

Informational Structure of the Living Systems: From Philosophy to Informational Modeling

Florin Gaiseanu

Science of Information and Technology Bucharest (Romania) and Barcelona (Spain)

In this paper, there are discussed the informational functions of the living structures, analyzing the properties of the simplest eukaryotic cell as an example of a structural unit of the living unicellular and multicellular systems. The initiation of this analysis starts from an older example of an imaginary mechanism, particularly that described by the Maxwell's demon experiment, which along the history of the information development concepts accompanied the philosophic vision on the structuration of matter and of the living entities, showing that these are actually the result of the intervention of information on the matter available substrate. Particularly, it is shown that the deoxyribonucleic acid (DNA) structure is appropriate to store a large quantity of structural information, allowing the transfer of this information by transcription and translation mechanisms to proteins, which act as (re)structuration/transmission informational agents, or the generation of a new cellular daughter structure by a replication process. On the basis of the theory of information in communication channels, applicable also in biological systems, it was discussed the followed line for the evaluation of the quantity of structural information in various cells, demonstrating the evolution of organism complexity by the increase of the structural information quantity from unicellular (bacterium) to human cell. Applying a natural strategy of entropy lowering mainly by heat elimination, folding protein structuration and compartmentalization on the evolutionary scale, the living structures act as dynamic entities assuring their self-organizational structure by a permanent change of matter, energy and information with the environment in an efficient way, following a negative entropic process by internal structuration, similarly with Maxwell's demon work. It is shown that to assure such a communication with external and internal intracellular structure, it was necessary the development of an own info-operational system of communication and decision, in which the operational "Yes/No" decisional binary (Bit) unit is essential. These revolutionary results show that the cell unit complies with the similar informational functions like the multicellular structure of the human body, organized in seven-type informational components, allowing the informational modeling of the activity of the living biologic structures and the opening of a shortcutting way to mimic the biologic functions in artificial cells.

Keywords: information/matter, structuration/destructuration, matter-related information, negentropy/information, non-living/living structures, informational system of the living structures

Introduction

The living creation and the mind mysteries are a few of the oldest philosophic issues of human and humanity, coming from immemorial times (Gaiseanu, 2019d) and in our nowadays even under discussion

(Schafer, 2020). With the contemporary available tools offered by the other sciences, or even exceeding them by using only the intuition and sentience human natural tools, the philosophers have built during the centuries empirical models of the living, mind and their inter-relation, starting from the Oriental bipolar Yin/Yang Chinese philosophy, the seven energetic centers of the human chakras-type architecture, converted sometimes in religious visions (Schafer, 2020), continued and developed by the Greek philosophers with new concepts and models, and passing through the Occidental contributing philosophic concepts (Gaiseanu, 2019d). Each of them tried to penetrate the mysteries of life and creation, imagining life as a gift, beyond of the human capabilities. Not latter than the recently passed 20th century, scientists, like the famous quantum mechanics physicist Schrödinger (1944), proposed to the scientific community an open discussion on the nature of life, asking the challenging question “What is life ?”.

The “fluidic” and invisible “ether” of the mind, as something different from the material body, was intuitively invoked from millennia, allowing us not only to explore the reality, but also to be creative and to modify it, gets in our days a new name: information. No other adequate way to approach this oldest and intriguing issue, if the science does not include in its investigating panoramic tools a new concept: information. As well as invisible-like “ether”, but with visible effects is information. In our informational 21st century, all of us speak about information in the most usual way, referring to internet or to any other form of info-communication, however, without associating a real significance to this concept, as the structuration of the living and even of matter is concerned.

From the point of view of the significance and intervention of information in the thermodynamic systems, the Maxwell’s demon, an imaginary experiment proposed in the 19th century and published by one of the Maxwell’s friend (Harman, 1995) is perhaps one of the most suggestive discussing challenge, because the thermodynamics is up to date one of the useful investigating tool to study the behavior of a system with respect to the rest, allowing in this way a high degree of applicability. This theoretic experiment asks the question whether the second law of thermodynamics would be violated in a system of two recipients with gas in thermodynamic equilibrium, if an “intelligent” demon would open a small door between them to allow the transit from a recipient to another when molecules with higher velocity are detected, so, in this way, a higher pressure in that recipient would be obtained. A first and valuable explication demonstrating that the second thermodynamic law is still valid also in this case, was given in the first decades of the 20th century (Szilard, 1929), showing that actually this “intelligent” demon needs to spend information in order to manage adequately the door.

Latter, the scientist and philosopher Draganescu (1979) stipulated that information is actually a fundamental component of the universe, from the primary stages to nowadays forms, which allows the structuration of matter (inert matter + information => structured matter) and of the living systems (structured matter + information => living structures) (Draganescu, 1990). Such a philosophic stipulation was probable difficult to be understood, however, more and more evidences converge to the same conclusion, showing that the substrate of the universe is actually informational (Gaiseanu, 2016). Moreover, it was shown recently that both the inert and living structures incorporate/release (“embodies” or “disembodies”) information during the structuration or destructuration processes (Gaiseanu, 2018a; 2019a; 2020b), so the properties of mind and the philosophic relation between mind and body could be clearly understood on the basis of the informational model of consciousness (Gaiseanu, 2019c) and of the informational model of the human body (Gaiseanu, 2020b). In the same way can be explained both the normal and “para”-normal properties of mind, like the

near-death experiences (NDEs) (Gaiseanu, 2017a; 2018c), religious and mystic experiences (RMEs) (Gaiseanu, 2019d) and extra-sensorial phenomena (Gaiseanu, 2017b).

Following the same line of investigation, in this paper it is presented and discussed an informational model of the living systems, starting from the informational modeling of the activity and functions of the cell, as a living unit for the structuration of the unicellular and multicellular organisms, showing a similar functionality/operability as the informational system of the human body.

Information/Negentropy Concepts in the Structuration/Destructuration Processes of the Non-living/Living Systems

The informational system of the human body (ISHB) consists in seven informational centers managed by the brain, as parts of the corresponding informational circuits (neuro-connections and transducing body organs as execution elements) (Gaiseanu, 2020b), as shown in Figure 1 (right side). Such a functional structure of the informational system can be understood taking into account two constituents of the structuration process, i.e., matter and information. Indeed, whereas the mind works with virtual information, either acquired in memory by “imprinted” image, sound, smell, taste and touch sensations from external sources, or coming from the internal body activity/reactivity as impulses transduced in emotions, corporal needs, sexual necessities and/or inherited behaviors, the info-management of the material body refers to matter-related processes. The structuration process itself is a result of information and matter interaction, because information, as an agent determining the change from a state of matter to another one, is supported by the driving forces of structuration, giving to matter the necessary directive sense, like in the intimate processes of the atomic/molecular reaction/reactive mechanisms.

In a simple basic form, if a free atom/molecule A interacts with another free atoms/molecule B, the state of the (A, B) system is changed, resulting a new structure, incorporating the information I which contributed as an active agent to this mechanism. Such a process can be written therefore as: $(A + B) + I$ (information) \Rightarrow $(AB(I))$, where (I) is in the right side of this relation the “invisible” component of the reaction absorbed/attached/“embodied” into the new material. We can refer to this structuring component as matter-related information. On a reverse way, the dissociation/destructuration process releases/emits/“disembodies” information during a reaction of the form: $(AB(I)) \Rightarrow A + B + I$.

The thermodynamic parameter defined as entropy is used as a measure of the disorder, and in an ordinate system the entropy is lower. In a reactive system, as it is the case in the living entities, the entropy depends on the chemical potential of the composing elements (D. Marín, M. Martín, & Sabater, 2009). If a thermodynamic system evolves to a structuring/ordinate state, the number of the free possible states decreases, so the entropy decreases, too. Such a decreasing process is assisted by an absorption of information, equivalent with a “negentropic” evolution. The “negentropy” term was introduced by Schrodinger to describe such a characteristic feature of the living systems, but not the concept of information was used. Indeed, according to the second thermodynamic law, the natural tendency of an isolated system is to increase its entropy, i.e., the degree of disorder, so the difference between the final entropy and the initial entropy is always positive.

The diffusion process, particularly the diffusion necessary to insert foreigner atoms in the silicon lattice structure to obtain microstructure devices with junctions, is a suggestive example, showing that at a given temperature the atoms go by substitutional or interstitial mechanisms from the local high concentration to the rest of the solid semiconductor, where the concentration is lower, till the equilibrium state is attained, i.e., when

no concentration gradient does exist (Gaiseanu, 2013; 2017c). The behavior of the living systems is contrary to this tendency, because the same difference is negative, the final value is lower. The living structures are dynamic systems far way from thermodynamic equilibrium evolving to lower entropy, permanently working for structuration to assure their existence, and against the disorder tendency dictated by the second thermodynamic law. Such a possibility is achieved by the absorption of information, like in the Maxwell's demon example. Similarly with the production of "negentropy" by the Maxwell's demon, the compartmentalization on the evolutionary scale of the living structures favors the decrease of the system entropy, always working for the heat removal to the outside, resulted from the internal work, like a refrigerating device (Marín et al., 2009; Gaiseanu, 2020c).

Our world is therefore composed not only by matter and energy, a fundamental contributor to the structuring/destructuring of matter is information, so matter, energy and information form actually the fundamental triangle of the universe. According to Einstein's relation $E = mc^2$, a mass m is actually expressible by a corresponding energy E and can be converted in this energy, multiplying this mass with the second power of the light velocity c . Such a relation points out the high quantity of energy concentrated into a modest quantity of mass, just because of the high contribution of the light velocity factor. On the other hand, information, as a changing agent, is supported by energy. Although this seems to be a surprising result, it was demonstrated recently that information could be also converted into energy, as in the imaginary experiment of the Maxwell's demon (Toyabe, Sagawa, Ueda, Muneyuki, & Sano, 2010). Instead of a gas, there were used small polystyrene particles randomly rotating in an electric field and when some higher energy particles starting to change the rotation in a contrary sense were observed, the polarization field was also changed in order to prevent the loss of energy gained by these particles.

Deoxyribonucleic acid (DNA) of the cell stores the necessary information not only for the (re)structuration process of the cell itself during the lifespan, but also for the reproduction of the cell, transferring this information to the cell daughter. The (re)structuration is achieved by means of the ribonucleic messenger (mRNA), which "reads" the stored information of some segments (sequences) of DNA in the cell nucleus during the transcription process (DNA \rightarrow mRNA) and a subsequent translation process from mRNA to proteins (mRNA \rightarrow Proteins), by the participation of amino acids, the transfer RNA (tRNA) and ribosomal RNA (rRNA), small molecules from ribosomes (special organelles of the cell involved in this process), which allows and help the protein synthesis (see Figure 1). The cells of the human body need 20 amino acids, 11 non-essentials (produced by the body itself), and nine essentials, received from the external nutrients (Alberts et al., 2015). The proteins show a folded structure, an example of the entropy decrease by such a specific configuration (Gaiseanu, 2020c). The proteins are the info-structuration material of the cells with specific functions, composing the cell architecture and/or working as informational dynamic agents.

The information is stored in DNA by the rigorous distribution of the four composing bases (nucleotides), i.e., adenine (A), cytosine (C), guanine (G), and thiamine (T) (uracil (U) in RNA) between the two strands of the helix DNA structure in a high number of combinations composing the very long DNA molecule. A key of the coding/decoding ("embodying"/"disembodying") process of information is the complementarity between these bases, determining that A will bind only a base T (or U) and G only a base C. A specific sequence of bases expresses on this way a specific information based on this type of four-letter type language. A sequence is transcript/translated to a protein, where the structuration blocks are the amino acids, composed also by sequences of these basic elements.

From the above discussion, it is evidenced that the transmission of information for protein construction, according to the material and informational needs of an eukaryotic (showing differentiated organelles) or prokaryotic (no differentiation) cell are managed by DNA processing via transcription and translation mechanisms. The information theory initiated and developed by Shannon for the informational transmission of data in telecommunications (Shannon, 1948), but applicable also for bio structures info-analysis and evaluation (Jiang & Xu, 2010; Adami, 2016; Adami, Ofria, & Collier, 2000), shows that more certainty (information I) on a system composed by N variants (states, possibilities or events) is obtained when more uncertainty (expressed by entropy H) is excluded, so I (as a positive value) is the result of the difference (ΔH) between the initial and final value of the entropy H , which in terms of info-theory is $I = \Delta H = \log_2(N)$, if all the states N are considered to have the same probability. This relation corresponds formally with Boltzmann's result of the theory on entropy S in thermodynamic systems ($S = k_B \log_2(N)$), excepting the Boltzmann constant k_B , but with different signification: while entropy S is a quantity of disorder, or unknown situation (H) of a system, information refers to an ordered system, so the information is calculable actually by entropy which must to be reduced to obtain order.

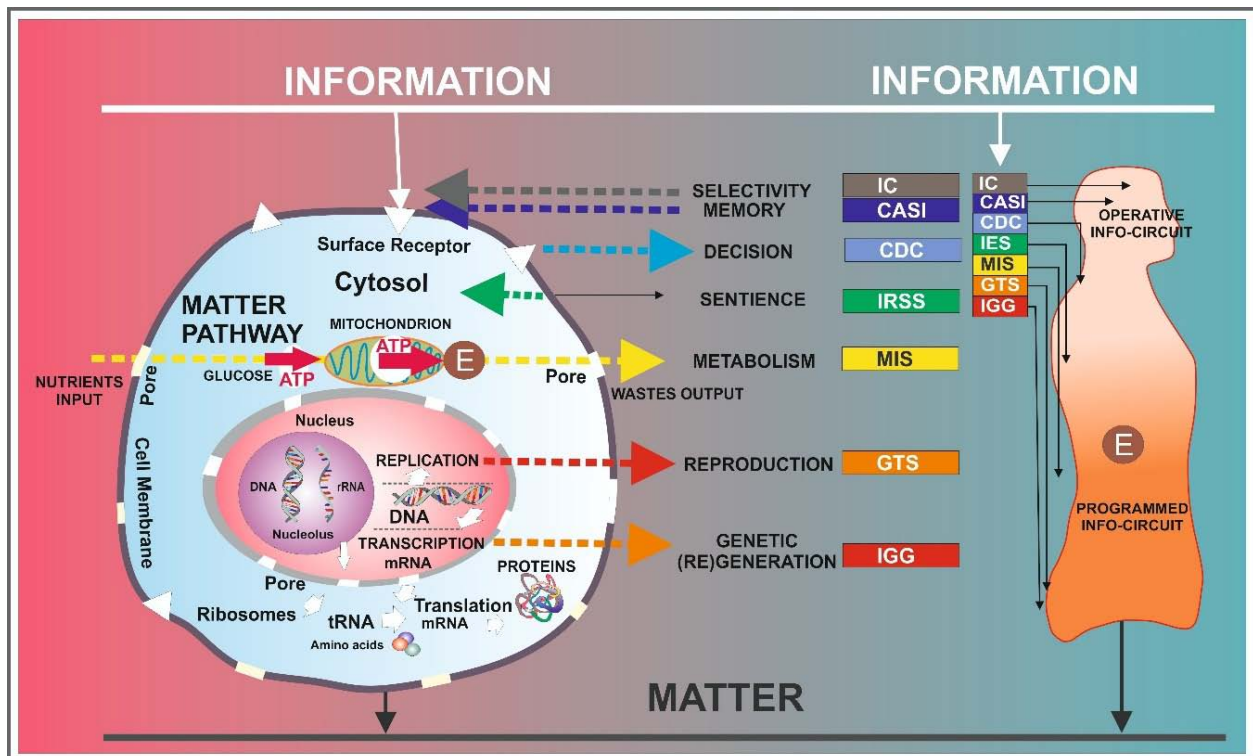


Figure 1. Informational activity in an eukaryotic cell (left side) compared with the informational activity in the human body (right side).

The above formula is a basic example, the real calculations are more complex, but on this way there were obtained estimating values of the quantity of information in various cells as follows: 5.07×10^6 Bits for *Staphylococcus aureus* (bacterium); 1.08×10^8 Bits for *Aegypti* (mosquito); 4.13×10^8 Bits for *Gallus* (chicken); 5.28×10^8 Bits for *Bos Taurus* (cow); and 8.38×10^8 Bits for *Homo sapiens* (human) (Jiang & Xu, 2010).

The necessary energy E to perform the needed tasks in the cell is provided by the cell itself, basically from the processing of glucose converted into adenosine triphosphate (ATP) either in cytosol (the aqueous

component of the cytoplasm, otherwise rather solid) and in the specialized organelle which is the mitochondrion, by an anaerobic and oxygen-assisted process respectively (see Figure 1, matter pathway). This process is managed by an informational “Yes/No” mechanism, depending on the concentration of ATP and that of a subsequent product which is the adenosine diphosphate (ADP) (Gaiseanu, 2020c): When the concentration of ATP exceeds the concentration of ADP, it is “Not” necessary to produce ADP, but in the contrary case, “Yes”.

Informational System of the Cell/Living Structures

The so called matter pathway consists in the circuit of the nutrients inflow by the pores of the semitransparent membrane (necessary therefore for energy production and the (re)structuration processes in the cell), and of the outflow of the wastes, as it can be seen in Figure 1. (Re)structuration concept includes the structuration growth for development and/or metabolic restructuring with necessary elements. This restructuring circuit is actually equivalent with the metabolic circuit in the multicellular organisms, specifically in the human body, with info-activity defined as the maintenance informational system (MIS) (see Figure 1, right side), allowing the energy production by oxidation and non-oxidation processes and nutrients digestion, connected to matter support (foods, air, water, and wastes). Therefore, the mitochondria in eukaryotic cells are equivalent with the lungs in the human body, as “compartmental” specialized organs. As a matter of fact, we have to observe that the functioning both in mitochondrion (see Figure 1) and lung is based on oxygen absorbing/processing operations poly-membrane structures. We have to note therefore that the evolution from prokaryotic to eukaryotic and multi-organic compartmental structures on the evolutionary scale is a entropy lowering process for gaining in structural information and complexity.

On the other hand, the sub-pressure of the ATP and/or nutrients components creates an internal informational signal/sensation of “hungry”, claiming a further supply with necessary matter nutrients. Two questions are to be highlighted from this observation: (i) the living structures are and must be connected permanently to the matter reservoir of the environment as a fundamental condition of their survival; and (ii) the functioning mechanisms themselves, in this case the matter internal processing, determine the generation of the internal impulses on the matter pathway as signals of informational “sensations”, asking the process commutation to a new (nutrients supply) state. The living structures as dynamic systems, generate themselves the conditions and the necessary informational sensitive tools rised from the dynamic processes themselves (overpressure/sub-pressure, over-concentration/sub-concentration with respect to an equilibrium value imposed by the homeostatic processes, action/reaction response), operating for, and assuring the continuous internal and external interactions for survival. The concept of survival itself refers actually to the internal maintenance of this steady-state dynamic equilibrium process traduced in homeostasis, such an ability of the living structures to maintain their internal global dynamic equilibrium of the entire system. The living structures cannot be in static equilibrium with their surroundings, they act as thermodynamic machineries absorbing external matter and information, and eliminating heat, material wastes and reactive informational response. Such a dynamic regime itself determines actually the need of an internal info-processing system, equipped both with informational sensors for informational perception, and tools for execution of the informational decision/response. The existence of the informational system in cells is therefore an intrinsic consequence of the survival need, based on internal stable (steady-state) equilibrium in the context of the external non-equilibrium with the environment, necessary for absorption/desorption processes. This is a sublime example of the conversion of matter in energy and information.

The decisional/informational output of the informational system of the human body (ISHB) is the attitude, and the center of the decision and command (CDC) manages this process (see Figure 1, right side), connected with the transduction/execution motor elements of the body (indicated by the corresponding arrow), especially with the vocal subsystem. The “Yes/No” informational units in the cells represent actually informational decisions, as parts of decisional/informational chains during the reactive processes. In the above example, the ratio between the ATP and ADP concentration determines both the sensorial and decisional response, allowing the trigger of the suitable execution processes of nutrition supply. In this case, such a decisional process is automatic, and is actually a precursor at the cellular level of MIS in the human body. However, similarly with the situation in multicellular animal organisms, particularly in the human body (see Figure 1, right side), the sensorial signal should belong to an info-acquirement system in the cell, represented by a center of acquisition and storing of information (CASI), as a sum of a network memorizing elements. Indeed, such a signal should be memorized, because every time when the “hungry” nutrient deficit will appear for instance, the same interpretation of such a signalization should be obtained and a subsequent suitable identical decision should be triggered.

In the human body, the signalization from external/internal sources is carried out by neurotransmitters, the same for every type of signal, in cell by various sorts of molecules. As necessarily connected to the environment, the cells communicate with this by surface receptors, represented in Figure 1 by small triangles inserted in the cell membrane with one of the top directed to the cell cytoplasm. These receptors are a certain sort of proteins, specifically able to recognize and receive only a suitable sort of signaling chemical agents, which are the ligands. Such a property is specific of memory, because only a certain signal is perceived and recognized as valid, according with the specific inherited and accumulated experience of the cell, manifested as an informational reference. This specificity is given by the puzzle-type behavior of binding between the signaling molecule and the surface receptor. This signaling messenger relays the received information to the intracellular regions by cascade of reactions many times amplifying and/or integrating the initial signal or multi-signals, which produce specific physiologic responses (Alberts et al., 2015).

Cells transmit also signals in the outside space (see Figure 1, triangles with one of the top side to the external region), communicating in this way with other cells after the info-processing. The communication in a multi-cellular organism could be accomplished by direct contact, junction gap (like in the nervous system) or by means of hormones, which support a long-range communication. Such a behavior in cells is equivalent with the activity of the CDC informational system in the ISHB (Gaiseanu, 2018b; 2019b), where the elaborated external or internal response represents actually the reactive attitude with respect to the initiating signal. As the info-signalization coming from the external region is filtered by the surface receptors on the basis of the inherited and acquired experience, such a network forms actually the corresponding “CASI” of the cell, similarly with that of ISHB, from which the decisional “Yes/No” types of chain reactions select and process adequately the perceived information along specific reactive pathways, to provide finally an internal and/or external response.

The reactive response to an activation signal as discussed above is processed by a series of internal reaction devolving an external response as “attitude”. However, as in the human body, which is a multicellular structure, the cell itself is sensitive to such signals, specifically selected and earlier experienced by the cell itself. Therefore, such a property can be actually traduced/felt/interpreted by the specialized sensors of the cell as a specific sentience or emo-state, like in the human organism. Indeed, in the last case the emo-states are

associated with the action of the signaling ligands, producing a “drug”-type dependence (Dispenza, 2007). In fact, it is already well known the emo-state effect of the endorphins producing a wellbeing state in human, so the sensitive receptors of the cell could also correspond to this type of sentience and not only. This type of reactions is typical for the activity of the info-emotional system of human (IES), as represented in Figure 1. On the same way, positive/negative sentient reactions of the simplest organisms—bacteria reported earlier (Peil, 2014), could be assimilated with an emotional reactivity, if so it is interpreted by the specialized internal sensors (Gaiseanu, 2020c). Generalizing, IES of human would correspond in cell with a sentient perceived signal or signals by a receptive part of the cell and interpreted as such, so an informational reactive-sentience system (IRSS) of the cell and living structures could be defined (see Figure 1, central-right side), equivalent with IES.

Although in the cell the microtubules were earlier considered to support only the cytoskeleton architectural structure of the cell, there are more and more evidences that such “wire” configurations could support also an electrical rapid intra-cell communication by ionic and electronic transport (Frieden & Gatenby, 2019). Such an electrical signalization was observed also in plants (eukaryotic) cells, interpretable as a proto-neural precursor of the nervous system in animals (Debono, 2013). It was shown hence that eukaryotic cells use this tubular wire-type structure to transport the external environmental information from membrane to the cell nucleus, involving ionic and charge free electron gradients near membrane and transmembrane proteins, describable in terms of information theory. The electrical info-communication in multicellular structures, like human by means of the nervous system could be rediscovered in the microscopic cell, where the cytoskeleton connects the body cell with the informational central center, which is the nucleus. In DNA of nucleus are stored both the structural and behavioral properties of cell: the special (sexual) replication of the cell reflected in the human and mammals by the genetic transmission system (GTS) assuring the reproduction, is actually the core of this process, whereas the transcription and translations are intimate mechanisms at the cell level reflected in the human body and animals by the info-genetic generator (IGG), assuring the development of the organism (together with cell replication for specific body growth/development) according to the age (see Figure 1, central and left side).

The info-connection center (IC) in the ISHB is responsible for info-selection, managing the external information in comparison with the internal stored information during the interaction with the environments, verified/validated already by experience and in agreement with the inherited genetic/epigenetic information. The long-time transgenerational acquirement and transfer of information during the adaptation process, as a consequence of the interaction with the external factors and cues (Gaiseanu, 2019e), is supported by the epigenetic mechanisms (Gaiseanu, 2019f), responsible for the integration of the external information into the genetic (stably “embodied”) matter-related information at the cellular level by a repetitive process assisted by chain cascade molecular reactions in cytoplasm. An evident selective role of information is assured by the surface receptors (see Figure 1, left side), allowing the transmembrane transfer only of certain types of information according to the cell adaptation and survival needs. On the other hand, as such receptors are designed and produced by the cell itself just to comply with such tasks, the various conditions of the surroundings imposing adaptation, determine corresponding suitable sorts of receptors to be generated, able to perceive specific information from the outside space. At human IC is associated with extra-sensorial phenomena, near-death and religious and mystic experiences (NDEs and RMEs), as it was shown recently (Gaiseanu, 2017a; 2017b; 2019c; 2019d). In other living organisms, the functions of this connection can refer

to the synchronous orientation to form the same configuration of the bacteria colonies (Jacob, Shapira, & Tauber, 2006), the spatial and temporal orientation of the birds during the migration, or to some species of fishes and animals sensitive to premonition signals before a bad time or catastrophic events. Such special communication can be interpreted like in human as “extra”-sensorial perception and is attributed to specialized sensorial properties revealed even by the smallest unit of the living category, which is the bacterium.

We have to observe therefore that the living organisms are matter-related info-structures, sensitive to information, depending on and communicating permanently with the external environment to assure their steady-state dynamic structure and functions. They are connected to two poles, like the human organism, i.e., matter and information. Their survival depends on such a collaboration, adapting their functionality with respect to the changing conditions of the external environment, if such changes conditions remain permanent/insistent during the lifespan, on the basis of the activity of seven informational components, similarly with the informational systems of the human body, where the operational info-system (OIS) for short-term reactive adaptation acts with the contribution of CASI, CDC, and IES/IRSS, whereas the programmed info-system (PIS) acts to maintain the actual structuration/(re)generation and energy (MIS), the generation of the material structure for growth (IGG) by transcription/translation processes, and for reproduction (GTS) by replication process. IC is also a participating center with extra-sensorial capacity, allowing the communication with the collectivity and external driving phenomena of the environment. According to this discussion, we have to conclude that the living organisms are bipolar self-organized entities, info-managed similarly with the human organism by an informational system of the living structures (ISLS), composed by seven info-subsystems, so that the informational system of the living structures can be described by the relation:

$$\text{ISLS} = (\text{CASI} + \text{CDC} + \text{IRSS} + \text{MIS} + \text{GTS} + \text{IGG} + \text{IC})_{\text{ISLS}}$$

The earlier predictions expressed by philosophic concepts (Draganescu, 1990) are supported by such a modeling process.

The revealing of this general info-structural architecture of the living organisms shows the common commandments on the entire scale, from simplest living units to multicellular organisms, working with matter and information in a combinatory and similar way. These revolutionary results open new perspectives both in the deeper study of the information-assisting living processes and in the simulating efforts to mimic the cell functions (Lim, 2010; Gibson et al., 2010), or for a suitable design of devices with biomedical applications (Gaiseanu, 2020a). The present study, synthetizing the basic activity of the living structures, explicitly revealing seven-type categories of distinct functions, creates therefore a basic platform not only for a deep understanding of the cell biologic functional architecture, but also of its “machinery” and associated working “modules”, constituting from this point of view a shortcut way to the design of artificial cells and of the rapid application of the “big data” methods from the domain of informational engineering (Filip, 2020) to the biologic natural and/or artificial mimic systems (Dolinska & Troyanskaya, 2015).

Conclusions

This paper discussed the developing process of the information concept initiated from the philosophic perspective, including both the hypothetical Maxwell’s demon experiment in thermodynamics and Draganescu’s philosophic assertion on matter structuration, pointing out that actually information is a fundamental component of both of them, participating to matter structuration and in a higher proportion in the

structuration/compartmentalization and functioning of the living entities, driven by entropy lowering processes determined by absorption of information.

As a demonstrating evidence, it was discussed the concept of negentropy derived from the observation of the thermodynamic behavior of the living structures, showing that these operate in a similar strategic way like Maxwell's demon, absorbing matter, energy and information and eliminating heat, matter-wastes and reactive information in the environment, in a permanent dynamic process of matter/energy/information inter-change.

Comparing the informational activity of an eukaryotic cell, as a basic example of the structural unity of the life with ISHB, there were observed and explained the similar informational functions of this basic structure with that of the informational human body, showing that the living cell comply with the seven distinct functional characteristics, i.e., memory (equivalent with CASI in the human body), decision (equivalent with CDC), reactive-sentience (IRSS similar with IES), metabolic automatism (like MIS), genetic transmission by replication (equivalent with GTS), genetic transcription/translation for own restructuration (MIS) and development (like IGG), and info-connection to the external environment by "extra"-sensorial channels (equivalent with IC). This modeling demonstrates the info-matter fundamental structure of the living systems.

According to these revolutionary results, the identification of the components of the informational system of the living structures allow the modeling of the informational activity of the living systems on the entire evolutionary scale and the opening of a shortcut way to mimic the biologic functions in artificial cells.

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