

# Advanced Results in Biological Researches: Informational Structure and Info-Operability of the Living Systems



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## Editorial

There are a few fundamental problems still unsolved up to date, in spite of the intensive and multidisciplinary researches with modern/highly developed means of investigation in biological structures, and of the great advances concerning especially the study of the mechanisms involved in the micro-structuration from the simplest to the more complex organism, that of the human. One of these major problems is to answer the question “what is life” [1]. This concise question, as simple as it is comprehensive in terms of the broad spectrum of scientific branches involved, lanced in the first half of the last century, remains a great challenge even today. Another fundamental question remained since millennia on the working table of scientists and philosophers refers to the understanding of consciousness, which however received recently an informational response [2]. And more than that, an immediate derived question is if the subhuman species could have consciousness.

Although present and extensively used every moment in our daily actions and activities during the communication by microelectronics means with laptops and smartphones, the concept of information is still not yet deepened enough, when the mechanisms of life and its functioning are approached at the global level. With the aim to cover this gap, remarkable advances were registered recently in biological field of researches, by the efficient introduction of the concept of information during the structuration/destructuration and configuration/reconfiguration of the living matter, appropriately defined recently as “informed matter”, to distinguish it from the inert, non-living matter structures [2-4]. A fundamental observation when the discussion on living is concerned, is first of all that the biological systems work every moment to maintain their structures, against the natural tendencies to deconstruction, marked by the law of the increasing entropy. This is a driving work for self-organization, continuously spent to maintain the entire structure under functional conditions, which is achieved by the absorption from the environment the necessary nutrient matter (foods, water, air), to convert it in energy (E) and the necessary specific micro-components for body construction/reconstruction, and the elimination of the unnecessary wastes. This process is managed by the Maintenance Informational System (MIS), marked in figure 1 left side, where it is schematically represented the informational system of the living structures, independently on their form, category or species. The living structures are therefore necessarily connected to matter, as nutrient source.

In the eukaryotic cell, the unit of life, specific for multicellular organisms like plants, animals and humans, but also able to maintain itself as a singular organism, the energy is basically obtained by oxidation processes of glucose within the specific mitochondria organelles, with similar functions like that of the digestive system in human (marked by the horizontal dashed

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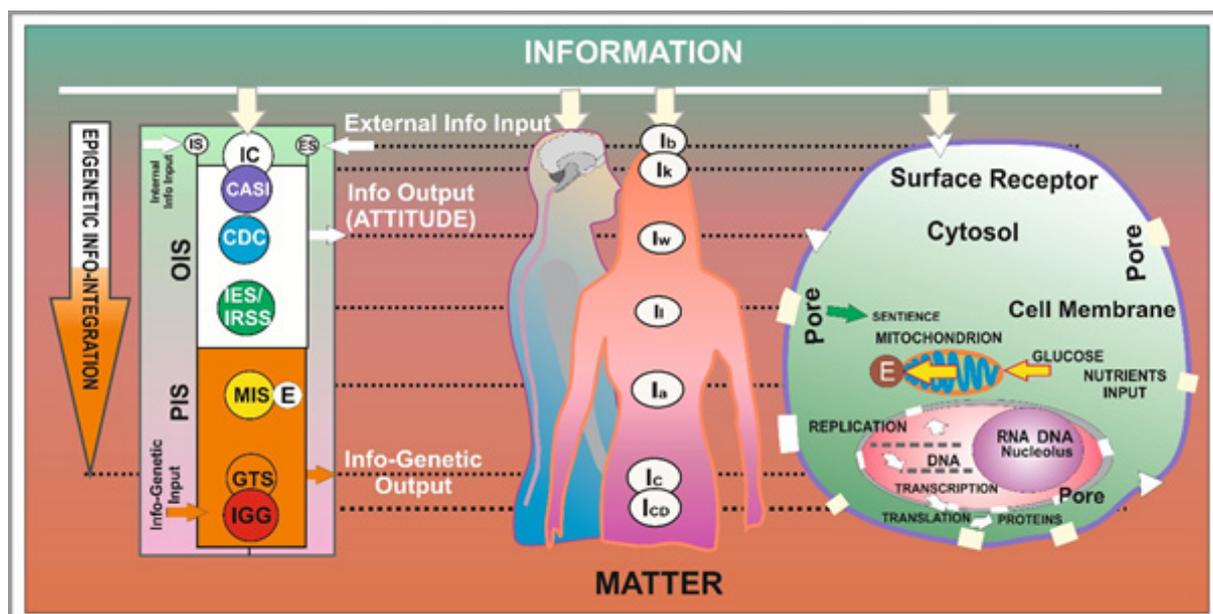
line in the figure 1, corresponding to MIS). In plants, the energy is specifically achieved by the light-assisted photosynthesis processes in chloroplasts organelles. These processes are similarly complied in prokaryotic cells, living organisms units typically represented by bacterium, where the nucleus is non-enveloped by a semi-transparent membrane (with info-receptors and pores), and the organelles are not separate entities within the cytosol volume, like in the eukaryotic cells.

How is achieved this self-organizing structure and what is the key to this strictly ordinated organization, are questions to which the response is given by the informational activity of the Deoxyribonucleic Acid (DNA) and Ribonucleic Acid (RNA) assisted by enzymes in the cell nucleus and cytosol. This activity allows the surgical/tailoring structuration/destructuration processes to copy sequences from DNA by mRNA (messenger RNA), and to transcript/translate them in cytosol for protein synthesis, which are the fundamental “bricks” of the body building of any biological structure [4], with the participation in a YES/NO algorithmic structural complementarity of the amino-acids (figure 1 right side), as discussed below.

In terms of information, the basic informational agents for info-communication in the unicellular and multicellular organisms are basically the proteins/peptides/amino acids in various forms, but the key of communication consists in the unique selective YES/NO-type binary (Bit) “conversation” by binding coupling between partners, only on the basis of their structural/functional complementarity, like the communicability between an informational agent and the corresponding surface receptor of a semitransparent internal or external membrane. Similarly, in human and subhuman organisms equipped with a nervous system, the inter-cellular communication is complied by excitatory/

inhibitory (YES/NO) opposite neurotransmitters (peptides/amino acids molecules) within the intercellular gap and supported by the ionic (K<sup>+</sup>/Na<sup>+</sup>) waves acting as a YES/NO (“all or nothing”) electrical firing mechanism along the axons of the nervous cells [5,6].

In a similar binary way, the nucleotides of DNA, i.e., adenine (A), thymine (T), guanine (G) and cytosine (C) can be chemically coupled only as pairs A-T and C-G. The info-communication from DNA to mRNA and proteins is achieved by a four-“letter”-type “alphabet” with “words”/“phrases” of various sequences copied by mRNA from the very large DNA molecules of the genes. The DNA replication to form a new cell is basic for the reproduction process, driven/managed by the Genetic Transmission System (GTS), assuring the info-genetic output, and the transcription/translation processes by the Info-Genetic Generator, leading the growth/development process of the new organism according to the age, initiated as the info-genetic input (“zip”-type compressed matter-related informational egg). It is important to note here the amazing info-assisted self-development of the “hardware”/“software” system triggered only by minimal, but obligatory conditions, specific for each species (temperature, nutrients, protection ambient). In superior multicellular organisms like human, specialized components of the brain manage/control these processes and are connected (schematically indicated by the corresponding horizontal dashed line in figure 1) with specific executory/sensitive organs of the body [7]. A Programmed (automatic) Informational System (PIS) can be therefore defined as PIS=MIS+GTE+IGG. Each component of PIS has distinct functions and works in an autonomic way, operating with matter-related information, achieved/released by structuration/destructuration mechanisms, as commented above [2,3].



**Figure 1:** Schematic representation of the informational system of the human body and living structures (left-central part of figure), particularly applied/explained for the eukaryotic cell (right side of the figure).

The living organisms are coupled at information from the internal/external environmental world by means of the internal (IS)/external (ES) sensor networks (figure 1 left side), which receive the input information and stokes them into the Informational and Acquisition Center of Information (CASI). The analysis and interpretation of information is operated by the Center of Decision and Command (CDC), which manages the decision process - the reactive response of the unicellular/multicellular organisms to the information, according to own "learned"/inherited strategy on the basis of decision criteria of the individual/species life experience for adaptation and survival, managed by the Info-Connection (IC) pole (figure 1 left side). This selective "navigation" pole in human distributes automatically information by the YES/NO type strategy from the inferior brain structures to prefrontal cortex via cingulate cortex [8,9]. In plants and animals this is manifested by the synchronized geometrical disposition of the bacteria colonies, by special sensitivity (sun-orientation/reactivity) at plants, anticipated danger detection and spatial orientation at some species of birds, fishes, snacks [10,11]. At human, CDC operates with conceptual/virtual information expressed as language by the vocal system [9], as gesture and mimics - the corporal "language", measurable also in Bits [10-12]. The vocalization and/or other forms of info-output manifestations are also commune to subhuman species. The internal sensorial/sentient/alarm reaction to the external information is managed by the Info-Reactive Sentience System (IRSS) in the living structures in general, interpreted at human as emotions, and as "sentience" by other species and the cell (figure 1 right side). At human, the emotional reaction is operated by the Info-Emotional System (IES), which is correlated with the hearth (schematically represented by a corresponding horizontal dashed line in the figure 1), for momentary redistribution of the blood (nutrients) to the cells in need. This system introduces an additional YES/NO (acceptance (GOOD)/rejection (BAD)) type of the binary info-operability [13].

An Operative Informational System (OIS) can be therefore defined, necessary for the local info-determination/surveillance status with respect to the internal/external survival needs (normal body functionality, nutrients availability, dangers avoidance), in a permanent collaboration/ confrontation with the environment. Remarkable for the living structures is their capacity/availability to adapt to the environmental change conditions, if these acts repetitively/intensively/permanently to them, by the integration of information into the stable genetic memory of the species by epigenetic mechanisms [14]. This process is initiated from CASI via CDC, IES (momentary reactivity), continues with MIS (automatic response) and is finalized by the stable integration in GTS, transmissible to the IGG of the next generations (schematically represented by the vertical arrow in the left side of figure 1). The large spectrum of the species categories, adapted to the air, water and hearth survival under various structural/constructive forms and behavioral manifestation, shows/demonstrates the powerful driving force of information on the evolution process of the biological structures and on their existence.

The info-projection in mind of the components (CASI, CDC, IES, MIS, GTS, IGG, IC) of the human informational system, is manifested/ detected as cognitive centers of consciousness, suggestively defined as Iknow (Ik in figure 1) - memory, Iwant (Iw) - decision, Iam (Ia) - self-status/ vigor/health/power, Icreate (Ic) - genetic/ biologic creation, Icreated (Icd)-genetic/biologic inheritance, Ibelieve (Ib) - beliefs/trust/confidence, mental spatial-temporal exploration/"navigation" [2,9], info-anticipation [15]]. These are the basic info-operational centers of consciousness, which practically express, represent and actually define consciousness, detected and recognized consciously by the self/ego "I" as:  $I=Ik+Iw+Il+Ia+Ic+Icd+Ib$ . According to this informational model, in the inferior organisms the sensory sentient/cognitive capacity/ capability/operability should be less developed but even active, according to the living needs amendments, as less developed as the complexity of the informational system and the body support is simpler.

Information is therefore a determinant component of life, intervening both in physiologic and behavioral structure of biological organisms, either by matter-related information as a genetic form, representing the long-time accumulated and stable experience of species, or by rapid adaptive reaction to internal/ external information, transported by chemical and electrical agents. As entities connected to matter and information, absorbent and emitters of information, the biologic organisms demonstrate the powerful role of information for their structural and behavioral manifestation and modification. This remarkable property can be used for the information-based neurorehabilitation [16] and treatment and/or preventive therapies of neuro-dysfunctions [5,17].

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