

Information in the Universal Triangle of Reality for Non-living/Living Structures: From Philosophy to Neuro/Life Sciences

Florin Gaiseanu

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

With the purpose to understand better the role of information not only in communication systems, but actually in our environmental reality, this paper presented the model of Universal Triangle of Reality, composed by Matter, Energy and Information, as fundamental constitutive components of this reality. Arguments coming from the field of physics, both at the cosmic and microparticles scale are presented, showing undoubtable conclusions that information is a fundamental component of reality in our material world. At the cosmic level, where the unusual high concentration of mass in the black holes constitutes a special state of matter, suitable for analysis of their special properties, the problem of the conservation principle of information is discussed. At the quantum level, the special unusual characteristics derived from the non-localization principle are also highlighted, together with information-involved problems and solutions. The Universal Triangle of Reality in the living systems reveals the high role of the involved information, both as the informational common organization on the entire evolution scale, and as the info-dynamics processes inside of own structure and resulted from interaction with the environment. The relevant advances in the approaching and understanding of the functionality of the living systems from informational point of view are highlighted, showing the high contribution of information concepts in understanding/solving of various older/recent problems in philosophy, neuroscience/neurology/psychiatry, neuro-physics/neuropsychology/behavior sciences, geriatrics/gerontology, biology and life sciences.

Keywords: information-matter-energy, universal triangle of reality in non-living and living systems, informational system of human body and living structures, neurosciences and life sciences

Introduction

Information has been penetrating many of our daily concerns, without us being aware of its special role. Our thoughts are actually information, independently whether these remain memorized/“lived” within our intimacy, or whether these are shared/communicated to the external world. Information comes to us also by communication through the means of modern techniques, which makes us feel closer to each other, although at great geographical distances. The media sphere offers us information, by all written, spoken means, or by means of television and/or live broadcast. We live in the middle of an ocean of information, without really being aware of it. However, in the common or scientific thinking, not only within the philosophical debates, but

Florin Gaiseanu, PhD, Principal Senior Researcher (Professor), Science of Information and Technology Bucharest (Romania) and Barcelona (Spain).

even in other branches like neurosciences, this is limited on the belief that reality is composed by matter and energy. Indeed, starting from the most important consignments of the past millennia, promoted by the Greek philosophy of Aristotle (Shields, 2020) about matter as the main/fundamental constituent of reality, and also by the Chinese Confucius's philosophy (Raphals, 2020), which promoted the energetic view of the Yin/Yang (Feminine/Masculine) type of reality structuration, the modern sciences base their philosophical construction mainly on matter and energy, as fundamental components of reality in which we live. Although information, as a concept, is sometimes explicitly recognized and used to describe the phenomena of nature and some processes in the human body, this concept is implicitly and tacitly assumed, without a deep understanding of its fundamental importance and involvement in the actual structuring of reality itself. In order to clearly understand the importance and involvement of information in everything that does surround us, in a series of recent articles was highlighted the role of information in describing the functionality of the human body (Gaiseanu, 2018a; 2019c; 2019d; 2020a; 2020b), of the mind (Gaiseanu, 2019d), and even of living systems in general (Gaiseanu, 2020a; 2020d; 2021a; 2021c), as well as of the relationship between the mind and the body, a problem debated since thousands of years ago (Gaiseanu, 2021b). However, the problem of how information intervenes in the structuration of matter was approached very little, and even less in the living structures, only sporadically and punctually, in some specific concrete cases.

Recently it was shown that the real concept of information has not a long history, starting actually since the middle of the last century (Gaiseanu, 2021h), although information (viewed as "ideas"/"forms"), was proposed/promoted by Plato in his Greek philosophy school (Kraut, 2016), as a key element in the organization of the world. In order to demonstrate the broad/deep effect of the introduction of information concepts, information is presented as a structural component of reality, from which many scientific branches find a suitable source and tool of investigation, or solutions to the problems under debate, as it will be shown in detail in the presentation bellow.

The Universal Triangle of Reality: Information, Matter, Energy

It seems strange to refer to reality as a composition not only of two elementary components, namely matter and energy, but also of a third component, which is information. That is because the role of information in shaping the surrounding reality is not really understood. If Plato imagined metaphorically the world not only as based, but even as initiated by "ideas" and "forms", we already live today in such a world of ideas, i.e., information. This is created by the human mind and communicated through the internet and the microelectronic-based means. However, we still believe that the structural basis of reality is simply assured only by matter and energy.

The intervention of science and technology of information in communications has changed definitely the life in the world and transformed it into the modern life we enjoy today. From the couriers of the Roman army, who were bringing news from the battlefield, and from the post chaise with horses carrying the written correspondence, from a not too distant past, today we are not only the partakers, but also the creators of the informational abundance coming from the events of daily life, and from the virtual media sphere of human creativity. The time difference since the middle of the last century, when started the intensive development of our informational era based on microelectronic devices is quite small, but the advancing technological/informational step is gigantic. We express our thoughts communicated through internet, we live and adapt to this formidable world of information, and the computer, telephony, audio-visual means, become

the informational extension of our senses that improved our life and made it more comfortable and longer than in the past. Communication through language is also a process of transmission and reception of information (Gaiseanu, 2019a), and human, as a rational being, has reached on the evolutionary scale this apogee through the development of the nervous system and the brain, as his own informational support (Gaiseanu, 2020e). And yet, what do we know, and how much more do we need to know about information and its involvement in reality itself?

Entering the thread of “ideas” and “forms” invoked by Plato’s philosophy and reaching the scientific approach of information in our modern era, we notice that the way was not easy at all (Gaiseanu, 2021h). Information is still viewed intuitively, as a novelty in the communication process, and that’s all. But information has a much deeper meaning, if we look at the way the matter is structured. The process by which microparticles combine to form the material macrosystems is an information-assisted process, as they transform from a multi-particle micro-configuration, into a new form of matter, in which these particles lose their identity and cooperate to form a new structure with modified properties, some of them different from the properties of the initial material. The transfer of a material system from a configuration to another takes place with information absorption, as recently was shown (Gaiseanu, 2020a; 2021c; 2021h), according to the schematic relation: $(A + B) + I \Leftrightarrow AB(I)$, where the initial distinct components A and B become linked within a composite system, and the information I becomes hidden (implicit) as (I) information, but still active within the composed structure. Indeed, information can be released by a decomposition/destructuring operation: $AB(I) \Rightarrow (A + B) + I$. The structuration/destructuration of the very long molecule of deoxyribonucleic acid (DNA) in the cells is a relevant example (Gaiseanu, 2020a; 2020c).

Information is therefore a component of structured matter itself, in whatever form of aggregation it may be found. According to the principle of conservation in nature, information is not lost; it is preserved, as well as matter and energy. Matter with a mass m can be transformed in energy, according to Einstein’s well-known relation $E = mc^2$, where c is the speed of light, as a universal reference. Matter is also generated from energy, the energy fluctuations of the vacuum giving rise to particles of matter and antimatter (Hajdukovic, 2012; 2011). In a recent reported experiment (Toyabe, Sagawa, Ueda, Muneyuki, & Sano, 2010), it was demonstrated the transformation of information into energy. Indeed, in a container with polystyrene particles suspended in an electric field, which mimics the imaginary experiment of Maxwell’s demon (Szilard, 1929), the sense of the applied field was changed to prevent the energy loss, when it was observed that a particle changes its rotation (marking a plus of energy). In this way, it was obtained an energy increase up to 20%.

The hypothetical experiment of Maxwell’s demon (known also as Maxwell’s paradox), consists in the opening of a door by an “intelligent” demon, which would allow the passage of gas particles with higher speed (so with more energy due to the fluctuations) in a second container with the same gas under equilibrium conditions. Such a process would increase thus temperature in the second container, violating the principles of thermodynamics. Such a paradox, however, cannot be explained without considering the information expended by the demon to measure the velocity of gas molecules and to synchronize the door opening (Szilard, 1929). Information is therefore an effective participant in the natural processes of inter-correlation between various forms of constituents, and a recent article discussed the convertibility between mass, energy, and information (Vopson, 2019) as follows:

- the quantitative conversion between a mass m operating as an informational device and the stored information I ($m \Leftrightarrow I$) in terms of digital (binary) units (Bits), can be expressed by the elemental relation $m =$

$kT \ln 2 / c^2$ corresponding to one Bit of information, where k is the Boltzmann's constant, T the temperature in °Kelvin and $\ln 2$ comes from Bit-unit information theory (Shannon, 1948); within this frame, the mass of a bit of information at room temperature (300°K) is 3.19×10^{-38} Kg, so I corresponding to a mass m can be calculated by the relation $I(\text{Bits}) = m(\text{Kg}) / 3.19 \times 10^{-38} (\text{Kg/Bit}) = m(\text{Kg}) \times 3.13 \times 10^{37} \text{ Bits}/(\text{Kg})$;

- the quantitative relation between mass and energy (mass \leftrightarrow energy) can be expressed by the Einstein's relation $m = E/c^2$, showing that a large quantity of energy is necessary to create a very small quantity of mass, because of the high value of c ;

- the conversion between energy and information (energy \leftrightarrow information) can be expressed by the elemental relation $E = kT \ln 2$ for 1 Bit of information, or $E = I(\text{Bits}) \times 3.19 \times 10^{-38} (\text{Kg/Bit}) \times c^2$ at room temperature, corresponding to the quantity $I(\text{Bits})$ of information.

Shannon approached information by probability theory in an electronic digital (binary—Bit) communication system, showing that information is treated as a new event that occurs distinctly in a series of events, like the encoded letters of a texts, in which noise can change their content on the transmission channel. Such a system is composed by an information source and an information encoder, connected through the communication channel to a receiver and an information decoder. The amount of information is obtained by eliminating the uncertainty expressed by entropy, where the entropy expression is similar to Boltzmann entropy, applicable in microparticle systems (Shannon, 1948), but distinct as interpretation. Communication circuits of this type are widely used in electronic transmissions, but information theory can also be applied as a communication process in the nervous system of humans and animals (Gaiseanu, 2021c; 2021h).

The exploration of reality by considering information as a constitutive element is an issue approached relatively recent by physicists in cosmology, where the black hole, formed by a huge concentration of mass, can reveal effects that cannot be explained without resorting to information and the conservation principle of information. The so-called black hole paradox shows that the black holes emit radiation that would cause their evaporation, and therefore information accumulated into the black holes should be lost during this phenomenon, which would violate the principle of information preservation (Hawking, 1975). This contradiction can be resolved (Hawkins, 2005), within the frame of the string theory of universe and holographic projection of information on a surface at the events horizon (Susskind, 2008; Stephens, Hooft, & Whiting, 1994). Therefore, information continues to exist, it is not lost, and can be found by holographic projection on this distant surface (Susskind, 1995; 2008), the whole universe thus appearing as a structure that preserves its information. Alternatively, it was shown that this paradox can also be solved by generalizing the law of entropy near the black hole (Bekenstein, 1974), consisting in the addition to the traditional term of an unconventional term related to information, so that the amount of information contained in the black hole and a portion/surface around it, never actually decreases, so information is preserved in nature.

At the level of microparticles, the evidences on information are even more surprising. One of the most amazing results obtained recently show that the properties of elementary particles, specifically those of neutrons, can be separated from their mass body (Denkmayr et al., 2013). Exposing a neutron flux to a magnetic field, two spin neutron beams (defined by the direction of rotation around its own axis), different from each other, were obtained. By introducing additional filters and magnets on the two fluxes, one of the neutron fluxes passed into the other, leaving only their properties in its initial trajectory. This effect has been experienced and shown to apply to a wide range of particles and even atoms or groups of atoms (Aharonov et

al., 2013), revealing two essential conclusions: (1) Information is implicitly contained in the material particle; and (2) information may be dissociated as a distinct entity from the material body.

The way in which information is obtained seems to have a decisive role in the behavior of the microparticles in quantum mechanics: when they are not observed, they may occupy more than one of the two (YES/NO) states, as it is the case in classical mechanics. To reflect this special property, the unit of information in quantum mechanics is called Qubit, or Quantum Bit, and is defined as a complex number. The fundamental difference between Bit and Qubit is that Bit is based on the operation between two states: 0 and 1, while Qubit includes the possibility of operating in so-called superpositions, consisting in linear combinations of states. The process of “collapse” consists in the reduction to one of the fundamental states, 0 or 1 (Nielsen & Chuang, 2000). Consequently, the state of a Qubit can be expressed by a two-dimensional vector of complex numbers, as a combination $(\alpha|0i + \beta|1i)$, where α and β are complex numbers, and the states 0 and 1 from the classical physics are denoted in quantum mechanics by $0i$ and $1i$, to distinguish them from the classical ones. According to quantum mechanics, what can be said about the measurement of a Qubit is that the value 0 would have the probability $|\alpha|^2$ and the value 1 the probability $|\beta|^2$. This specific behavior has been recently interpreted/explained and described mathematically (Laloë, 2020) as a process of gravity-induced quantum collapse, originally proposed by the physicist Roger Penrose (1965). This process would lead to the reduction of the multiple system to one of the real states, 0 or 1. Such a quantum mechanics problem is known as the Schrodinger paradox, and is suggestively expressed by the fact that a cat in a box can be both alive and dead simultaneously, because its true state cannot be known until the box is opened.

The principle of non-localization of particles in quantum mechanics consists in the fact that the position of a particle cannot be precisely determined, as it can “co-exist” in several states simultaneously. However, as Gaiseanu recently suggested (Gaiseanu, 2019b), the complementary pairs of elementary particles in vacuum are generated and recombined continuously, so that if the position of a single particle is followed, it can disappear and reappear elsewhere through the generation/recombination phenomenon, which maintains the local concentration in a dynamic equilibrium state. Because the frequency of occurrence/disappearance is much higher than the time allocated to a theoretical “observation” in the closed box with particles, this phenomenon appears as uncertainty of location of the particle. The real (physical) observation by an instrument includes a new component in the system, which determines the separation of the real signal from the generation/recombination phenomenon as a “background noise” of the process.

A direct application of this phenomenon is the quantum computer based on superconducting systems technology (Van der Waal et al., 2000), or on semiconductor structures (Loss & DiVincenzo, 1998). In this situation, if, in classical computers, the Bit unit is related to the states 0 or 1 associated with the closed (NO), or respectively open (YES) conduction of transistors or operational circuits, in quantum systems of isolated particles and under controlled temperatures, these computers can work at the same time in parallel, with the superposition of both states 0 and 1 simultaneously, which can “collapse” in one of the real positions 1 or 0, as commented above. If these atoms/systems are observed while working, these overlays disappear, decompose. As expected, the speed and computing power of such computers would increase enormously compared to existing classic computers, the application potential being extremely high.

The dual behavior as particle/wave also does not allow us to specify exactly the state of a beam of quantum particles, because this state depends on the experiment: indeed, such a beam behaves like a wave

when is observed in an interference system, or as a discrete particle, in the case of light measurable by the number of photons, for instance in a laser system. The two forms of manifestation are totally different: while the wave refers to the propagation of the perturbation of a physical property with energy transport but not mass, the other form of manifestation involves mass. The information, mass and energy seem to be consequently associated in the same whole, the form of manifestation depending on the conditions of the experiment.

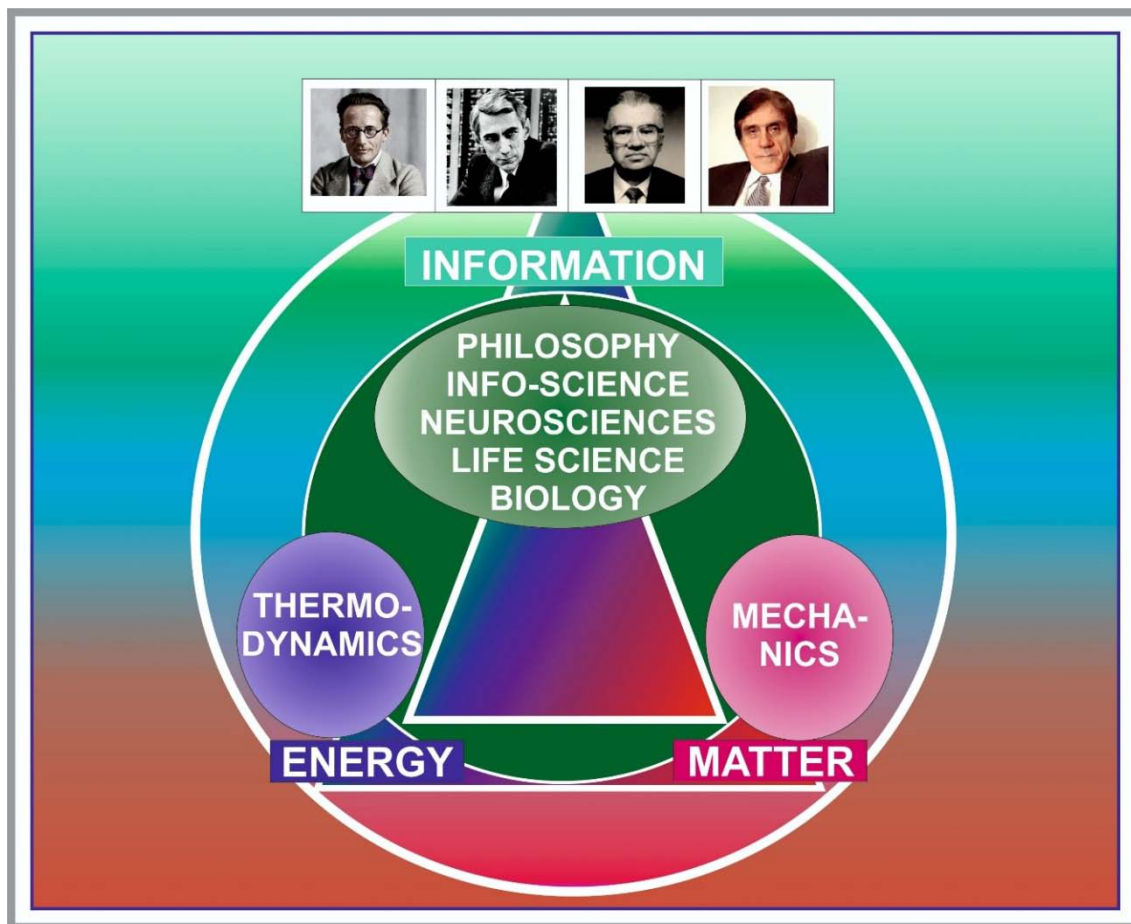


Figure 1. Schematic representation of the Universal Triangle of Reality (UTR).

Note. It is composed by Information-Energy-Matter trinomial shown in the background by a triangle inserted in the big circle (non-living world), and the similar (smaller) triangle corresponding to the living world, inserted in the green circle of the foreground in this figure. In the top side of this triangle are shown respectively Erwin Schrödinger, Claude Shannon, Mihai Draganescu, and Florin Gaiseanu, as contributing authors to the development of information concepts and modeling, especially in the biological systems. In the same figure are represented the scientific spheres mainly dedicated to the study of each of indicated components of the triangle, in this particular case philosophy being included as co-participant to the approach of information concepts.

We can conclude therefore that, according to the recent theoretical and experimental studies, our reality is composed not only by matter and energy, but also by information, as a fundamental component associated to the first two. On the microparticle scale, the real state cannot be defined exactly as long as the system is not observed. Information is conserved in universe and is not lost. As a consequence of the analysis presented above, a Universal Triangle of Reality can be defined, able to describe reality at micro/macro or cosmic level, shown in the background plan in Figure 1, in which the information was represented in the upper point, the energy in the left point and matter in the right point.

In the same figure in the foreground is represented the living world by a similar triangle, as part of reality. If ancient and until recent philosophy called information as a world of “ideas”/“forms” (Kraut, 2016) or “informatter” (Draganescu, 1990), the universal triangle represented in Figure 1 reveals at the top information according to the information theory proposed by Shannon (1948). The microparticle behavior in quantum mechanics was described by Schrödinger (Rechenberg, 1987). Gaiseanu showed that reality can be described from informational perspective by the binary YES/NO unit of complementary components, associated to maintain global neutrality/stability, even if these components can be separated both in the non-living structures (Gaiseanu, 2016) and in the living systems (Gaiseanu, 2020d; 2020f). He contributed to the understanding from the informational perspective of the structuring/destructuring processes in living and non-living systems (Gaiseanu, 2021h), and to the modeling of informational organization in biological systems, as will be presented below. In the same figure are marked the main current sciences dedicated to the study of energy behavior—the sphere of thermodynamics, and to the study of matter/materials, which is the sphere of mechanics. The next chapter presents in more details the contribution of information to the current development of the sciences that study the living systems, particularly the field of neuroscience, biology and life science, starting from the principles of philosophy and information theory.

The Universal Triangle of Reality for Living Systems: From Philosophy to Neurosciences and Life Sciences

On the Universal Triangle of Reality of the living systems in Figure 2 are shown schematically the components of the Informational System of the Human Body and Living Structures (ISHBLS), which can be described as follows. The Center of Acquisition and Storing of Information (CASI) (see Figure 2, left side) is connected to the internal and external sensors (IS and ES) for the detection of reality signals from own body and external environment, and with the corresponding body regions marked by the dashed line in eukaryotic cell (surface receptors shown in the central part of Figure 2) and with the human brain (right side of Figure 2). In human, this is reflected in mind as the cognitive center suggestively called Iknow (abbreviated by Ik). The Center of Decision and Command (CDC) manages the reactive response of adaptation to the stimuli and is connected in the eukaryotic cell with the cell cytosol/info-output (chemical chain reactive pathway of decision) and with human/subhuman organism by the brain and especially by the info-output (attitude) expressed as a vocal reaction (by Iwant (Iw)). The Info-Emotional System (IES) or Info-Reactive Sentient System (IRSS) of the cell and inferior organisms, responsible for emotional/sentient reaction to the input information, is connected with the cytosol body in eukaryotic cell and with the brain/heart region of the human/sub-human organisms, reflected in the human mind as the cognitive center Ilove (Il).

The Maintenance Informational System (MIS) is the manager of the metabolic processes both in eukaryotic (by mitochondrion pathway) and in human/subhuman organisms by the digestive system, both for energy (E) delivery and the necessary nutrients for body maintenance and growth. In human, this activity is reflected in mind by the cognition center Iam (Ia). The Genetic Transmission System (GTS) manages the info-genetic output, related in the eukaryotic cell to the DNA replication process, and to the brain/reproductive apparatus in the human and subhuman organisms, projected in the human mind by the cognition center Icreate (Ic). The Info-Genetic Generator (IGG), as the info-genetic inherited input, coordinates by means of hypophysis at human/subhuman the body growth and development according to the age, reflected in mind by the cognitive centers Icreated (Icd), and is related in the eukaryotic cell by the DNA/RNA (ribonucleic acid)

process of transcription and translation of information from DNA to proteins, the basic construction material of the body. The Info-Connection (IC) center manages the selection of Good/Bad information according to the survival necessities and mentality/acquired experience, detected in mind of human as the cognition center Ibelieve (Ib), explaining the Religious and Mystic Experiences (RMEs) (Gaiseanu, 2019b), Near-Death Experiences (NDEs) (Gaiseanu, 2017a) and Extra Sensorial Experiences (ESEs) (Gaiseanu, 2017b). At the inferior organisms, this center is highlighted for instance by the synchronous organization of bacteria in geometrical colonies and extra-sensorial sensitivity of some birds/animals/fishes to external preventive signals (Gaiseanu, 2019e).

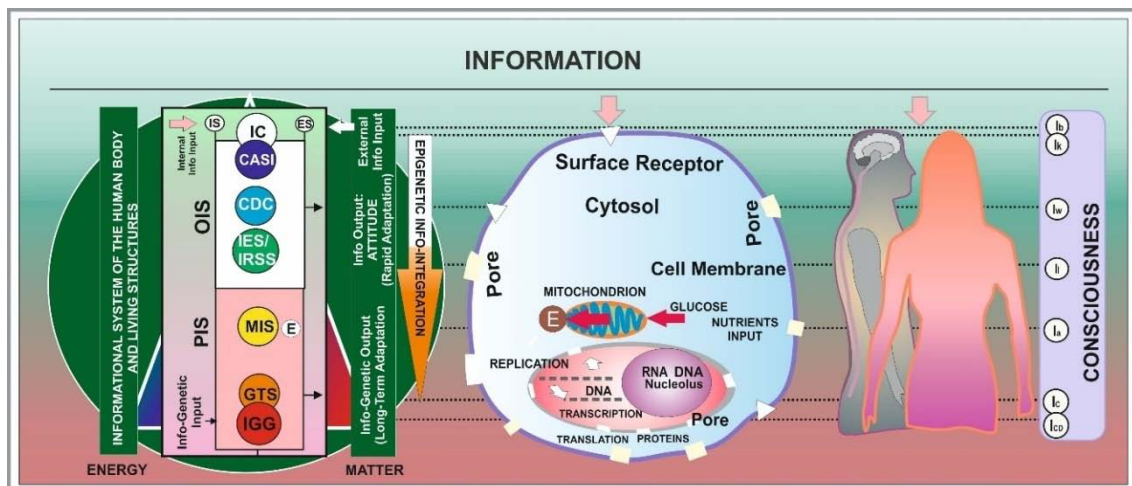


Figure 2. Schematic representation of the Informational System of the Human Body and Living Structures (ISHBLS) on the Universal Triangle of Reality (UTR), and the corresponding connection to the eukaryotic cell and human body, where this is projected in mind as cognitive centers of consciousness.

The Operative Information System (OIS = CASI + CDC + IES) assures the connection with reality at human and subhuman organism, and the reactive response by decision and emotional response, whereas the Programmed Informational System (PIS = MIS + GTS + IGG) assures the maintenance of the body during the lifespan, on the basis of the info-genetic mechanisms inherited and/or acquired for adaptation (Gaiseanu, 2018b; 2019f), and prepares/transmits to the next generation the info-genetic support for the survival of species. The adaptation on long-term period to the environment conditions is obtained by the epigenetic info-integration process, suggestively represented in Figure 2 by an arrow connected with the info-input of the informational chain CASI/CDC/IES (IRSS), finalized in GTS and transmitted to IGG of the next generation. Such an admirable tool patented by nature works in living systems gradually, starting with the detection/capturing of information by sensors. For the currently received information (small amplitude/non-repetitive regime), OIS provides a reactive response to the info-output, which represents the attitude with respect to the informational signal or chain of signals. When the information is repetitively received and/or the signal amplitude is high, the epigenetic mechanisms progressively act for info-integration, transferring it from CASI/Ik to CDC/Iw, IES(IRSS)/II, MIS/Ia (stereotype, automatically triggered acquired abilities) to GTS/Ic and further to IGG/Icd of the next generation.

Comparing this process with the distribution of information/energy/matter in UTR in Figure 2, it can be seen that OIS specifically works with information in the superior side of the triangle, whereas PIS mainly with matter/energy components. The living systems according therefore with the operational mode of ISHBLS,

absorb information from environment and are able: (i) to react and express the response by info-output (attitude); and (ii) to progressively integrate this information into the info-genetic system, modifying their own genetic informational structure accordingly, but without the modification of the structural info-library of species in DNA. The human/subhuman and elementary organisms functionality is based on the co-participation of matter/energy/information, and the role of information is fundamental for their functionality. The functionality itself is an informational concept, showing that the living organisms operate with and by informational processes.

Comparing with the UTR of information/energy/matter distribution applied to living systems in Figure 2, it appears that the body of the living entities is actually informed-matter structures, where the energy/mass and information flow by the entire structure. In human and subhuman organisms, the centralized informational headquarter is the brain, leading all the processes of the body, and at the cellular level DNA/genes in nucleolus/nucleus is the main informational center, co-operating especially with RNA by means of operational chains of info-chemical reactions assisted by enzymes to maintain conveniently the body structure and functionality (Gaiseanu, 2020d). The living organisms act therefore as animated/self-organized info-hierarchical structures, managing both the informational, mechanical (material execution elements) and thermodynamic (energy and heat balance) processes, with the main objective, which is the survival. This is suggestively represented in Figure 2, where the top side of triangle is assigned to the corresponding sciences/spheres interested and/or involved specifically in information, the left side of triangle in thermodynamic sphere disciplines, and the right side of the triangle representative for matter, is involved especially in mechanic sphere sciences. For the long term survival, the living species are also able to reproduce themselves, acquiring from the environment the necessary information for adaptation by epigenetic processes, and integrating this information into their info-genetic system.

The concept of information defined by Shannon in communication circuits/systems is applicable also in the analysis of the activities of the living systems. The brain circuitry is an intensively studied topic, and can be observed the similarity with the circuits used in the microelectronic devices (Gaiseanu, 2021h) and the concepts of information theory, which can be applied even to the cellular level (Gaiseanu, 2019c; Faria, Rocha, & Palazzo, 2014). The circuits analytics can serve today to observe and describe the neurofunctional/neuropsychological properties of the brain (Gaiseanu, 2021h; 2021c). From thermodynamic perspective, the so called “negentropy” defined by Schrödinger to describe the global functionality of the living organisms is actually information (Gaiseanu, 2020a). From this point of view, the living structures acts as thermodynamic systems, similarly with the refrigerator machines, which work to eliminate outside the heat from their internal enclosure. The compartmentalization by specific functions (organelles in eukaryotic cell and organs in animals) is a form to lower the organism entropy on the evolutionary scale (Gaiseanu, 2020a; 2020d). The living organisms use the external nutrients (food, water, air) to transform them in energy, information and suitable form of materials used for the organism (re)construction. From this point of view, the living systems are examples of admirable natural mechanisms, which continuously convert any form of elementary constituent of UTR, in every other form of constituents. As it was shown above, the living organisms do not feed only with nutritive substances, but also with information, under two forms: (i) within the interaction conditions with the environment reality for short-term reactive adaptation, engaging the OIS component of ISHBLS; and (ii) under stress conditions for long-term adaptation by epigenetic processes, engaging also PIS. Such a process is actually a learning process. The living creatures learn by interaction with their environment. Referring to

human and subhuman organisms, we have to observe that the learning process constitutes the basic mechanism to acquire the necessary informational experience in memory and the formation of the decision criteria, mentality and beliefs (Gaiseanu, 2018b; 2019f). The repetition is a form to consolidate the learning, and is supported by epigenetic-type processes in the long-lasting memory. The training of animals is also a form of learning, based on epigenetic and associative process of a certain reward information.

Draganescu proposed a philosophic model of matter, supposing that this is composed by two species: a neutral “ortomatter”, unable to form by itself the real matter, and “informatter”, uniquely able to intervene on “ortomatter” to form matter of our reality. Gaiseanu has shown that the structuration of matter is actually a process with absorption of information I, which is hidden in the structure, and the destructure is a process of releasing of this information, schematically represented by a relation of the form: $(A + B) + I \Leftrightarrow AB(I)$, where A and B are the components of an interaction process, I the participating information, which becomes a hidden information (I), incorporated (“embodied”) into the structure AB(I). Such an interaction is very frequent especially in the living structures, where the interactions between the organic components of the body are based on absorption and releasing of information (Gaiseanu, 2021c; 2021h; 2020a). The chemical informational agents absorb and release information by interactions between complementary components, like in a puzzle-type combination of elements. Such a process allows the reception of information for instance by the surface receptors on the cell membrane and the subsequent cascades of interaction in the cytosol of the cell, with multiple absorption/release of information during the common reactive pathways, and/or epigenetic processes. The learning processes at least in the long-lasting memory are supported by such type of interactions and the transfer of information from the nucleus for the structuration of certain kind of proteins is also based on the same type of info-transmission during the transcription/translation process. Within the nervous system, the transmission of information is basically supported by ionic Na^+/K^+ (sodium/potassium) participation along the axon of the nervous cell, responding to information as a YES/NO (all-or-nothing Bit-type unit) “firing” informational mechanism, controlled by a threshold minimal fire value. The chemical informational agents continue the transfer of information in the junction gap space (synapse) between two neurons, allowing a selective passing only of a certain type of information, according to the YES/NO complementarity between the chemical agent and the corresponding surface receptors of the subsequent neuron.

Defining the matter-related informational processes as described above, supported by the chemical agents, Gaiseanu has elaborated and developed the Informational Model of Consciousness, distinguishing the basic functions and functionality of the brain from informational point of view, i.e.: (i) memory (CASI/Ik); (ii) decision (CDC/Iw), operating by YES/NO acceptance/rejection (Bit-type mechanism) based on decision criteria; (iii) emotions (IES/II) (interpreted as Good/Bad—YES/NO states); (iv) self-status (MIS/Ia), representing especially the power/health of organism; (v) reproduction (GTS/Ic); (vi) info-genetic inheritance (IGG/Icd), working in an informational four-letters alphabet/language of DNA/RNA molecules during the replication and transcription/translation processes at the cell level, and by reproduction and inherited aptitudes/behavior at centralized level; (vii) info-perception/selection (IC/Ib), acting as a Good/Bad (YES/NO) selective Bit-type operator. He also developed the Informational Model of the Living Structures, arguing that the same type of functions/functionality is characteristic to all creatures on the entire living scale, starting from the simplest (prokaryotic/eukaryotic) individual cells to the most complex structure, that of human. IES in the inferior organisms was defined as Info-Reactive Sentient System (IRSS), just to highlight the universal characteristic of the living structures, which is the sentience-reactivity to information. The reactivity to an

informational stimulus is manifested therefore on two ways: by an info-motor response/decision with respect to the nature of information, and by an info-motor sentence/emotion according to the nature of received information, expressible in the external environment as attitude.

Coming from a solid preparation/contribution in solid-state physics/information technology (Gaiseanu, 2013; 2017c), and based on informational modeling of consciousness and living structures, Gaiseanu has approached and explained a series of problems and suitable solutions in language communication, philosophy, neuroscience, neuropsychology, neurology, psychology, psychiatry, geriatrics, behavioral sciences, biology, as follows: language patterns and certainty/uncertainty in cognitive-sentient exploration of reality (Gaiseanu, 2019a), informational intra and inter-communication between the cells in human body by embodiment/disembodiment process of information (Gaiseanu, 2019e) in neuro-physics science, analysis and modeling of cognitive centers of consciousness (Gaiseanu, 2019e, 2019f, 2018a; 2019c) in neuro-physics, modeling of the informational systems of the human body (Gaiseanu, 2016) in physics of consciousness, information as a solution to the millenary mind-body relation problem in philosophy/neurosciences (Gaiseanu, 2021b), information-matter bipolarity of the human organism (Gaiseanu, 2020b)/living structures (Gaiseanu, 2020a, this work) and corresponding fundamental circuits in philosophy/neuroscience, information as a solution for the nature/nurture problem, the oldest debated in psychology (Gaiseanu, 2019h), sharp definition and evaluation/quantification of attitude in cognitive and behavioral sciences (Gaiseanu, 2020h; 2021e), the neuropsychological response to information of brain Beauty/Ugly and “Beauty-is-Good” circuits (Gaiseanu, 2021g)—some more recent not understood problems in neuropsychology, the info-relational cognitive operability of the posterior cingulate cortex, a problem not understood in brain sciences (Gaiseanu, 2020g), informational neuro-connections of the brain with the body in neurology and neurosciences (Gaiseanu, 2019d), hierarchical brain organization/evolution in neurology/neurosciences/life sciences (Gaiseanu, 2020c), epigenetic information-body interaction and information-assisted evolution in biomedical engineering and biotechnology/life sciences (Gaiseanu, 2019g), multitask music-based therapy optimization in aging neurorehability (Gaiseanu, 2020i), informational modeling of the living structures (Gaiseanu, 2020a; 2020d), information as an essential component of the biological structures and their informational organization in biology (Gaiseanu, 2021e), mental aggressive operability from informational perspective in neuro/behavior sciences (Gaiseanu, 2021f), pathological expression and circuits in addiction and mood disorders in psychiatry (Gaiseanu, 2021d), mind-body equilibrium and health from informational perspective and the anterior cingulate cortex in psychology/psychiatry (Gaiseanu, 2020f).

The science of information, initiated on the basis of the development of the electronic/microelectronic devices and technology, enters now with high efficiency in the living domain, for a better understanding of the functionality of the human body, human mind/consciousness (Gaiseanu, 2020c), and of the biological structures on the entire scale (Gaiseanu, 2020a; 2020d; 2021h, this work). The actual advances of artificial intelligence, concerning the memory device development (Stefan, 1998), big data analysis on the basis of learning machines technology (Filip, 2020), as well as the progressive and firm penetration in the field of living systems in agriculture, zootechnics and veterinary applications (Filip, 2021), is a promising way for mutual development. The increasing role and diversity of biomedical and biocompatible devices with applications in the detection and treatment of various disorders in human body, is a natural consequence of the fruitful collaboration between the informational domains in medicine, and engineering science and technology (Gaiseanu et al., 1998; Gaiseanu, 2020c).

The actual philosophic culture is more and more interested of informational contribution for a deeper understanding of reality, both on the computational thinking area (Tsoukalas, 2021) and on the philosophical ontology in a general system theory (Cui, 2021).

Conclusions

The analysis of the involvement of information in universe, both at the quantum and cosmic scale, reveals the fundamental role of information in the constitution/structuration of reality, justifying the understanding/settlement of reality, as an interchangeable whole composed and described by an information-matter-energy trinomial, according to the model of the Universal Triangle of Reality.

The same model of the Universal Triangle of Reality applied to the living systems reveals the deep involvement of information in this world, connected to reality by Informational System of the Human Body and the Living Structures, according to the same organizational structure on the entire living scale, from the simplest to the more complex organisms. The involvement of information in such systems is high, as a basis of their dynamic functionality, necessary both to maintain their internal organization and the inter-connection with reality. The epigenetic processes allow the integration of environment information as the matter-related information in the body informational structure, explaining the adaptation process and the species evolution. The involvement of informational concepts in the structuration of the living creatures, particularly in that of human, allowed a significant/revolutionary advance in understanding/resolution of various older and more recent problems in philosophy, neuroscience, neuropsychology, neurology, psychology, psychiatry, geriatrics, behavioral sciences, biology and life science, with the perspective to potentiate a parallel/collaborative development of mimic artificial systems and to improve the human health.

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