Similarities and Differences between Entropy and Enmorphism: An Attempt to Define the Enmorphism

Dimitrios Samios

Institute of Chemistry - Federal University of Rio Grande do Sul Bento Gonçalves, 9500, Postal Box 15003 Postal Code 91501-970, Porto Alegre, RS, Brazil

Abstract

The aim of this article is to differentiate and indicate the similarities between entropy, related to the energy and the enmorphism, related to the information theories. According to Szilard L, any action resulting in a decrease in entropy must be preceded by the acquisition of information”. The introduction of the free energy of Gibbs, the internal Energy, the free energy of Helmholtz and the Enthalpy as energy, resulted for the state of equilibrium in minimization of all forms of energy and the maximization of the entropy. It is possible to decrease the entropy investing in information as Caratheodory proved and this was the case of the Carnot cycle and other engines discovered later. However, “The process of decreasing the entropy is invariably associated with production of an equal or greater amount of entropy in the surrounding”. Parallel to the entropy we developed the notion of enmorphism. For the definition of enmorphism we consider that it is “Proportional to the logarithmic equivalent to disorder”. Schrödinger consider that the order is related inversely to disorder. Then, in the function of enmorphism, we have introduced a function $f(ξ)$ which is the integrating factor of enmorphism, including two variables at list: the temperature and the time, as well as, the disorder itself can be expressed by a polynomial function of n degree. With this mathematical formalism we introduced the definition of Enmorphism and the relation between order and enmorphism. Finally, it was open the discussion about the relation of Enmorphism X Time (the temporal behaviour) and Enmorphism X Temperature (the thermal behaviour) the two parameters included in the integrating factor.

Keywords

Integrating Factor of the Enmorphism; Disorder as a Polynomial Function of n Degree; The Case of Molecular Dynamics Simulation; Maxwell’s Demon

Introduction

The interdisciplinary researches continuing, as before, the centre of the interest of many scientific activities. Medicine, biology, physics, chemistry, geosciences, agronomy, social sciences, arts and other related areas, demonstrate strong interest for interdisciplinary projects. It is impossible to understand interdisciplinary research without informatics. In the last two decades many authors published different works in interdisciplinary areas, [1-6] mainly in the area of medicine. In geosciences some recent publications like [7-9] are worth to remember, among other publications. In a previous study [10] was discussed about the thermodynamics, the conception of Matter - Energy - Entropy as they were proposed by Clausius, Boltzmann, Gibbs [11-14] and the other authors who have contributed for the development of Thermodynamics, versus the conception of Matter - Information - Enmorphism as it was proposed for the informatics theories [10]. The notion of entropy was elucidated and the new term of

*Corresponding author: Dimitrios Samios, Institute of Chemistry - Federal University of Rio Grande do Sul Bento Gonçalves, 9500, Postal Box 15003 Postal Code 91501-970, Porto Alegre, RS, Brazil. E-mail: dsamios@iq.ufrgs.br; Tel: +55.51.3308.6290

Received April 05, 2018; Accepted October 11, 2018; Published October 30, 2018


Copyright: © 2018 Dimitrios Samios. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Enmorphy was introduced. Shannon [15-18], defined as Entropy the quantity of information. Entropy in an open system can be increased or decreased, resulting for the environment into increasing of entropy. In the same way, the enmorphy can be increased or decreased. Considering that information exist in two forms, namely, structural and kinetic. Structure means current or momentary order. The kinetic or the temporal behavior of information (order) takes care about the changes, the transformation of information as structure with the time. This article aims to create a possible relation between information as order and enmorphy and to propose a mathematical model which describes the relation between enmorphy and order.

Physics, Mathematics and Chemistry versus Intelligence and Creativity of Nature.

The thermodynamics are to be understood in terms of Matter - Energy - Entropy, from the other side, informatics theories work with Matter - Information - Enmorphy. The Enmorphy can be understood as the “Degradation of information, or creation wrong and incorrect of information”. Entropy and Enmorphy have two different definitions. The entropy, according to Clausius is equal dS = dq/T, is related to the energy. The enmorphy can be increased or decreased. The enmorphy, as it is demonstrated later, is related to the order (structural or kinetic) by the equation Enm = K \( f(\xi_i) \ln \left( \frac{1}{Or} \right) \). In this equation: K is the Boltzmann constant, \( f(\xi_i) \) is the integrating factor of enmorphy including two variables at list: the temperature and the time, Or is the order, X is the result obtained by \( aD + bD^2 + \ldots + kD^{(n-1)} \), where D is the disorder.

In the next chapter it is described some examples for the kinetic, the temporal evolution in terms of order, keeping in mind that our goal is to describe the structural (order) information.

Imagine the question of the lost continent “The Atlantis”. There are testimonies and evidences about the existence of the Atlantis in Plato, who lived 427 - 347 BC, however, humans continuing working on this “Information” without success. Someday, maybe, with the continuing evolution of science, technology and informatics the humans are going to discover the Atlantis, or no discovering of the Atlantis indicating this information as “Fake news, fake information”. A similar case is considering a man who has problems with his memory because of the syndrome of Alzheimer. He does not remember what he has done yesterday. All the information have go away from his memory. Considering the cases of Atlantis and memory (Alzheimer), in both cases there is incipient information in order to solve the problem. But, there are many researchers working in these problems accumulating very important information. For both problems it is a question of time to be resolved. The cases of Atlantis and Alzheimer are qualitatively presented, in terms of order, in figure 1. Both cases start with incipient information expressed as order. It is a question of time to find the solution of the problem. Maybe, the discovering of Atlantis will remain insolvent, but the problem of the syndrome Alzheimer will be resolved.

**Figure 1:** The Time Evolution of Order in the Case of “Atlantis and Alzheimer”

The other case of the “Increasing enmorphy” or “Degradation of information” came from the communication engineers. In the time of discovering the electricity, approximately in 1850, the engineers thought that it was time to connect the old continent Europe with the new continent America through a wire. In this time, the telegraph was the last word in technology. After hard work they succeeded to connect the old continent with the new continent. Trying to contact via telegraph, it was a disaster. Simple, the text formed by words, has arrived without meaning, or in the cases where included some meaning, it was difficult to interpret it. The engineers worked for more eight years in order to resolve the problem. It was a question of time to resolve the problem. This case is qualitatively presented in figure 2. The initially existing information was not enough to connect the old continent with the new one.

The creating information can be defined as enmorphy decreased. Again an example from archaeology: There was a temple of the goddess Artemis in the island of Euboea-Greece. Paul Harper [19] write “A mystery
over the location of Ancient Greek temple honouring a famous goddess of hunting and the moon has been finally been solved after more than 100 years. The legendary sanctuary dedicated to the worship of Artemis was found when researchers discovered instructions written by a Roman geographer Strabo were wrong. This historic site was found in the fishing village of Amarynthos on the second largest Greek island Euboea. Since the late-19th century archaeologists have been excavating around one mile from Eretria based on the calculations by Strabo but were consistently frustrated. The breakthrough came when 10 years ago the Swiss Archaeological School on Euboea estimated that the ruins were actually more likely to be located 6.8 miles". This is a case of increasing or creating information and decreasing enmorphy. The case of Artemis (Diana in Latin) is qualitatively presented in terms of order in the figure 3.

Figure 2: The Time Evolution of Order in the Case of Electrical Engineer

The other case which must be discussed is the catastrophes provoked by natural phenomena like tsunamis, hurricanes, earthquakes, forest burning etc, or by humans’ conflicts, like atomic bomb explosion and other like the First and the Second World War and currently the Syria disaster etc. There is a huge difference in the prediction of time for natural phenomena disasters and the conflicts caused by humans. Natural catastrophes occur suddenly, the disaster of human conflicts are caused by humans and they can be avoided. These cases, qualitatively related to time, are described in the figures 4 and 5.

Figure 4: The Time Evolution of Order in the Case of Natural Catastrophes

Figure 5: The Time Evolution of Order in the Case of Human’s Conflicts

All these cases, namely, the Atlantis, the memory (Alzheimer), the electrical engineers, the discovering of the temple of Artemis, the natural disaster and the disasters caused by human’s conflicts have their time and
location evolution. We have to observe the evolution of
the information as order or disorder with the time and the
location. For all these cases, previously discussed, there
is an initial information which we define as pre-existing
information. In the case without any information, we
are talking in “Discovering”. Then for the pre-existing
information there exist three possible situations: the
information remaining constant, or it is increasing, or it
is decreasing with time. These three possible events can
be followed by other nine (9) possible events and so on.
However, we have to consider that the information is
always a positive number.

Every kind of life possesses an elemental natural
intelligence. As nature intelligence we understand not
only the intelligence of humans, but we include every
kind of intelligence, including animals, fishes, plants and
microorganisms, starting with the simplest form of life and,
until the complex nets of human societies. Currently, we
believe that life includes intelligence because of its DNA.
Life exists in open thermodynamic systems. Physics and
Chemistry and their representatives Clausius, Boltzmann,
Gibbs, Maxwell and the others whom have worked on
thermodynamics, have reproduced a strictly mathematical
model. They have used the Mathematical Intelligence as
a tool for producing the results of thermodynamics [20].
They have used the Thermodynamic Potentials expressed
by the following four functions.

(1) \[ dE = T \, dS - P \, dV \]
(2) \[ dH = T \, dS + V \, dP \]
(3) \[ dA = S \, dT - P \, dV \]
(4) \[ dG = S \, dT + V \, dP \]

In these equations: \( E \) is the internal energy, \( H \) is
the enthalpy, \( A \) is the free energy of Helmholtz, \( G \) is the
free energy of Gibbs, these four forms are the energies,
\( S \) is the entropy, \( T \) is the temperature, \( V \) is the volume
and \( P \) the pressure. The result of these equations was
the minimization of energy and according to Clausius’
inequality, the maximization of the entropy expressed by
the following function behind:

\[ \Delta S \geq 0 \]

“In any adiabatic process, reversible or
spontaneous, the entropy is a never-decreasing function”
[14]. Even in the statistical thermodynamics the result
was not different from the obtained one in the classical
thermodynamics.

Maxwell in his Theory of Heat (1871)
hypothesized an imaginary being denominated “The
Maxwell’s demon” [20] possessing capacity of perception
and agility on a molecular scale.

Maxwell presumed that any entropy produced
by the demon himself could be neglected. A strong
controversy was created about the “Maxwell’s demon”
relating the foundation of thermodynamics and the
nature of information. According to Blinder SM [20],
Szilard [21] has proposed that any action resulting in a
decrease in entropy must be preceded by the acquisition
of information, which process is invariably associated
with production of an equal or greater amount of entropy.
Brillouin [22] showed that the assumption of Maxwell to
be unjustified, and has equated information with negative
entropy, creating the connection between thermodynamics
and the information theory, in this time a new science. As
we are going to see, Maxwell’s demon was not necessary,
he can be replaced by the “Informatics Intelligence and
Creativity”. However, the credit must be given to Maxwell
because he is the author who felt the necessity to introduce
“The Maxwell’s demon”, to introduce something additional
to the mathematical formalism namely “Somebody” with
Intelligence and Creativity and the capacity of perception
and agility on molecular scale. This is exactly what the
universal language of the “Informatics” has reached today
and is doing it in a virtual level of perception.

The representatives of the thermodynamics
produced a mathematical model including “Ipsis litteris”
the logic of the language of mathematics. According to
mathematics, we need to prove every theorem, the only
sentence we have not to prove are the axioms. They have
used the axiom of the conservation of energy. As example
of this logic, we propose the Carathédory’s [23] principle
as it is given by Blinder SM [20]. The second example we
have is the Kinetic Theory of Gases developed by Bernuli
D, Clausius, Maxwell, Boltzmann and van der Waals
and others, based on the following fundamental postulates: for
a gaseous macroscopic system composed of \( N \) particles
(N approximately equal \( 10^{24} \)) at equilibrium, the motion is
considered to be isotropic independent of time, the laws of
the Newtonian mechanics are valid, additional to the axiom
that the particles are that small and they do not occupied
any volume. The Thermodynamics and the Kinetic
Theory of Gases, between other examples of theories, are
purely mathematical constructions. From the other side,
informatics is considered as the second universal formalism
or language, additional to the Mathematics. Informatics,
is able to realize complex calculus and various simulation and uses the Monte Carlo Simulation which do not include time evolution, the Molecular Dynamics Simulation which include time evolution and a mixture of these both processes. The “Maxwell’s demon” doesn’t exists, or it is possible to exist in a virtual level in the Molecular Dynamics Simulation and this was a result of Informatics. Every computer today has the perception and the agility of the “Maxwell’s demon”, if it is adequately programmed.

Enmophy is related to information and entropy is the thermodynamic result, related to energy. It is possible to increase or decrease the enmophy as it is the case of entropy. “The process of decreasing the entropy or the enmophy is invariably associated with production of an equal or greater amount of entropy in the surrounding”. In order to increase or decrease enmophy we need information, in other words, need energy as information. Additionally to Energy we need “Natural Intelligence and Creativity”, specifically we need “Human Informatics Intelligence and Creativity”. In this case, it is very difficult to count the energy expended, if not impossible. This is because of the continuing evolution of the informatics. So, there’s not equation given the result in energy of “Human Intelligence and Creativity” of the person, or the persons, or companies and universities involved with the programming of the computers.

The informatics intelligence and creativity is represented by the Shannon [15-18] who performed the mathematisation of information and all the other authors worked in question related to informatics. The Shannon’s mathematization of information just have seven decades. At the time that Shannon lived there were no computers as we know them today. The computer science lives a continuous evolution. My experience of programming includes five different computer languages. Still we live the revolution of the informatics. Contrary to mathematics, the history of Mathematics, in his formulation as addition, subtraction, multiplication and division, including three areas, namely, algebra, geometry and trigonometry counts with some millennia. Leibniz GW [24, 25] completed the four basic operations with differentiation and integration. Considering that informatics is the second universal formalism or language, we have to study more and more the informatics devices.

Carnot [26] is the one who conducted the thermodynamic studies on the steam engine. The steam engine and the other engines discovered later are the symbol of the industrial revolution. The industrial revolution has come to an end. We are facing the new revolution, namely, the computer science and the informatics revolution. Of course, this evolution leads us to artificial intelligence; we know nothing about the next step. We have no idea where the computer science revolution can guide us. The revolution of Informatics is not over yet.

The Theory

Starting with the definition of entropy
\[ dq = T \ dS \] (1): \( dq \) is the heat, \( T \) is the temperature and \( dS \) the entropy.

\[ \Sigma P_i = 1 \] (2),

\[ S = - K \Sigma P_i \ln P_i \] (3),

\[ S = - K < \ln P_i > \] (4)

\( P_i \) is the probability and \( K \) the Boltzmann’s constant.

\[ S = -K \Omega ((1/\Omega) \ln (1/\Omega)) = -K \ln (1/\Omega) = K \ln \Omega \] (5)

\( \Omega \) is the thermodynamic probability which can be defined as the number of possible ways, in other words arrangements, which can assume the system.

The formulation proposed by Stonier [27, 28] consider the observation of Schrödinger [29] that the order or is the inverse of the disorder, \((Or = 1/D)\). The theory of Stonier can be resumed as follows.

\[ -S = K \ln Or \] (6),

\( Or \) is the order, \( D \) is the Disorder.

Stonier considered Information \((I)\) proportional to the Order through the factor \( c \), then the following equations can be written:

\[ I = c \text{ Or} \] (7),

considering that disorder \( D = 1/\text{Or} = c/I \) (8).

Consequently:

\[ S = K \ln (c/I) \] (9),

\[ I = c e^{-S/K} \] (10)

According to our theory, we introduced in the formula of Stonier for the disorder: a) a function \( f(\xi) \) defined as integrating factor of Enmophy which must include two variables at list: the temperature and the time, and b) a polynomial function of \( n \) degree in relation to disorder, according to the following equation.

\[ (D+a \ D^2 b + \ldots D^n k) = D (1+X) \] (11)

\[ Or = 1/(D + D X) = 1/(D (1+X)) \Rightarrow D= 1/(Or (1+X)) \] (12)

Were \( X \) is the result obtained by \( aD + bD^2 + \ldots + k D^{(n-1)} \).

The integrating factor of enmophy must include two variables at list: the temperature and the time. Then we define the function of enmophy as \( \text{Enm} \):

\[ \text{Enm} = K f(\xi) \ln D \] (13) \( \Rightarrow \)

\[ \text{Enm} = K f(\xi) \ln (D+ D^2 a + D^3 b + \ldots D^n k) = D (1+X) \]
(1/ (Or (1 + X))) (14)

Considering that Information is proportional to the created order through the factor c
\[ c/I = 1/Or = D (1 + X) \] (15) \[ D = c/I (1+X) \] (16)
and consequently
\[ Enm = K f(\xi) \ln(c/I(1+X)) \] (17)
\[ I = c e^{-\text{Enmorphy}(\xi)/I(1+X)} \] (18)

Evaluating this equation in relation to X we have the following cases.

If aD+ bD^2 . . . + KD^{n-1} is equal to 0, and \( f(\xi) = 1 \), then the order is the inverse of the disorder.

If aD+ bD^2 . . . + KD^{n-1} is given by a positive number, and \( f(\xi) = 1 \), that means that the disorder must be dislocated according to eq. 17.

If aD+ bD^2 . . . + KD^{n-1} is given by a negative number, X must be greater than -1, (-1 <X), and \( f(\xi) = 1 \), that means that the disorder must be decreased according to eq. 17.

These three cases for X = -0.4, X = 0, X = 0.4, and \( f(\xi) = 1 \), are demonstrated in figure 6.

**Figure 6**: The Relation between Order and Enmorphy

---

**Conclusion**

Similarities and differences between entropy and enmorphy were discussed. The enmorphy is “Proportional to the logarithmic equivalent of the disorder” including: a) a function \( f(\xi) \) defined as integrating factor of the enmorphy, which include at least two variables: the time and the temperature, and b) a polynomial function of n degree in relation to disorder. The kinetic or the temporal evolution of information as order of some real examples were presented and discussed, namely, the Atlantis, the memory (Alzheimer), the electrical engineers, the discovering of the temple of Artemis, the natural disasters and the disasters caused by human’s conflicts. The theoretical model proposed, additionally to approximation of disorder through a polynomial of n degree, includes the function of the integrating factor. The cases mentioned before were elucidated in relation to kinetic or temporal behaviour with the theoretical model. The discussion about the relation of Enmorphy X Time (the temporal or kinetic behaviour) and Enmorphy X Temperature (the thermal behaviour) was open. These two variables, time and temperature, at least, must be included in the function of Enmorphy through the integrating factor. Additionally, some thoughts came in to my mind about the imaginary and virtual case of Molecular Dynamics Simulation. Considering that the results of MD are virtual and imaginary, this case must be discussed separately from the “Real cases” mentioned above. It is demonstrated that people (programmers) are able to create “Somebody” with the capacity of perception and agility on molecular scale, in other words “The Maxwell’s demon” was created in virtual level. For this reason people have to differentiate between real information and imaginary or virtual information.

**Highlights**

Enmorphy is proportional to the logarithmic equivalent of the disorder. The inverse of order is the disorder.

The integrating factor of Enmorphy was introduced which, at least, include two variables, the time and the temperature, and parallel to this we expressed the disorder as a polynomial of n degree.

**References**


