What Is Life and What Is Consciousness

What Is Life and What Is Consciousness:

A Front-Line Informational Model and Applications

By

Florin Gaiseanu

Cambridge Scholars Publishing

What Is Life and What Is Consciousness:
A Front-Line Informational Model and Applications

By Florin Gaiseanu

This book first published 2026

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-0364-6181-2
ISBN (Ebook): 978-1-0364-6182-9

To my Son Adrian Gaiseanu and
my Daughter Ana-Maria Gaiseanu,
with Love

TABLE OF CONTENTS

SUMMARY

This book approaches and offers a suitable response to the millenary questions of humanity – "What is life" and "What is Consciousness". For this, based on a new concept defined as matter-related information, coherently allowing to unitarily approach the structuration and functioning of living organisms, it is shown that information is an essential/ indispensable contributor to the organization of living systems. This assures their structuration/functions and connectivity/reactivity to the environment events using an informational system. In living systems, where the constitutive micro-components are under a permanent inter-correlation and inter-dependent interaction, it is necessary to reconsider the information concept. Information is an active participant in the living processes, consisting basically of reaction/interaction between complementary components, defining in this way the configuration/reconfiguration of various subsequent structures in a binary YES/NO Bit-type informational activity is hidden inside of a composed component after its structuration by micro-material components, and is released during its destructuration. Therefore, the structuration of a certain configuration, with subsequent functionality effects, can be achieved only in a certain way from a multitude possible, such that this is an informationally driven process. The understanding of such an informational mechanism is, therefore, a key to understanding both the structuration and behavior of living organisms.

Following this front-line direction of investigation, it is shown that the informational system of the human and of the eukaryotic cell – the elementary component of planta, animals, and humans—consists of seven informational components, with the same informational characteristics on the entire organizational/evolution scale able to make decisions for survival as a function of circumstances. The experimental evidences and multidisciplinary studies confirm the informational organization revealed by the informational model of the human and living structures (IMHLS) on the entire organizational scale, from a bacterium (considered the simplest living organism of the prokaryotic cell), protozoan (elementary eukaryotic cell, singular or as part of multicellular organisms), to plants, animals, and humans. As the owner of the most developed informational system, the human is endowed with consciousness, which is the result of the activity of the seven components of ISHLS, reflected in the mind.

The present results allow to open/break the currently closed circle of stagnant ideas in various ancient/older still persisting problems concerning the nature of life and of mind/consciousness, with applications in philosophy and neurosciences, (heritage)/nurture vs. (training) dilemma in psychology, operability of the living structures in life science, contributing to a large range of applications in various scientific fields like neuroscience/neurology, psychology/psychiatry, geriatrics, biomedicine, and bioengineering; and even in the field of information science, showing the essential role of information and its operability in living organisms.

Keywords: what is life and consciousness, information, matter-related information, info-organization of the living organisms, eukaryotic/ prokaryotic cells, informational system of human and living structures (ISHLS), front-line informational model of human and living structures (IMHLS), decision making, applications.

CHAPTER ONE

INTRODUCTORY WORD

The scientific community agrees nowadays that the existent concepts and the laws in biology, physics, chemistry, and mathematics are not sufficient to explain and understand life and consciousness, and a revolution should be necessary to approach and respond to the millenary question "What is life" and "what is consciousness." This book introduces and presents a new concept of information in living systems is needed for a suitable and coherent approach to these questions.

Information is recognized nowadays as a powerful social factor, so much so that the large public assimilates information through mass media and transmission by the internet, radio, press, and television or by other mass widespread informational devices like smartphones, laptops, and tablets (Gaiseanu, 2019a, 2022a). However, information is a powerful tool also in artificial intelligence and learning machines for big data analysis and processing (Filip, 2020), for decision-making (Filip, 2022), under conditions of compatibility with human health (Filip, 2021), with applications for processes control/automation and decisional processes in industry (Xu and Duan, 2018), healthcare (Wang and Alexander, 2020) and scientific investigations (Pala et al., 2020), or recently used for the prediction of the evolution of COVID-19 infections in the entire world (Gaiseanu, 2021a, 2022b). The current increasing interest in healthcare in-situ or automatic data processing is based on the high development of microelectronics and micro-systems and technologies (Gaiseanu, 2013, 2017a). This development is fully engaged in the accurate design and fabrication of informational devices like silicon capacitive sensors for biomedical applications by bulk micromachining technology (Gaiseanu, 2022b, 2022c, 2022d) and material and process characterization (Gaiseanu, 2022e, 2023b), for further miniaturization and integration in telematics lines and automatic processing data machines (Gaiseanu, 2023b, Gaiseanu and Tsoukalas, 2023).

However, the issue of information in human and in the living structures, is not systematically approached, so few/sporadic and non-coherent references are given to information in living organisms (Gaiseanu, 2022f), although information plays an essential role recently demonstrated in their structuration/organism development (Gaiseanu, 2020a) and functioning (Gaiseanu, 2021b, 2022g). As was recently shown, this occurs under continuous inter-communication with themselves and with their neighbor environment (Gaiseanu, 2022g, 2021c), supporting their existence/ maintenance and their adaptation to the external cues (Gaiseanu, 2021c, 2021d, 2021e). In the present informational era, especially in information and informational devices stimulating/incentivizing the development of knowledge and creative contributions in the face of the challenges to the informational society in multidisciplinary directions, it is a necessity to approach and highlight the driving role of information in living structures/systems. This proves to be imprescriptible in a large spectrum of sciences related to the human health, with confidence in the present and future destiny of information science and technology as a determinant contributor to the patrimony of the scientific community, addressed – and with beneficial effects – to the entire society in our informational era.

After a context background in Chapter 1, highlighting the evolution of the concept of information, a new concept defined as matter-related information is introduced, which allows a coherent and unitary description of the structuration and functioning of living organisms, all of them capable of decision making. The defined new informational concepts allow the development of the Informational Model of Human and Living Structures (IMHLS), presented in Chapter 2, dedicated to the informational organization of living structures, and to the description of the components of the Informational System of Human and Living Structures (ISHLS), showing common similar characteristics of its components on the entire evolutionary/organizational scale, as a common fundamental characteristic of life. This Chapter responds essentially to the question “What is Life” from informational perspective.

The third Chapter – “What is Consciousness” – is dedicated to revealing on this basis the informational nature of consciousness as a projection of reality in mind through ISHLS and its informational activity. As all living systems are structured and function based on the same type of informational system, the same chapter proposed and discussed a general cognitive model that explains the connection and reactive response of living organisms to the external and internal reality as individual participants in this reality, different from the rest. In the same Chapter is shown that the experimental

evidences and multidisciplinary studies support the informational model on the entire organization scale of complexity, from bacteria – a unicellular prokaryotic organism – to eukaryotic cell, the composing unit of the multicellular organisms – plants, animals and humans. Chapter 3 is dedicated to the applications of IMHLS, showing the large range of fields where this model can contribute solutions for stagnant problems from philosophy to neurosciences, psychology and social sciences, psychiatry and gerontology.

In the fourth Chapter are presented the numerous applications of IMHLS in various branches of science, from philosophy to medicine, neuroscience/ neurology, gerontology/social science and biotechnology.

I. A Front-Line Direction of Investigation: Information in the Living Structures

1.1 Evolution of the Concept of Information in Multicomponent Systems

The concept of information was not easily crystallized and understood, and even nowadays, there are difficulties in accepting the role of information in the matter, either in the organization of non-living (Gaiseanu, 2021e) or living structures (Gaiseanu, 2021c).

Since immemorial times, humans contemplated the nature of life, mind, and consciousness, this immaterial form of reality, asking themselves how the surrounding reality can be perceived with the common senses by the biological systems and how this becomes a personal reality (Gaiseanu, 2019a, 2021c). The philosophy was primarily involved in such contemplation in ancient and more recent times. In the 16th century, Descartes defined the mind as a distinct entity from the material body, not only from the functionality point of view but also as a physiological constitution, so that the two entities are actually different parts of the human organism (Brook, 2008). This view indicates with clarity that the mind shows a different consistency and works based on distinct principles in comparison with the material body. Such a perception still dominates nowadays not only the philosophical view, but even the neurosciences and other connected fields. That is because the necessity to introduce new terms in the study of life and consciousness made it impossible to really understand how the human Organism and the consciousness phenomenon could be explained. Introducing a new concept of information, which acts

in the human organism, it was possible in this way to successfully solve the mind-body problem as defined by Descartes's philosophy, (Gaiseanu, 2021b) and moreover to decipher the informational mysteries and functional properties of the living cell (Gaiseanu, 2020a), demonstrating that human is actually a bipolar info-matter/energy structure (Gaiseanu, 2020b), connected to information and to matter/material support.

With this aim in mind, it is necessary to show, first of all, which was the evolution and development of the concept of information since the antique times of the empirical models and philosophical views on the nature of life and consciousness. In particular, this regards not only the investigation of the nature of life and of the mind but also the problem of the primordiality of the ideas/forms vs. matter in the material/living world and universe, as Greek philosophy proposed to debate thousands of years ago. In this regard, it is highlighted the contribution of the philosophic/scientific personalities to such a development of the understanding of information concepts over the centuries. Following this line, such an analysis allowed the development of the informational model of the human and living structures as a general informational model explaining the informational structure, organization, and functionality of biological systems, integrating, and not rejecting or ignoring, the wisdom of the ancestors.

1.1.1 Ancient Empirical Philosophical Models

Looking back to the traditional view on the nature of the world and life, several intuitive empirical models remained still present in the scientific and public attention. These included: (1) the old Yin/Yang Chinese model of the organization of the world in complementary opposite principles/energies, referring specifically to a female/male-like unit as a typical expression in nature and human and promoted in healthcare and non-conventional, traditional medicine (Liu, 2018), which can be interpreted nowadays as a first intent to describe nature in terms of information (Gaiseanu, 2016; Gaiseanu, 2021c); (2) Plato's model of "Ideas" and "Forms" as the primordial factor which determines the geometrical "sacred" structures of matter and reality (Kraut, 2016; Gaiseanu, 2019a) as a basis for the organization of nature; (3) Aristotle's material view on the substrate of the world as an origin of everything including the living and soul; and (4) the "chakras" ("channel-wheels") model, developed especially in India, governing the functioning of the human organism (Gaiseanu, 2019a). The ancient philosophical models and some significant promoters are represented in the left side of Figure 1.1, where the central circle signifies the world with its fundamental components.

So, looking back to ancient times – from the perspective of actual knowledge (Gaiseanu, 2019a, 2021c), it is necessary to reconsider the evolution of the information concept, taking into consideration the first proposed empirical models of the world and human (Gaiseanu, 2021c). Thus, the bipolar Yin/Yang concept in Chinese philosophy represents actually, in the empiric terms of that epoch, a binomial of two contrary principles: Yin – a receptor/passive and Yang – a donor/active principle/agent, able to initiate a change. Such a "feminine"/"masculine" Yin/Yang unit, with a specific symbol, is represented in Figure 1.1 on a circular area symbolizing schematically the world in the 1st left upper side position. It is interesting to note here the similarity of such a view/description with the hole/electron unit in semiconductors (Gaiseanu, 2013; 2017; Gaiseanu et al., 1997), particular in the silicon material, which constitutes actually the basic mobile informational agents in the informational devices in the present informational era. In this material, each atom is bounded with four valence electrons to the neighbor atoms. If an electron leaves its position, a hole (lack of electron) is generated, so a position could be statistically occupied (YES) or NOT, which in terms of information can be expressed as a YES/NO Bit-type informational unit.

Based on the Yin/Yang principle, between the fifth BCE (Before the Christian Era) and the first CE century, a traditional Chinese philosophy was initiated and developed, with fruitful medicine applications, raised especially from Confucius's ideas (2nd position of the left side column in Figure 1.1). Historically speaking, the period of 500s BCE, was significantly marked by Lao Tzu and Confucius' philosophic conceptions. About in the same period, and a little before Socrates in Greece, Buddha (shown in the 3rd position of the left column in Figure 1.1), initiated the reincarnation and "channel-wheels" (chakras) philosophy in India (4th position in Figure 1.1) (Gaiseanu, 2019a). The practitioners of the Yin/Yang principles developed an additional model concerning distinct flowing energies, which refer to positive/negative (Yin/Yang) energy (Raphals, 2020; Gaiseanu, 2019a). The Five-Agents Buddhist thinkers promoted in parallel an additional current regarding material, feelings, perception, volition, and sensory forms (Raphals, 2020; Karunamuni, 2015).

The Yin/Yang binomial representation by two opposite but complementary alternatives of the same unit in the Chinese conception is expressed in nature and universe by order/disorder, by dynamic cycles, and such a binomial energy would be derived from the so-called 'qi' fundamental energy. In the Chinese conception, the Yin/Yang in the human body would support the living flows along a network of meridians and nodes, passing through the

organs and through the entire organism. The Yin/Yang symbol is a suggestive representation of this negative/positive female/male energy, like a black/white-(bright) passive/active unit, in the universe and in the human body, permanently interconnected and interdependent with each other. The existence of such a mysterious energy is still a controversial topic in the attention of scientists, taking especially into account the satisfactory results obtained by the practitioners of naturist therapies (Liu, 2018). The Yin/Yang binomial can be interpreted in informational terms as a Yes/No informational Bit-type unit, participating in the structuration/destructuration processes (Gaiseanu, 2016), showing actually the informational nature of universe and of any surrounding part of reality, including the biologic structures, as it will be discussed in detail below and along entire this book.

In the archaic Buddhist conception, in particular, within the so-called Five-Aggregate Model, it is shown that there are certain body functions/flowing streams, i.e. the material forms, feelings, perception, volition, and sensory awareness, which determine the mind, entering/passing continuously through the mind as a changing mind-stream energy (Karunamuni, 2015; Gaiseanu, 2021b).

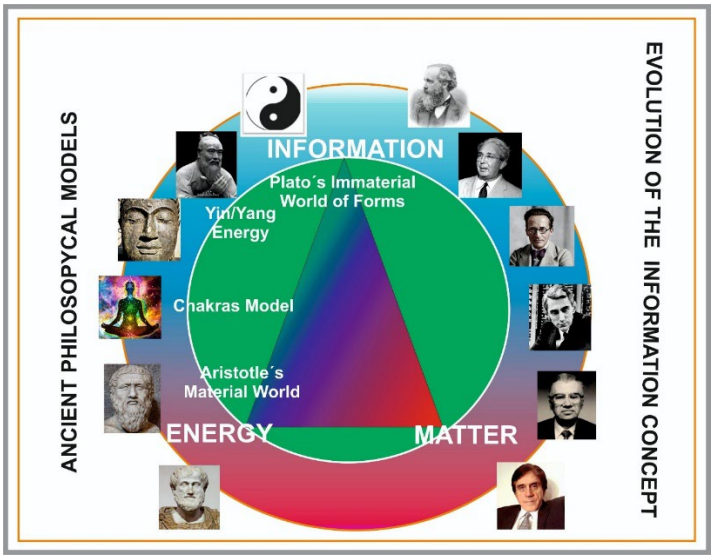

Figure 1.1. A schematic diagram representing the evolution of information concept in living organisms and in the world reality, drawn as a circle. On the left side of the circle area, there are represented consecutively: the Chinese symbol Yin/Yang in the

superior part, Confucius, Buddha, the chakras system, and the Greek philosophers Plato and Aristotle at the bottom. On the right side of the circle area are represented the consecutive scholars James Clark Maxwell, Leo Szilard, Erwin Schrödinger, Claude Shannon, Mihai Draganescu, and Florin Gaiseanu, as contributing authors to the development of information concepts and modeling in biological systems. In the center of the circle is represented the Universal Triangle of Reality (UTR), formed by Information/Energy/Matter shown on the green circle, which symbolizes the living world as a part of the material world, which is represented by the larger circle.

The model of the chakras system, shown in Figure 1.1, left side, 4th position, is of Indian Hinduism origin, developed later by additional experimental practice and theoretical knowledge, and is in Buddhist conception regarded as vital centers, driving the flowing of energies in the human body. The chakras are detected by trained practitioners as "wheels" form colored centers, distributed along the central axis of the spinal cord as following (Jain & Hauswirth-Jain, 2017: Gaiseanu F and Gaiseanu AM, 2023): (i) the root chakra, appearing in red color, is located at the bust/spine base and is associated with the earth; (ii) the sacral chakra (orange color), is located at the lower abdomen and is related to the sexual activity; (iii) the solar plexus chakra (yellow color) is located in the central abdomen, expresses an improved self-esteem and self-confidence; (iv) the hearth chakra is a green color, located at the level of the hearth; (v) the throat chakra appears in bright blue color, related to the ability of communication and expression of personal power; (vi) the "third eye" chakra is of the indigo color between eyes, allowing an "extra" visibility; (vii) the crown chakra is of the violet color, and is associated with spirituality and enlightenment, allowing the connection with the "universe".

Plato (427/428?-347 BCE) – shown in the 5th position of the left side of Figure 1.1, was born in a noble family in Athens, a disciple of Socrates, and inspired by Pythagoras and by the Egyptian hermetic (closely kept/hidden) philosophy, was the creator of the theory of "forms" and "ideas", which would be the changeless/eternal principles of the world, determining the "sacred" geometry of matter, the primary "structure" of the surrounding reality (Kraut, 2016; Gaiseanu, 2019a). Aristotle (384-322 BCE) – shown in the 6th position on the left side in Figure 1.1, was one of Plato's disciples and is considered the greatest philosopher of all time, together with Plato (Shields, 2020). Both of them were active Members of the Academy founded by Plato in Athens in the 380s. Aristotle's works cover a large range of disciplines, including logic (practiced today in mathematics and computer systems), philosophy of mind, and empirical biology, containing a detailed description of plants and animals. In Aristotle's view, the world is

built on material "substances," which generate the objects of surrounding reality consisting of matter and forms which cannot be actually separated. According to Aristotle's philosophy, even the soul is a special form of matter, so the "forms" predicted by Plato would be actually properties of matter.

1.1.2 Crystallization and Development of the Concept of Information in the Recent Era

The physicist James Clark Maxwell, shown in the 1st position of the upper right side of Figure 1.1, proposed in 1867 an imaginary experiment in a thermodynamic system of an ideal gas under equilibrium conditions, composed of two containers, separated by a wall with a small door, which could be opened by an "intelligent" demon (Maxwell's demon), just when the molecules with higher velocity (temperature) would attain the door, allowing the passing of these molecules to the second container. In this way, according to such an experiment, the pressure in the second container would be increased by the flowing of heat from a lower to a higher temperature, which would be impossible from a thermodynamic point of view. violating the thermodynamic laws (Gaiseanu, 2020a). Analyzing such an imaginary experiment, the physicist Leo Szilard (shown in the 2nd position of the right side in Figure 1.1), demonstrated however that this "intelligent" demon should spend "intelligence" (so information) to measure/determine the molecule velocity and to synchronize the door opening process in a convenient way (Szilard, 1929). Later in 1944, the physicist Erwin Schrödinger (shown in the 3rd position of the right side of Figure 1.1), observed that in living organisms, the entropy evolves from higher to smaller entropy, so that the difference between the final and initial entropy gets a negative value, contrary to the general evolution of entropy in the material world, which naturally increases over time (Schrödinger, 1944).

A few years later in 1948, the engineer Claude Shannon (4th position on the right side in Figure 1.1), developed a theory of information by using statistical analysis operating in a binary (Bit-type) mode (Shannon, 1948) referring to an electronic systems of communication (in particular a Morse-type system), composed by an emitter and coder of information (in the practical example a Morse "alphabet"), a channel – normally a noise-inducing line, and a receiver, previewed with a decoder of information. According to this theory, information is deduced by counting certainty vs. uncertainty events in a system of states with equal probabilities. The quantity of information is calculable by the elimination of uncertainty events, measurable in terms of informational entropy. However, such a

theory is not really applicable to living systems, where the basic processes of transmission and detection of information occur between various dynamic micro/macro fix/mobile components (Gaiseanu, 2023j).

The theory of information shows that more certainty, expressed by the information I in a system composed by N variants (states, possibilities or events, having the same probability of occurrence), is obtained when more uncertainty (expressed by entropy H) is excluded. Thus I (as a positive value), is the result of the difference (ΔH) between the values of the entropy H before and after a change, which in terms of information theory is I = ΔH = log2(N). This relation is similar with the Boltzmann's formula which expresses the entropy S in a thermodynamic system of micro-components, but without the Boltzmann constant. However, the signification is completely different: while the entropy S is a quantity referring to disorder state in the Boltzmann's system, the informational entropy H expresses the uncertainty. Thus formally, if compared with Boltzmann's statistics, the information concept would correspond with the degree of order/organization state in a multicomponent system, and the amount of information would result from the elimination of entropy (expressing disorder/uncertainty) to obtain certainty, a structural order (Gaiseanu, 2023c).

Referring to the nature of the universe and living structuration, the philosopher and scientist Mihai Draganescu (5th position of the right side in Figure 1), stipulated that the ultimate layer of reality, defined as a "deep matter", would be actually the indestructible and eternal matter "source" of everything, which can generate universes and time (Draganescu, 1990). Such a "deep" layer/substrate is actually composed by a passive "orthomatter" component, which can be structured only by the intervention of "informatter", an active component uniquely able to structure it. Therefore, according to the Draganescu's view, "informatter" would be an active component, assimilated to a tendency to configure the matter in a certain way. A schematic relation describing a structuration process would be therefore written as: Deep matter ("Ortomatter") + Information ("Informatter") => Structured matter. The living structuration is a further result of a restructuration by adding a new "informatter" as follows: Structured matter + Information ("Informatter") => Living. The great merit of such a view consists mainly in the introduction of the concept of informatter, as an activator of structuration, actually an informational agent, as it was discussed recently by Gaiseanu (2023c), and also in the recognition of an additional informatter, which should be added to structure the living organisms.

The physicist Florin Gaiseanu (6th position of the right side in Figure 1.1) (Gaiseanu, 2021c), showed that information is intrinsically contained in the composed system, and the structuration process is actually a result of the interaction between various components of the material components including information I. As the quantic mechanics developed by Schrödinger shows (Schrodinger, 1926), an atom – the smallest material component of matter that maintains the specific properties of a chemical element from the universal chemical table, the electrons cannot occupy any orbit around the nucleus, only some locations well established by physics and mathematics laws. This would be an expression of Plato's "forms" because the electrons can occupy only some priory' established locations, following precise "geometrical" positions, as Plato's philosophy predicts.

Thinking in terms of information, an atom contains, therefore, intrinsic specific information, which participates in its structuration and determines its destructuration, too. The structuration of a solid material is driven in a certain way, not randomly, according to a certainty vs. uncertainty (informational) fashion: indeed, the atoms could be bounded ("operated") by an electric field following rigorous physics/electrochemical laws, as the atoms of Na+ and Cl- could form for instance a NaCl neutral compound, or by covalent relations, like in tetravalent Silicon or Carbon materials. As will be discussed below, the genetic reactions in living organisms follow biological laws, specifically by complementary (informational) operability. Therefore, the structuration process can occur between species with complementary informational structure, well fitting their structural/ physical/chemical or biologic components, allowing a favorable interaction - the alternative YES, and otherwise NOT.

The structuration and the reverse destructuration process can be described therefore schematically by a basic relation of the form: (A + B) + I <=> AB(I), where A and B would be some interacting components operating with the participation of information I, hidden/absorbed as (I) into the new complex compound structure (Gaiseanu, 2021b; 2021c; 2023c). What such a schematic relation shows, is that the structuration is an information-absorbing process, while the destructuration is an information-releasing process. Information appears thus to be a result of an operation, independently of the nature of this operation, either be this a physical, mathematical, chemical, biological or mental operation, or resulting from a computer or other forms of artificial intelligence (AI) operability. The functionality of living organisms, not only that of humans, is actually a result of various successive structuration/destructuration processes, absorbing and releasing information. The entire universe includes and

involves actually the participation of information, the operational "forms" of changes, and the configuration/reconfiguration of matter (Gaiseanu, 2021c), as is presented in more detail below.

1.1.3 Information in the Living Structures and Universe: a Front-Line Model

The living organisms are self-organized and self-driving systems, where the communication between components is distinct from that one in the informational devices, where the informational is carried by electrons and holes in the semiconductor (specifically silicon) junctions of the microprocessors' components (Gaiseanu 2013, 2017). The holes are defined as opposite positive charges created by the lack of electrons in the bonding structure. The communication in living organisms is carried out by specific mechanisms based on the dynamics of the chemical reactions between the composing microelements, which determines the interaction with themselves and with the external environment, on which they permanently depend for food needs, defense and reproduction (Gaiseanu, 2023m). Therefore, the concept of information should be revised, in accordance with such a reality, introducing the concept of matter-related information based on the structuration/destructuration processes, which absorb and release information in living organisms.

The classical theory of information described earlier (Shannon, 1948) treated information as a result of statistical binary (Bit-type) probabilistic events, in an electronic info-transmission system through a noise generating line, from an information source to an info-codifier receiver and a suitable info-decoder. However, the informational operability in biological (living) structures, based on the structuration and destructuration processes of the material system itself, is not really evident from such a model. Therefore, approaching the information concept and the info-operability in living systems should be different.

Thus, distinct from electronic devices, where information is carried out by electronic/holes agents, in living organisms the structuration process involves specific mechanisms. In a multi-particle interactive system, like the biological systems are actually, the interaction between two material particles A and B, or between a particle and a macro part of the system, can usually be written from a chemical or physics point of view as: A+B<=>(AB). However, as this interaction is actually an information-assisted process, this should be written as:

$$(A+B) + I => (AB)(I) \quad (1)$$

where I is an absorbed information during the direct (=>) composing structuration process, which allows the integration (“embodiment” of information (Gaiseanu, 2019b) as hidden matter-related (I) information in the composed product (AB)). This information can be released during the reverse (<=) process (if this is possible), or “disembodied" from a complex structure like that of the organic substances, by a mechanism of destructuration (Gaiseanu, 2019b). Information is therefore a factor of organization/reorganization of systems, referring to a certain mode/pattern or pathway of configuration/reconfiguration in the living and non-living structures. This involves certainty vs. uncertainty, a change perceived as a "message" from some components of a system, with a decoding/"effector" result, coming from interaction partners through an info-communication "line" by informational messengers, which carry out this message to the target/receiver, able to decode the message. Therefore, the structuration/ destructuration (info-embodiment/disembodiment) processes in living (or non-living) structures absorb or release information. Such information is defined as matter-related information (Gaiseanu, 2019b) and is a fundamental key concept allowing the coherent reference to information in living structures, able to describe both the structuration and transmission processes of information. Moreover, as a direct consequence, these processes explain mind and consciousness as a “pure" informational manifestation of matter processing mechanisms (Gaiseanu, 2023f), an issue not understood till now.

Information I is therefore, according to this concept, the result of an operation (Gaiseanu, 2021f, 2024b) on an interactive system (represented formally by the “open" symbols {}) of components A, B with the participation of information I, where the chemical, physics, biologic and mathematical laws act as operators (O), becoming a correlated/closed system (represented formally by the rectangular parentheses). Therefore, a more general representation of relation (1) can be written as:

$$O\{(A,B), I\} => [AB(I)] \quad (2)$$

which shows that relations (1) and (2), although seemingly “simple," demonstrate in a suggestive form the fundamental/key active role of information in nature, especially in living structures. The operative way to a reverse action/reaction should involve a distinct operator (Or) rather than that of the forward operator, so this could be written as:

Or{[AB(I)]} => (A,B), I) (3)

The informational signals in the silicon chips, the largest category of info-active components of the informational systems, are carried out at/through the junctions between two regions "doped" with opposite YES/NO contrary types of conducting impurities, by electric small carriers – electrons and their positively charged opposite partners – holes, as separate entities with which they can recombine (Gaiseanu, 2013). As a hole is a consequence of the lack of an electron in the silicon tetravalent lattice, the occupancy (by an electron) or the liberation of such a site (to create a hole) is actually equivalent to a YES/NO local informational process.

In a larger sense, information can, therefore, be defined as a result of an operation determined by physical, chemical, biological, or mathematical laws. In mathematics, an operation achieves a result – a (new) event/news. In a physical, chemical, or biologic system of interacting micro/macro particles/components, the corresponding laws act as informational operators, determining the absorption ("embodiment") or release ("disembodiment") of information (Gaiseanu, 2019b) by structuration/ destructuration mechanisms, schematically represented by informational relation (1) or a chain/cascade of relations, as derived from this one.

Consequently, both living and non-living matter structures contain hidden (embodied) information, and this can be released (disembodied) by informational reactions of the type (1), expressed in a more general manner by the relations (2) and (3), so a universal triangle of reality can be defined, composed of matter, energy and of a fundamental constituent of the living world (Gaiseanu, 2023c; 2023m) and of the non-living world, which is information (Gaiseanu, 2021e; 2023m).

In the living eukaryotic cell, the unit component of the multicellular organisms (humans, animals plants), the interactions between a ligand (external informational agent) and a specific surface receptor of the cell membrane, or with an internal cytoplasm bulk receptor, which triggers a chain cascade of specific reactions (Alberts et al., 2015; Gaiseanu, 2023m), is actually a matter-related information process generated by structuration/destructuration mechanisms, as represented by the relations (1)-(3) (Gaiseanu, 2023c, 2023m). The genetic processes of cell reproduction and of the fabrication of the proteins for body material construction are also informational processes based on the embodiment/disembodiment of information hidden in the genetic structure. The excitatory/inhibitory activity is also characteristic of an informational

matter-related process because they access and determine the synaptic transmission of information by a similar mechanism, triggering (or not) the electrical conduction mechanism of the nervous cell as a YES/NO – Bit-type operation. The various messages are distinguished from each other in a specific "language" based, in this case, on the number and frequency of the electric pulses and the nature of neurotransmitters (Gaiseanu, 2021h, 2020g).

1.2 The Universal Triangle of Reality

Scientists and researchers investigating life, consciousness, and mind agree that the physics, chemical, or other known laws in nature alone are insufficient to describe and understand their nature and functioning (Gaiseanu, 2021e). This is because the information was not taken into account, although it should be included as a participative factor of structuration/destructuration processes (SDPs) (Gaiseanu, 2021c), so the world can be described by a Universal Triangle of Reality (UTR), which is composed of matter, energy and information (Gaiseanu, 2021e).

The role of information does not consist, therefore, only in the communication by the informational systems, as it is commonly considered nowadays, but is actually observable in the environmental reality, where information is a contributive constituent. The model of the Universal Triangle of Reality composed of Matter, Energy, and Information presented in this section shows that these are fundamental constitutive components of this reality, with arguments coming from the field of physics, both at the cosmic and microparticle scale, indicating undoubtedly conclusions that information is one of the fundamental components of reality in the material world (Gaiseanu, 2021e).

1.2.1 Information at the macro-scale level

Plato's metaphorical view of the world, based – and even initiated by "ideas" and "forms", starts to be demonstrated nowadays, when it is more and more evident that the world of ideas (so of information), created by the human mind and communicated through internet and through the microelectronic-based means, changing permanently the world, became a full reality (Gaiseanu, 2021e). The way was not easy at all: from the marathon of the Roman couriers, running to bring news from the battlefield, and from the post offices with horses, carrying correspondence, the world of information is nowadays abundant and creative, based/aided first of all by the exponential development of the informational devices. Although

information is still viewed nowadays intuitively as a novelty in the communication process, information has, however, a much deeper meaning, also contributing to the world's structuration, either of living or non-living nature.

As it was discussed above, the material world is composed of atoms, the smallest units that maintain the properties of the chemical components, and they consist of a nucleus and electrons, moving on certain (informational) discrete orbits, well established by mathematical and physical laws of (informational) eigenvalues. The chemical bonds between atoms in the matter, either electrochemical or covalent, are also informational ones, following certain laws. Information is thus a component of structured matter itself, in whatever form of aggregation it may be found (Gaiseanu, 2021e). According to the principle of conservation in nature, information is conserved in nature (Pelisser, 2022: Gaiseanu, 2020d), as well as matter and energy (Gaiseanu, 2020d).

In cosmology, the conservation of information was approached in black holes, which are huge concentrations of matter, absorbing also the light, The so-called black hole paradox consists of a loss of information by the emission of radiation, that would cause their evaporation, which would violate the principle of information preservation (Hawking, 1975). However, the contradiction was resolved (Hawkins, 2005): according to the string theory of the universe and a holographic projection of information on a surface at the events horizon (Susskind, 2008; Stephens et al., 1994), the whole universe thus is a structure that preserves its information. Alternatively, this paradox can also be solved (Bekenstein, 1974) by the addition of the traditional term in the thermodynamic law of an unconventional term related to information, so the quantity of information is not lost even in this particular case; the total information is conserved in nature.

A demonstration of the unitary universe is also reflected in the interconvertibility of energy, mass, and information. Indeed, a material body with a mass m can be transformed into energy, according to Einstein's well-known relation E = mc2, where c is the speed of light in vacuum, as a universal reference. Matter can be also generated from energy: the energy fluctuations of the vacuum may give rise to particles of matter and antimatter (Hajdukovic, 2012, 2011). Information can be converted into energy, as a recent experiment shown (Toyabe et al., 2010): reproducing in fact the demon's imaginary experiment, consisting of a container with polystyrene particles suspended in an electric field, the sense of the applied

field was changed to prevent the energy loss, when a particle tended to change its rotation (marking a plus of energy), so an energy increase up to 20% was obtained in the end.

The hypothetical experiment of Maxwell's demon, known also as Maxwell's paradox, opened actually a discussion on the role of information in nature, because this paradox cannot be explained without the introduction of the concept of information, which the demon should expense to measure the velocity of gas molecules (Auburn University, 2014) and to synchronize the door opening. The demon's intervention can be actually interpreted as a process of elimination of a disorder state, so an entropy quantity from the total, corresponding this with the Szilard's calculations and with the Shannon's considerations in his theory of information. Information is, therefore, an effective participant in the ordering or structuration of the natural processes during the interactions and inherent inter-correlation between various constituents of a multicomponent system. The universe is constituted, therefore, by three fundamental/primary components, namely matter, energy, and information, which can be represented by the Universal Triangle of Reality (UTR), as it was defined earlier (Gaiseanu, 2021c). Such a triangle is schematically shown in Figure 1, representing the particular world of the living structures. A triangle of reality could be used as a diagram to represent the proportion of each component in a particular body, or in a part of it.

The unitary manifestation of universe is reflected by the convertibility between its fundamental components. An example of such a possibility (Vopson, 2019) is presented below.

(i) The relation between a mass m, representing the quantity of matter in a body, and a corresponding energy E, can be expressed by the Einstein's relation $m=E/c^2$. This expression indicates that to obtain a small quantity if mass, a high quantity of energy is necessary to be spent, because of the very high value of c;

(ii) The elemental relation between a mass m, operating as an informational device, and 1 Bit of stored information at the room temperature T expressed in °Kelvin, can be expressed as $m=kTln2/c^2$, where k is the Boltzmann's constant (kT kinetic energy), and ln2 comes from the Bit-unit information theory (Shannon, 1948). Thus, the mass of 1 Bit of information at the room temperature (300°K), corresponds with 3.19×10^{-38} Kg, so a quantity I Bits of information contained in a mass m (measured in

Kg) is: $I=m/3.19\times10^{-38}$(Kg/Bits) = $m\times3.13\times10^{37}$ Bits/Kg. This relation shows that a mass m operating as an informational device, of a body contains a high quantity of information.

(iii) The conversion of energy in 1 Bit of information in an informational device, can be expressed by the elemental relation E=kTln2. By using furthermore the Einstein's relation, and the expression of m deduced above, the final relation between the energy E and the corresponding quantity of information I (Bits) becomes: $E=I\times3.19\times10^{-38}(Kg/Bit)\times c^2$ at the room temperature. According to this estimation, it would be necessary to obtain a significant quantity of information, to obtain a small quantity of energy.

1.2.2 Information at the microscale, quantic level

The evidence on information contribution to the creation/composition of the world is even more surprising at the microscale level: indeed, as it was recently shown, the properties of neutrons can be separated from their mass body (Denkmayr et al., 2013), something which is equivalent to think that matter is different/separable of its properties/Plato's "forms", so of information. This experiment was performed by exposing in a vacuum recipient a neutron flux to a magnetic field, which split it into two fluxes. However, adding more filters to them, one of the neutron fluxes passed into the other, leaving only its properties/forms in the initial trajectory. A similar effect was observed by using a wide range of particles and even atoms or groups of atoms submitted to similar experiments (Aharonov et al., 2013). Such results reveal two essential conclusions: (1) information is implicitly contained in the material bodies, at least at the micro level scale; (2) information may be "extracted"/dissociated from the material body.

How information appears in quantum mechanics depends on the way of observation: when the microparticles are not observed by an investigation tool, they may occupy more than one of the two (YES/NO) binomial states, just like in classical mechanics. Such behavior, known as the principle of non-localization of particles, refers to the impossibility of predicting/ determining precisely the position of a particle, as this can "co-exist" in several states simultaneously. Such a simultaneous existence is a not understood problem known as the Schrödinger paradox and is suggestively expressed by the "co-existence" of a cat in a box to be both alive and dead simultaneously because its true state cannot be known until the box is opened.

However, as it was recently suggested (Gaiseanu, 2019g), such a paradox could be explained as follows: complementary pairs of elementary particles which recombine continuously are permanently generated in vacuum, so that if the position of a single particle is followed, it can disappear and reappear elsewhere through the generation/recombination phenomenon. Such behavior maintains the local concentration in a dynamic equilibrium state. The frequency of the occurrence/disappearance of particles is much higher than the necessary time for the "observation" in the closed box, so this appears as an uncertain location of the particle. The intervention of a physical instrument includes actually a "background noise" within this process.

To reflect this special property, a specific unit of information in quantum mechanics is defined as a complex number called Qubit, or Quantum Bit. 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 a so-called superposition state, consisting of a linear combination of states. The passing from a quantum to a classical state is defined as a “collapse” process, which consists of the reduction from multi to one of the fundamental states, 0 or 1 (Nielsen & Chuang, 2000). Consequently, a Qubit can be expressed by a two-dimensional vector of complex numbers of the form ($\alpha|0i + \beta|1i$), where α and β are complex numbers, and the states 0 and 1 from classical physics are marked by 0i and 1i, to distinguish them from the classical ones. Therefore, measurement by a Qubit offers results equivalent to the value 0, which corresponds actually with the probability $|\alpha|2$ and equivalent to the value 1, corresponding to the probability $|\beta|2$. Such a behavior is a consequence of a gravity-induced quantum collapse process (Laloë, 2020), as was earlier proposed (Penrose, 1965).

The functioning of a quantum computer is based on superconducting systems technology (Van der Waal et al., 2000), or on semiconductor structures (Loss & DiVincenzo, 1998). The classical computers act by Bit units of 0 or 1 states associated with the open (YES), or closed (NO) conduction of the operational circuits, and the quantum systems of isolated particles at very low temperatures, work at the same time in parallel, with the superposition of both states 0 and 1 simultaneously so the speed and computing power of these computers are increased enormously.

As expected, the dual particle/wave behavior does not allow to specify exactly the state of a beam in quantum mechanics, because this depends on the experiment. A wave behavior is exhibited when a beam is observed in

an interference system, and as a discrete particle, measurable by the number of photons, in a laser system. From the physics point of view, the wave state refers to the propagation of a perturbation based on the energy transport but without mass, while the particle behavior involves mass. Therefore, from such experiments, it can be concluded also that information, mass, and energy seem to be associated in the same whole, the form of manifestation depending on the conditions of the experiment. The universe is thus a result of the coexistence of matter, energy, and information, which form a fabric, a matrix of mathematical/physical laws as a constitutive substrate.

Therefore, taking into account such a reality, a Universal Triangle of Reality can be defined, able to describe the universe at micro, macro, and cosmic scales, in which the information plays a distinctive and fundamental role, even if this is not a perceptible direct contributor, like matter and energy are.

Referring in particular to the living world, Figure 1.1 presents schematically the triangle of reality for living structures as part of the universal reality, where information plays even a major/crucial role in their existence and operability as dynamic organisms capable of decision-making. Information in ancient philosophy is described as a world of “ideas” / “forms” (Kraut, 2016), as binary Yin/Yang and “chakras” concepts. represented in the left side of Figure 1.1, evolved as “negentropy” organization and quantum mechanics concepts (Rechenberg, 1987), information in communications (Shannon, 1948), "informatter” (Draganescu, 1990), information as matter-related information in living structures (Gaiseanu, 2016), represented in the right side of Figure 1.1 (Gaiseanu, 2021c,e). Gaiseanu showed that reality can be described by the binary YES/NO digital/informational units of complementary associated components, maintaining a global neutrality/stability, both in the non-living (Gaiseanu, 2016, 2021e) and in the living systems (Gaiseanu, 2021c).

CHAPTER TWO

WHAT IS LIFE: A FRONT-LINE INFORMATIONAL MODEL

What is life? – this is an old and still an actual question. More than seven decades ago, in 1944, Schrödinger launched this question: "What is life?" (Schrödinger, 1944). This question is not really new, it comes since immemorial times from human philosophical contemplation from various realms of earth (Gaiseanu, 2019a). However, every time is still new, as no clear response has been given yet by the sciences. At the individual level, each person asks himself/herself various time this question, consulting the latest news, scientific reports, and opinions of expert people, scientists, and scholars, and trying to find a suitable response. Although each day people are involved in their habits and duties, forgetting themselves, the question remains and comes more and more frequently in their minds as a foreground preoccupation (Gaiseanu, 2019a), especially when the equilibrium of their own life or of their dear persons starts to be modified (Gaiseanu, 2020d), or when the age advances deeper and deeper, marking their life trajectory to unknown horizons (Gaiseanu, 2018a,b; 2019e). The triumphal scientific and technological results in various scientific fields, especially in micro/nanoelectronics, driving undreamed-of advances in all areas of private or professional life in today's informational era, may encourage the scientific community and the large public to believe in the power of the science and human mind, discovering the mysteries of life.

Schrödinger's question is therefore still actual, although an adequate response was searched with abnegation and interest starting from philosophy, even since Aristotle's century (Weber, 2011) to astrobiology (Berner, 2010), or from biology, which is the main science dedicated to the study of life (Makoto, 2010; Morris et al., 2019) and chemistry (Molnar et al., 2016) to physics of life (Popkin, 2016), scrutinizing the life origin on earth (Thaxton et al., 1984-1992) or on extraterrestrial realms (McKay, 2004), from the protein precursors (Joyce, 2009), physics of bacterium (Jacob et al., 2006) and cell functions (Adams, 2010), to highly organized