of mutagenesis and cannot work forever. b) The information transformed into order can be lost because of different events and catastrophes that we live daily. To recuperate the information lost it is needed knowledge and to recuperate the order is needed energy that means costs. The human civilization is based on electricity. Every scientific instrument and generally instruments and electronic devices, from the water heater to very complex international networks, work with electricity. The information is transferred electrically. For this reason, if we want to preserve our civilization, we must consider other means than electricity. This means new computers that work totally with the principle of light.

II. Spontaneous and Non-Spontaneous Transformation

For an established order, every change of the order is followed by the change of enmorphy. As established order, we consider the order that can remain constant for a relatively long time. Enmorphy is related to the disorder. This way, the discussion is elevated from the abstract level of energy and entropy to the concrete level of information, order or disorder, in other words in the enmorphy as defined before.

The spontaneous change of enmorphy is the event, characterized by a total lack or incipient information. Considering the earth we present as examples: the catastrophes caused by tsunamis and earthquakes, the recently Marianas and Brumadinho (MG) dam rupture [19], the change of the height of the mountains, the creation of new island the by volcanic activity, the aging of the marvels of the Acropolis, the physical and chemical aging of the materials including the processes of fatigue, the aging of any living

organism, and many other examples. The former order stopped, slow or fast, to exist and give way to disorder.

Probably the information is hiding behind the physical and chemical properties of the matter. Specifically the structure of the matter and structure means order.

The non-spontaneous change of enmorphy is forced by the living organisms, in the sense of increased or decreased disorder. According to Szilard L [12], *any action resulting in a decrease in entropy must be preceded by the acquisition of information*. We transform the expression of Szilard to this, *any intelligent or non-intelligent action of the inhabitants of the earth (maybe the universe) needs acquisition of information.* Living organisms are constructed with the matter. Every kind of life possesses an elementary intelligence [5]. This fact is explained by the DNA which includes, in this stage of the evolution of the different species, previously defined information. The experience factors we do not want to discuss in this publication. The evolution of living nature is responsible for this fact.

We have to spend special attention to the catastrophes and conflicts caused by humans. First and Second world wars, the atomic bomb in Hiroshima and Nagasaki, the continuing civil war of Syria and other countries and the in-numerous conflicts around the earth are some examples. Additionally, the revolutions can be observed from this angle, the angle of enmorphy. The revolutions that failed to introduce the new order can be explained by failure and lack of information, consequently wrong and inadequate planning. They usually guide to civil wars and, consequently, catastrophe.

The transformation of information into the order can be discussed under the angle of non-spontaneous enmorphy. Any achievement, for example, the construction of a building (or monument) on clean ground, begins with the justification, search of the financing and the design of the building. In this stage, all this is called planning of the enterprise, the logistic works with virtual information, information that the scientists and engineers brought with them. Depending on what was initially planned at the virtual level, a percentage of the information will be transformed in order. If, on the other hand, the land is not cleared, planning should include the destruction of the old building, removal, and disposal of the rubble generated. The destruction of the old building should include information about it, and the process is quick and the execution of this work at the lowest possible cost. The issue is not just a problem of physical-chemistry, but for the engineers and computer science. It is accepted that physics and chemistry describe with approximations the reality, informatics, on the other hand, can describe with approximations the reality and virtuality. In this case, destroying the old structure, the old order is equivalent to expending energy to acquire the necessary information, the entropy is increased and parallel to this, the enmorphy increased too. *To change the created order, we have to pass from the step of the disorder and then established the new order.* The difference between humans and the animals is that, every human achievement includes Justification, Financial support, Planning, and Execution, for the animals there are no justification or financial support, the information necessary for planning is already available in the DNA and the previous experience.

To transform information into order, the information must include a logical sequence. In the construction of a building, first comes to the foundation and support parts, second the walls are constructed, and after the demand necessary for the finishing, etc. According to this, the information can be divided in to: the basic step information which has to be included to relatively finish the construction, the parallel steps and the consecutive steps. The parallel steps are those that the workers can perform at the same time. The consecutive steps are the ones the workers can complete one by one.

Considering that the degree of the transformation of the information is zero, then the equation that describes this transformation is the following one.

$$-dI/dt = k_0 I^0 \quad [4]$$

-dI/dt is the velocity of the transformation of information with the time, k_0 the velocity constant, I^0 indicate the zero degree of the transformation,

The integration of this equation gives the following result.

$$I = I_0 - k_0 t \quad [5]$$

I_0: is the initial value of the information.

Figure 1 demonstrates the evolution of the information with time for the zero degree transformation. As seen, it follows a linear decay.

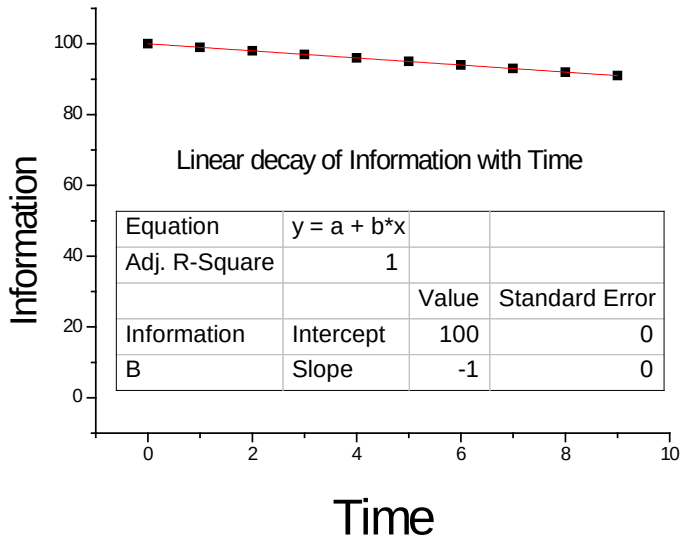

Figure 1: The zero degree transformation evolution of information with the time

In this paper, instead of *order of the transformation*, the expression *degree of the transformation* is used to avoid any misunderstanding with the word *order* indicating structure and the other synonyms giving in the abstract. The proportionality factor must be considered in all the operation, according to Eq. [2]. Additionally, arbitrarily it is used the number of information 100. In the cases of parallel and consecutive transformation the degree of transformation is equal to 1. All the following examples should accompany the same numbers.

According to equation [5], the construction of a building would initiate and be finished in determined time. However, the constant k_0 depends strongly on what is the material planned to be used in the construction. If parts are prefabricated, includes silt or/and reinforced concrete or/and wood, etc. The time to initiate, the work and the duration are predefined.

Assuming that the velocity of the transformation is described by the equation of the first degree.

$$-dI/dt = kI^1 \quad [6]$$

I^1: indicate the first degree of transformation.

The integration of this equation gives the following result.

$$I = I_0 \exp(-kt) \quad [7]$$

Figure 2 resumes the exponential decay for the first degree transformation with the time. The created order follows an exponential growth, considering the respective value of the proportionality factor.

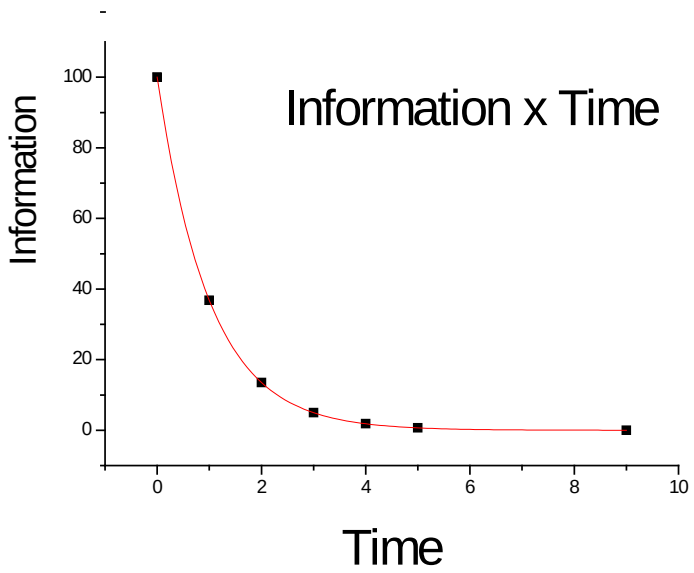

Figure 2: Exponential decay of information with the time

Assuming that the velocity of the transformation is described by the second degree equation.

$$-dI/dt = kI^2 \quad [8]$$

I^2: indicate the second degree of transformation.

The integration of this equation gives the following result.

$$I = Io / (1+k\, Io\, t) \quad [9]$$

Figure 3 describes the equation of second-degree kinetics for the transformation of the information to order, according to eq.(9).

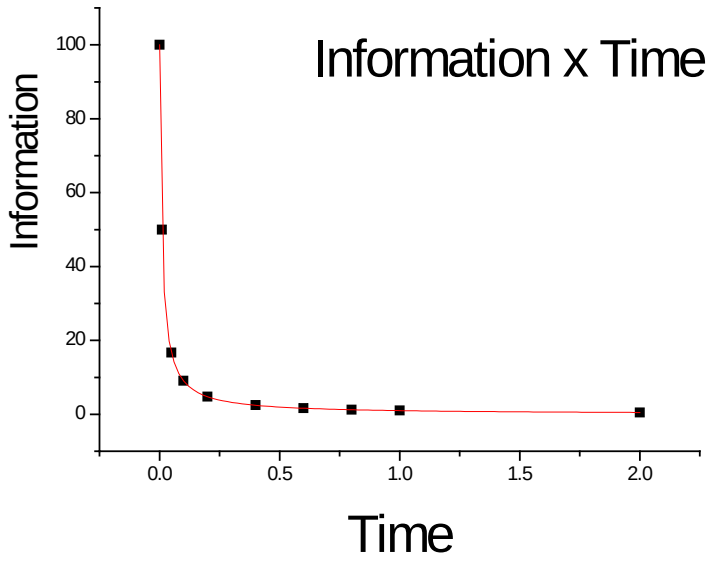

Figure 3: The evolution with the time of the information for a second-degree transformation

It is mentioned before, that there are three types of information to be transformed into the order: the basic, the parallel and the consecutive, however, the combinations of this can lead in a much more complex system.

Considering that planning includes parallel actions, then, we can describe the transformation of information into order according to the following scheme.

$$I \xrightarrow{k1} Or1 \quad [10]$$

$$I \xrightarrow{k2} Or2 \quad [11]$$

This scheme corresponds to tow parallel reaction of the first degree (order). For the corresponding velocities are valid following equations.

$$-dI/dt = k1I + k2I \quad [12]$$

$$dOr1/dt = k1I \quad [13]$$

$$dOr2/dt = k2I \quad [14]$$

The integration of this scheme leads to following equation.

$$I = Io \exp [-(k1 + k2)\, t] \quad [15]$$

$$Or1 = (k1\, Io / (k1 - k2)) [(1 - \exp(-(k1 + k2)\, t)] \quad [16]$$

$$Or2 = (k2\, Io / (k1 + k2)) [(1 - \exp(-(k1 + k2)\, t)] \quad [17]$$

The figures: 4, 5 and 6 describe the parallel scheme of the transformation of information to order. The exponential decay, according to Eq [15] and the products of order is presented according to Eq. [16] and [17].

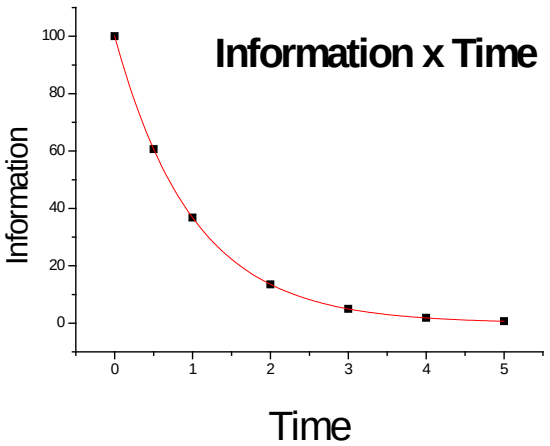

Figure 4: The exponential decay of information, according to Eq [15]

Figure 5: The first product according to the parallel scheme, Eq. [16]

Figure 6: The second product according to the parallel scheme, Eq. [17]

The other case to be discussed is the consecutive transformation of information to the order, represented by the scheme.

$$I \xrightarrow{k1} Or1 \xrightarrow{k2} Or2 \qquad [18]$$

This is represented by two sequential first order (order) processes.
For the velocities are valid following equations:

$$-dI/dt = k1\, I \qquad [19]$$

$$dOr1/dt = k1I - k2\, Or1 \qquad [20]$$

$$dOr2/dt = k2Or1 \qquad [21]$$

The integration of this scheme leads to following equation.

$$I = Io \exp[-k1\, t] \qquad [22]$$

$$Or \quad 1 = (k1/(k2 - k1))\, Io\, (\exp(-k1t) - \exp(-k2t)) \qquad [23]$$

$$Or \quad 2 = Io\, (1 + (k2/(k1-k2))\exp(-k1t) + (k1/(k2-k1))\exp(-k2t) \qquad [24]$$

The case of consecutive transformation can be applied perfectly in the construction of a work, beginning with foundation, then follows the walls, the coating, the painting and other details to finish the work.

Figures 7, 8 and 9 show the result of the transformation of information into order in the case of consecutive transformation. The exponential decay of information, according to Eq. [22]. The products of order are described by eq. [23] and [24] respectively. The Eq. [23] presents a maximum, easily predicted. The Eq.[24] is a sigmoid curve.

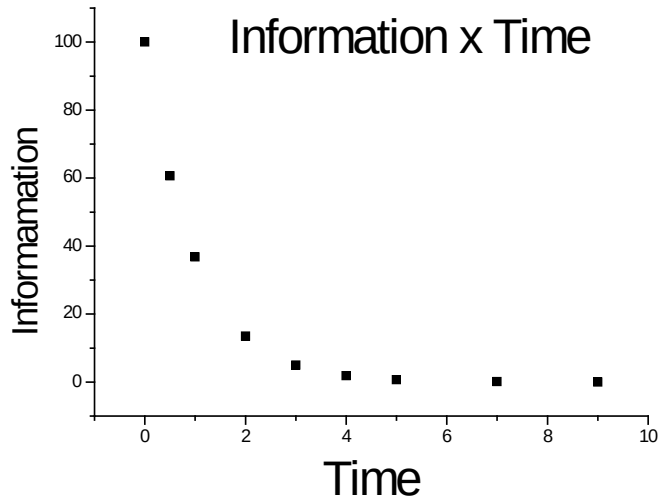

Figure 7: The evolution with time of the exponential decay of information, according to Eq. [22].

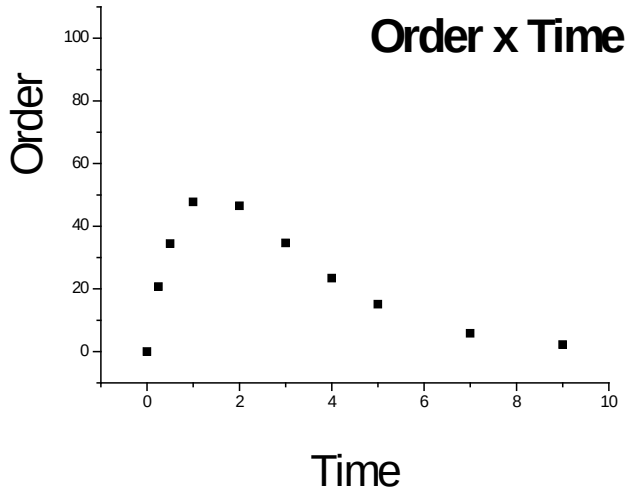

Figure 8: The evolution with the time of the first product (considered intermediate) according to Eq. [23]

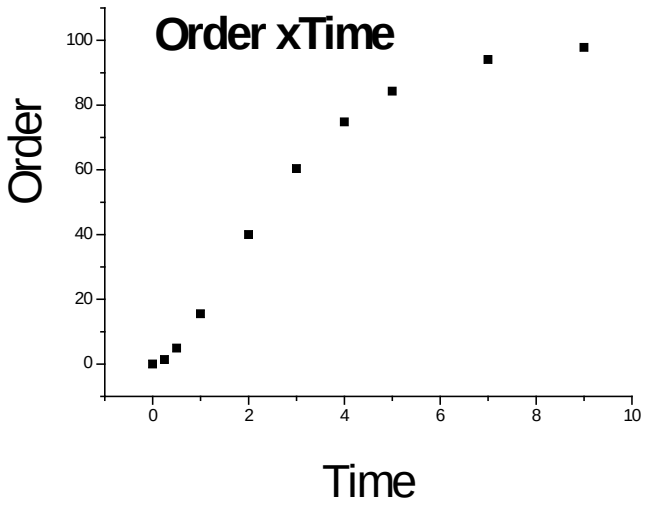

Figure 9: The evolution with the time of the second product (considered final product) according to Eq. [24]

The combination of the cases discussed above, specifically the two last, and the definition of the degree of transformation, would be an excellent instrument for the planning of any kind achievement.

III. The Deterioration of the Order Itself

There is a natural phenomenon related to the deterioration of the order. This phenomenon obeys to the spontaneous and non-spontaneous processes discussed above. The deterioration of the order can be described by the same principles as the process of the transformation of the information into order, using the same formalism, that is zero or first or second or parallel and consecutive and more complex schemes. However, the product, in this case, is the disorder and disorder is related to the enmorphy, as previously defined (5).

A chemist would explain the deterioration of the order by the strength of the bonding of the molecules forming the materials used. Strength is related to vibration; consequently, according to Blinder (7), vibration is related to the temperature. All forms of deterioration of the order, namely: zero, first, second, parallel and consecutive and other more complex schemes, starts with decay: linear or exponential or even more complex forms. This is defined as the characteristic correlation time of the decay of the deterioration of the material. This way, it was justified the dependence of the integrating factor of the Enmorphy on the temperature and the time, as predicted in our earlier publication [5].

IV. Synopsis

The Informatics Potential, dI was introduced as a consequence of the four energetic potentials, namely:

dH the enthalpy, dA the free energy of Helmholtz, dG the free energy of Gibbs and dE the internal energy, and the chemical potential $d\mu_i$. A general kinetic theory of informatics was presented, similar to chemical kinetic theory. The main issue is the transformation of Information into Order. In this case, order means: structure, organization, form, aligning, composition, establishment, grouping, layout, pattern, scale, sequence, symmetry and uniformity and all other notions which can be understood as the order. A discussion was presented of what is considered as spontaneous and non-spontaneous process in informatics. The aim to mathematically describe the transformation of Information into the order and the deterioration of the order itself was achieved. Some examples, considering different degrees of transformation, were demonstrated. The general kinetic theory of informatics can be applied to all areas of science, i.e: physics, chemistry, medicine, biology, geosciences, agronomy, architecture and civil engineering, social sciences, and other related areas. It is exactly the informatics that creates the link between the physical sciences and the human sciences. That is why today we cannot exclude computing from any interdisciplinary research. Nowadays we cannot imagine interdisciplinary without the participation of computer science.

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