

Reflections on the Nature of the Evolution of Organisms and Environmental Systems in Conjunction with the Existence of the Universe and Thermodynamics of Irreversible Processes

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Abstract:

This paper explores the deep interconnections between ecology, thermodynamics, cosmology, and the nature of life, arguing that energy, not matter, is the fundamental unifying principle underlying all natural and cosmic phenomena. Challenging mechanistic and reductionist paradigms, the authors integrate concepts from irreversible thermodynamics, open systems theory, and the anthropic principle to explain how life maintains order despite the universal tendency toward entropy. The discussion spans biological organization, the subjective perception of time (biological vs. thermodynamic vs. astronomical), and the cosmological conditions, such as the number of spatial dimensions and the role of dark energy, that permit complex life to exist. The paper posits that ecological and evolutionary processes are manifestations of universal thermodynamic regularities. It further contemplates the holographic nature of reality, memetic evolution, and humanity's unique capacity for foresight and cultural development, all within the expanding framework of the Universe. Thus, the work presents a holistic, transdisciplinary vision in which life, consciousness, and cosmic structure emerge from the dynamic interplay of energy, space, and time.

Keywords: thermodynamics, universe, anthropic principle, ecology.

1. Introduction

Ecology as a branch of science investigating phenomena occurring around us, i.e. nature surrounding man, lacks parameters describing it as is the case in physics or chemistry. The occurring phenomena are defined with the use of knowledge and intuition of the individual who describes or defines the phenomenon. Time as the fourth dimension existing in nature alongside three-dimensional space is not strictly defined as well because it is approximated by the lifetimes of individual organisms, animated nature and minerals generated as a part of inanimate nature comprising the phenomena occurring in it. This is the relativity of time – but in a different manner than in relativistic physics. Phenomena occurring in the Universe and significantly impacting the earthly nature demonstrate that we are a part of the Universe – the one that surrounds us – but the clear metric definition of that Universe is not possible. Therefore, one could ask how to measure phenomena occurring around us and in the surrounding Universe. How to measure the lifespan of organisms? Time measurement in the form of a second, a minute, an hour, a day or a year offers a comprehensible concept but fails to clarify all the occurring phenomena, e.g. the evolution, changes occurring in the trophic pyramid, the body ageing process, biodiversity, etc. and even qualities of the mind in the case of man and, perhaps, other animals as well. Energy is one of the features existing in all organisms, minerals and phenomena occurring in earthly nature and in space and connecting them.

One should have in mind the entire complexity of the Universe and, in particular, nature surrounding us that consists of three main components: matter, energy and space. One should consider Einstein's deliberations when he states that mass and energy is the same thing, which is demonstrated in the basic formula by Einstein: $E = mc^2$ and means that mass can be treated as one of the forms of energy and vice versa. Therefore, we conclude that the Universe and nature surrounding us have two components: energy and space. Space and energy emerged during the Big Bang. Huge quantities of energy were released at that moment, accompanied by the expansion of emerging space retaining the entire negative energy. It means that the origination of matter and energy contained in it balances originated negative energy retained in space so that the energy balance remains constant.

Therefore, one can assume that it will be possible to explain all the phenomena mentioned above with the laws of thermodynamics of irreversible processes and energy measurement. Our knowledge still does not let us explain all phenomena occurring in nature and in the Universe with the help of the laws of thermodynamics. One can assume that regularities of the thermodynamics of irreversible processes occurring in nature are the cause of its continuance and of the life on Earth. Let us stress that we differentiate between regularities (general natural regularities) and laws: the latter are the expressions of the former.

1. The Universe As The Co-Existence Of Environmental Systems

Both an organism and each environmental system are open systems that remain in the condition of a continuous inflow and outflow of matter and energy, building and destroying its components while retaining the condition of dynamic balance. The theory of open systems shed light on many biological or environmental phenomena not explained before and resulted in the formulation of many general and important messages. The equifinality principle is one of such messages just (Bertalanffy 1984, Wawrzyniak 1998). The end state of each closed system is manifestly determined by its initial conditions, for example the chemical balance where the end concentrations of substrates depend on initial concentrations. Each change of initial conditions or a change of the process itself in the same initial conditions will also change the end result. In other words, closed systems are deterministic. In open systems, the same end result can be obtained while starting from different initial conditions or by taking different paths. This is what we call the equifinality principle. It is worth stressing that equifinality does not equal the statement that open systems are

not subject to regularities, e.g. statistical or chaotic ones (i.e. as understood in the chaos theory – see below).

The principle allows us to understand and explain many phenomena currently occurring in nature. Equifinality opposes mechanistic explanations of the natural phenomena and looks for different explanations by creating hypotheses that are closer to the truth of the occurring phenomena. In the light of equifinality, the opposition between the degradation principle formulated by Kelvin and Darwin's theory of evolution, i.e. between the law of the dissipation of energy in physics and the law of evolution in biology, is an apparent opposition between inanimate nature and animate nature. According to the second law of thermodynamics, the general direction of physical events is towards an increase in entropy and, as a consequence, towards the maximum disorder and the bridging of gaps until entire energy has been equally distributed in the system and its development has ceased (Wawrzyniak, 2001). In the living world, it usually happens in a continuous way on the path of evolution as the transition to higher levels of order, i.e. to heterogeneity and organisation. However, it has to be noted that entropy is increasing up to a certain point in all irreversible processes. We have to do not only with the progress of entropy resulting from irreversible processes but also with its cessation at the final moment of the process. It is usually the case in an open system that absorbs complex particles rich in free energy and discharges simple particles that are redundant to the system. This is why living systems, while retaining dynamic balance, nevertheless are geared towards an increased order and organization. Whittaker's (1969) well-known theory of succession can serve as an example.

The mechanistic worldview originating from the 19th century classical physics had no place for any direction, order or intentionality. The world was presented as a "product" of chance that originated as a result of random mutations and natural selection while the spiritual (mental) world was a strange (from that point of view) and erratic epiphenomenon of material occurrences and, according to extreme opinions, as a deliberate "will of the Creator". Scientific knowledge available then was based on the analysis of the phenomena, which means that it was reducing the surrounding reality into smaller units and extracting single causal links. In this manner, the physical and environmental reality was broken into elementary parts called atoms, cells, organs, organisms or into other components of the reality while retaining reflexes and perceptions of point sensations. With such reasoning, causality was a one-way path and concepts such as the interaction and organisation did not appear at all.

The one-way causality model turned out to be insufficient for contemporary science contributed to the fact that concepts generalizing the phenomena and, at the same time, assigning a causal direction to them, i.e. a holistic one, reflecting a different approach to reaction and interaction started to appear in all branches of science. In a certain period, concepts from the area of teleology and directionality found themselves beyond the frontiers of science. Environmental theories appeared in this situation, initially from the auto-ecological perspective, evolving to the synecological understanding of the adjustment ability, purposefulness (emergence) or even the search for a goal on the path of evolution in environmental systems. Two of them have been mentioned before, i.e. equifinality, entropy and feedback, which can be reduced to the homeostatic maintenance of balance. Homeostasis is understood as a condition striving for a target, based on dynamic phenomena in causal chains and mechanisms providing feedback about deviations from balance or offering a target that is attained in the end. One should not omit the adjustment ability model that specifies a system of discontinuous functions that, having exceeded a critical value, transform into a new family of differential equations. It means that a system that exceeds the critical condition starts to behave differently, in a different manner that often demonstrates evolutionary characteristics. Therefore, one can assume that each system demonstrates an adaptive behaviour in this way, i.e. tries out various methods and means to finally determine the optimum condition of its internal environment so that it does not conflict with critical values of the external environment. In any case, a concept of anti-entropy processes is necessary. The faith that, as Poincaré formally demonstrated, entropy is reversible in the infinite perspective (from the perspective of time) is not sufficient for biology and ecology as the horizon of phenomena studies in these branches of

knowledge is always limited (rather than “finite”). Traditional determinism (pure cases exist) does not help much as it entails the abandonment of explanations. The theory of deterministic chaos offers some hope. The name can be misleading as “deterministic” does not have its traditional meaning here (the end status is unambiguously determined by initial conditions); it only means that chaotic phenomena are subject to regularities.

Similar deliberations are possible for the concept of an organisation. The organisation understood as order was also foreign to the world interpreted from the mechanistic perspective. An interesting thing is that the problem did not appear in classical physics, in mechanics or electrodynamics etc. What is more, the second law of thermodynamics pointed to the destruction of order as the general course of events. An atom, crystal or particle are the simplest organized structures as Whitehead (Jurek A. 2013) has always stressed. In biology, it is a principle that organisms are organized as they could not have been functioning otherwise. We have a huge quantity of data today regarding the biological organisation of the animate world: from biochemistry to cytology to histology and anatomy; however, the theory of biological organisation is lacking, i.e. there is no conceptual model that would allow us to explain empirical facts we encounter continuously. Concepts such as wholeness, growth, differentiation, hierarchical order, domination, control, competition, etc. are characteristic for the organisation understood as governance. Thermodynamics turns out to be very useful in the study of each of these concepts. One can define them through the lens of the mathematic thermodynamic system with the help of one can build detailed theories that allow for the making of general assumptions from which conclusions are drawn with regard to special cases that will be mentioned below.

In contemporary science, a large number of striking theories are encountered more and more frequently; they result from continuously appearing modernized research methods, better computing possibilities and the constantly changing and growing analytic reasoning of man. One of the theories that present the view of the theory of evolution slightly differently was presented by Dawkins (1996) who suggested that biological evolution occurs among genes irrespectively of the development of individuals, species, groups or the animated world. Genes are what is copied or not and only the competition of genes directs the pattern of biological evolution.

So far, most biologists shared the opinion that did not focus on genes but rather looked for the explanation of the laws of universal Darwinism expressed, as follows: if living creatures change to increase their ability to survive only the best adapted individuals will survive when the offspring is excessive. Therefore, each of the following generations will be stronger and better adapted to survive. However, Dawkins (1996) asked subversively whether this principle was true for genes and for biology or, perhaps, it had a different application. Are there units other than genes that can multiply? Obviously, it turned out that such units exist and are called memes or mimicry units. A meme is everything we learn through mimicry: conditioned reflexes, adaptation, habits, language, proverbs, prejudices, scientific theories, etc. Memes are patterns of behaviour, habits, skills – everything that last thanks to being transferred from one mind to another through mimicry. Therefore, they are the information subject to selection and evolution related to opinions resulting from scientific progress. A meme is what has been copied and transmitted further. Memetic evolution follows the same principles as biological evolution. Survival is the guiding principle. It is not because it is good for a group or beneficial for an individual but rather for the good of memes. In other words, one can say that memes that survive are not the good ones but rather the ones that are easier to copy. According to Dawkins’ assumptions (1996), a meme is a pertinent term for replicating beings including a gene that prevail on our planet. Are there extra-terrestrial forms of life whose existence is based on elements other than carbon, for example, on silicon and ammonia, when beings die at the temperature of minus and plus 100°C. From the astronomical point of view, we will continue to search for the general law true for each life while, in fact, we would like to know what exactly it is...

Ecology is a natural as well as a branch of the humanities and, therefore, also an art (a skill, understood in the sense of traditional *artes*) as it requires the ability to get to know the nature or the functioning of one’s environment from the practical perspective. As a consequence of this

definition, each environmental problem has to be analysed in line with the progress of general knowledge. Thermodynamics is physical science focusing on energy phenomena occurring in macroscopic bodies. Depending on applied research methods, we can distinguish *statistical thermodynamics* based on the assumption that measurable macroscopic parameters and properties of bodies result from their microscopic structure while *phenomenological thermodynamics* deals with macroscopic phenomena and characteristics.

A unique feature of man, probably resulting from memetic achievements, consists of the ability to predict the future. Genes cannot do it. They are only replicators. Their replication and other, additional conditions are the reason why they are geared towards the creation of certain characteristics: both egoistic and altruistic ones. With significant simplification, one can conclude that people were built as gene machines and raised as meme machines but we are given the power to oppose our creators. Man is the only inhabitant of the Earth that can riot against the tyranny of selfish replicators or genes. At least this is what Dawkins (1996) believes. I think that looking at the problem through the lens of the thermodynamics of irreversible processes will show it in a slightly different light, the more so as we can use the thermodynamics of irreversible processes to explain practically all natural phenomena occurring in the Universe: from the phenomena occurring in space to biological, biostructural or biochemical and physical ones.

Cognition of the Universe and one's environment depends on one's physical and mental organisation. The presentation of the world through the eyes of Uexküll, Kirszat (1934) can be reduced to the statement that each living organism cuts out its own slice of a great cake of reality, which can be perceived and reacted to in line with one's mental and physical organisation or the structure of one's receptors and effectors. According to this thought, the psychological mechanics of animals is similar to the psychological mechanics of man; if one questions the psyche of non-human animals one can talk about proto-psyche. The attempts at the presentation of the worldview of various animals result from the thoughts of Uexküll and Kirszat (1934) on behaviour of animals. According to their opinions, each organism discovers a certain number of phenomena, situations and characteristics in and around itself, resulting from the multitude of bodies surrounding it (matter) and reacts to these properties by generating a "coating" around itself. In such "coating", the organism feels like in a "soap bubble" saturated with features to which that organism is sensitive, features that it can use and co-exist with. If we manage to reconstruct the "coating" of an organism and get into its "soap bubble" the world will change beyond recognition for us.

The organizational limitation of the direct "coating" reaches more deeply. It also applies to forms of sensuality as Immanuel Kant would say. At this moment, the biologist's perception can be reduced to the statement that there is no absolute space of time, that they depend on the organisation of the receiving organism. Time that we feel is not Newtonian time. We feel time individually; it does not flow uniformly but rather depends on our physiological conditions. The memory of time in animals and people is determined by their specific "physiological clocks". For example, bees appear in the vicinity of food at a specific time thanks to a conditioned reflex. If we use preparations that accelerate or slow down their metabolism they will start arriving earlier or later. Time we can feel seems to fly quickly if we are full of emotions, adrenaline and stressed and it slows down if we are bored, idle and lazy. However, acceleration independent of our interference occurs when one is ageing and time seems to pass faster. This phenomenon is related to an increase in the frequency of α waves in the brain (Hoagland, 1951) in a unit of time. The wound healing rate also diminishes proportionally to the age and both psychological and physiological phenomena are related to the fact that the metabolism slows down with age. Time that can be defined as biological is the generalization of the subjective time concept well known to philosophers and psychologists. A few attempts have been made at the consolidation of the biological time with astronomical time. Homologation of growth curves was one of them. From the perspective of physics, one can introduce thermodynamic time based on the second law of thermodynamics and irreversible processes as opposed to astronomical time (Prigogine, 1947). It is known that thermodynamic time is not linear but rather logarithmic and dependent on probabilities and, for the same reason, statistical and local as events at the analysed point determine it. However, it is very likely that

biological time remains very closely linked to thermodynamic time that it far from astronomical time.

All organisms including humans are not only spectators looking at the world but also reactors and actors of their specific worlds. They have to react to external stimuli in line with their inherent psychological and physical inventory. There is a certain range of stimuli, signals and characteristics received by an organism. However, its perception has to make it possible for the organism to find its path in life. It would not have been possible if such categories of experience as space, time, matter or causality were illusory. Categories of experience emerged in the course of the biological evolution and continuously prove themselves in the struggle for existence. Had these categories been unreal appropriate reaction would have been impossible and an organism would have been eliminated very quickly by way of selection. One should also remember that extreme conditions influence the way in which people experience time, e.g. reports of Holocaust survivors stress that “time was passing differently there” and they do not only mean that it was passing slowly or more quickly as commonly understood. An interesting thing is whether other animals feel the same.

The very fact that organisms exist proves that their experience and interaction with the environment reflect the reality. While looking at the world and creating science, humans had to get rid of their egoism and egocentrism and look at the reality “from outside” and go beyond the limits of the observations of a physicist, biologist or mathematician. It means that man starts with the sensory experience but it quickly merges into areas that correspond to areas of extrasensory experience, e.g. optics and electricity merge into the electromagnetic theory while mechanics and the theory of heat create statistical thermodynamics. One of the functions of contemporary science is that it expands the limits of what can be observed and leads to the elimination of restrictions imposed on our experience by the inborn psychological and physical organisation of man. For that reason, even if our entire knowledge is “disanthropomorphised”, it will reflect only certain aspects of the reality or its perspectives because categories of our experience and thinking are determined both by biological and cultural factors.

However, it is possible to assume that the exactitude of our reasoning and predictions is restricted by the uncertainty principle corresponding to the one known from the quantum mechanics and possibly related to the latter. This restriction cannot be disregarded. In practice, it turns out that one restriction is less important than another one and this, in fact, is just our perception. Faith and other psychological processes, e.g. thinking traditions, perceive our reality and how we live in it. As it has been scientifically demonstrated that we are an inventory (or rather a configuration) of atoms, compounds creating inanimate and living structures, it means that our existing life consists of these particles and compounds generated of them. The Universe with the existing life consists of these particles and living organisms, both of plant and animal origin; they react on the level of their being and are probabilities of existence with an unlimited possibility of the occurrence of changes. Presented scientific theories are so complicated that they can be presented in the form of formulas only in the simplest situations. We know laws governing the movement of matter and laws underlying chemistry and biology. However, we cannot predict human behaviour solely on the basis of mathematical formulas. The structure of our Universe covers various levels that are interrelated, which can result from the Big Bang theory; the entire Universe is interrelated and influencing one of its parts in one place always causes a reaction of the entire system. One person’s feeling is perceived by another person and by other organisms, e.g. a dog, a cat, flowers that grow better when they are loved. All these things are usually understandable for people, not always though.

Considering the achievements of contemporary physics pertaining to the theory of relativity and laws of quantum mechanics, observing changes occurring in contemporary Universe and their interpretation, the view close to transcendental philosophy appears, namely, that we have to assume something to understand our situation in the Cosmos; this is a transcendental argument as understood by Kant already mentioned before but it does not require the acceptance of the entire theoretical luggage suggested by the author of “Critique of Pure Reason”. This view encourages us to think that laws of quantum mechanics govern our nervous systems and brains, which entails the

possibility of connection to or direct communication with the expanse of the Universe. Human action influences the human environment, the nature and the Universe existing around us; it appears that the Universe influences us with similar power. The simplest example is in the saying that *if we do something evil the action will turn against us* because, by doing evil, we influence the whole of which we are an integral part. Each civilization on Earth was shaping the world and its views in line with the reality of its existence and, therefore, in line with the rule that we perceive what we comprehend with our minds. The existing world was interpreted by various civilisations and cultures according to the way that the civilization or culture was placing it in its conceptual framework.

At present, the interpretation of the nature of the contemporarily recognized Universe gives up dogmas and is based on the concepts and latest achievements of contemporary physics, chemistry and biology. The book by S. Roney-Dougal (2003) that, among other things, offers an interpretation of parapsychological phenomena discusses an order not based on time and space but rather on the degree of non-transparency. The conclusion is that the primary world is a hidden one behind which there is an open world that is a part of the existing world, the world of all organisms existing in it. However, these worlds are interwoven and overlapped. This interpretation of the contemporary Universe leads us to the paradigm of the holographic world. A hologram is usually generated by two laser streams that overlap. A hologram is a perfect example of a hidden order because the information is not available to our senses directly; it has to be developed with the help of light. It results from the fact that a hologram consists of light patterns and we can only see it with an appropriate stimulation. In a hologram, the entire image is contained in each tiniest fragment. It means that if we divide a hologram into two parts we will get two complete but independent images. Fine details will disappear but the image will be preserved in full. Irrespectively of which fragment of the original we cut off a specific image will remain, it will just be less detailed. There is something in human consciousness that connects it directly to the whole, to a hidden order or collective unconscious; we can assume that the connection is similar to the one found in a hologram. In the contemporary world, one can even create a non-existent reality, an illusory one based on our sensory perceptions.

The trouble with reasoning and understanding of the world appear when space has more than three dimensions. Gravity decreases by four times in three dimensions, eight times in four dimensions and sixteen times in five dimensions. In such a situation, planets' orbits around the Sun would be unstable. What is real then?

2. Nature Of Space And Time Of Environmental Biosystems

Space and time contain the review of physical concepts important for the main topic discussed in this article. According to Boltzmann's law, nature strives to go from a condition that is less likely, often objectively unknown, to a more likely condition. The changing dynamic balance aims to increase entropy. The entropy increase is one of the examples of the arrow of time, i.e. the attribute that makes it possible to distinguish the past from the future. The discovery that the speed of light is the same to all observers irrespectively of their movement led to the creation of the theory of relativity and the abandonment of the idea of the single, absolute time. Instead, each observer has their own measure of time in the form of the clocks they carry and clocks carried by different observers do not have to show the same time. Time became a more personal concept related to the observer who measures it. When analysing actual time, we observe a huge difference between the forward and the backward direction. So, where does the difference between the past and the future originate? Why do we remember the past and cannot see the future? What gives the direction to time? From the natural perspective, there are at least three arrows of time. The thermodynamic arrow links the direction of the passage of time to the direction of the entropy increase; the psychological arrow, related to our sense of the passage of time and the fact that we can remember the past but not the future and the cosmological arrow linking the direction of the passage of time to the expanding universe. The hypothesis of the "universe without borders" combined with the weak

anthropic principle can explain why all the three arrows indicate the same direction and why the arrow of time exists at all. One can assume that the psychological arrow is determined by the thermodynamic one and these two arrows always have to point at the same direction. If we acknowledge the “no borders” condition it will entail the existence of the cosmological arrow and the thermodynamic arrow that have to be in agreement throughout the entire history of the Universe.

The second law of thermodynamics results from the fact that there are always many more disorderly states than orderly states. Let us assume that a certain system starts to evolve to one of the few orderly statuses. With time, the system changes according to the laws of science. After some time, it will be more likely for such a system to be in a disorderly state because there are many more such states. So, if the initial state is highly orderly the disorderliness will increase with time. Therefore, a question arises: why does the Universe exist at all? Why is it in a highly orderly state on one end of time and not on the other end? Is it always possible to call the orderly time the past? Why is it not in the completely disorderly state for the entire duration of its existence? It is most likely after all. Why is the direction of time in which the disorder increases the same as the direction of time in which the Universe is expanding?

Physics suggests various explanations on the beginning of the Universe and the arrow of time. According to the general theory of relativity (plus the theory of initial explosion), it is not possible to find out how the Universe started to exist because all laws of physics break at the moment of the Big Bang. The Universe could begin its evolution in a very orderly state since conditions have arisen to create the beginning of arrows of time: the thermodynamic and the cosmological one.

We can also adopt the concept according to which the Universe could have started in a disorderly state. It would have been in the condition of a complete disorder so that the disorder could not increase with time. It would have to remain constant and, in that case, the thermodynamic arrow of time would not exist or it would have to diminish and then, the thermodynamic arrow would point to the opposite direction than the cosmological one. After the careful verification, none of these concepts is compliant with the reality observed experientially. The classical general theory of relativity provides for its own decline; the classical theory ceases to describe the reality accurately at the moment when the curvature of the space-time becomes very large and quantum-gravity effects start to play an important role. To understand the origins of the Universe and the existence of living organisms in it, we have to use the quantum gravity theory. To determine the quantum state of the Universe, one has to determine the situation prevalent on the edge of the space-time. It is difficult to describe something we do not and cannot know because it is practically impossible. The problem can only be solved if the occurring situations meet the “no limits” condition, i.e. space-times have finite extent with no singularities or limits. In this case, the beginning of the Universe would be a regular point of the space-time and the Universe would have started its evolution in an at least partly orderly state. Obviously, such a state is not uniform as it would be contrary to the uncertainty principle. In such a partly orderly Universe, fluctuations of the density and speed of particles had to exist. The lack of limits condition means that the fluctuations were as minor as possible without the violation of the uncertainty principle. The Universe began its evolution with the period of the exponential or inflationary expansion in which it increased significantly. Density fluctuations initially remained minor during that expansion but continued to increase. Areas with the greater than average density had to expand more slowly due to the additional gravitational pull of excess matter. At the end of the process, areas ceased to expand and even contracted creating galaxies, stars, planets and moons. As we know now, conditions for the emergence of living organisms and sentient beings such as man have arisen on one of the planets called Earth.

The initially smooth and heterogeneous Universe became lumpy and disorderly, which is what can explain the emergence of the thermodynamic arrow of time. First hypotheses that the Universe has been expanded faster than in the past were published in 1998. Two groups of astrophysicists, namely Saul Perlmutter’s team from San Francisco and Robert Kirshner’s team

from the Harvard University reported for the first time that observations of supernovas exploding about 5 billion years ago are indicative of an accelerated expansion of the expanse of the Universe. It is possible to calculate it precisely because light waves from an object that drifts away are stretched accordingly. The stretching increases proportionally to the speed of departure. The sound of a departing train changes similarly (Doppler's effect). The discovery was so impressive that Steven Hawking (2018), one of the most renowned astrophysicists, reacted with incredulity. Results achieved by both teams became commonly accepted.

The existence of the expanding Universe brings to mind the opposing concept of a contracting Universe. This one, in turn, entails the question whether the thermodynamic arrow of time can turn around at a certain moment (and when exactly) in the contracting Universe and the disorder will start to diminish. Organisms and people who would survive that transition from the expansion of the Universe to its concentration would observe and participate in the sci-fi world currently created by people. The concept of a contracting world has to return to the smooth and orderly state. It means that the contraction phase of the Universe would be the same as the expansion phase but with the reversed time. Living organisms and people would live their lives backwards, they would die before having been born and would become younger with the contraction of the Universe. Because of that, it is not possible to adopt this concept irrespectively of all the other characteristics of the Universe and specify that the concept results from the lack of limits and, perhaps, it may be contrary to that condition. The lack of limits condition does not require the concentration phase to be the exact reversal of the expansion period and the contraction of the Universe is completely different than its expansion. The thermodynamic and psychological arrows of time will not change their direction as soon as the Universe starts to contract; black holes are a good example of this fact. Hence the thermodynamic arrow of time has the same direction as the cosmological one. This is why the disorder increases in the same direction as the Universe and time. Therefore, it is obvious that the contraction of the Universe will not offer conditions advantageous for the life of organisms and the creation of their cultures.

The principle of the lack of limits of the Universe entails the existence of the inflation phase that makes the Universe expand exactly at the critical rate, i.e. at a uniform pace allowing it to avoid concentration. It seems that this phase will not begin for a very long time and, when it finally starts, all stars will be completely burnt out. All neutrons and protons will disintegrate into light particles due to radiation. The Universe will find itself in the state of a complete disorder. The thermodynamic arrow of time will not exist because the order, having reached its maximum, will not be able to continue to increase significantly. A strong thermodynamic arrow of time is necessary for organic life to exist. To be alive, organisms have to eat food acquired by different means, which is an orderly form of energy that can be transformed into heat, i.e. a disorderly form. Therefore, living organisms will not be able to exist in the contraction phase of the Universe. This concept explains why the thermodynamic arrow of time points in the same direction as the cosmological one. It is so not because the expansion of the Universe causes a permanent increase in the disorder of entropy. An increasing disorder results from the principle of the lack of limits (another consequence of the openness of systems) and the disorder, in turn, creates conditions advantageous for organic life in the expansion phase of the Universe.

While combining thermodynamic deliberations with the psychology of man and the development of the Universe, we tried to define time and its function in the lives of organisms and people as well as environmental bio-systems. We should define space now. What is it? How did it emerge? And what is its purpose? The general theory of relativity or the partial theory of gravity can be merged with partial theories of weak and strong interactions combined with electromagnetic impacts to create uniform theories called grand unified theories. However, these theories are not fully satisfactory as they neglect gravity and contain numbers that cannot be calculated on the basis of this theory even though these numbers have to be measured, for example, masses of particles. The principal difficulty in the search for a theory combining gravity with other forces results from the fact that the general theory of relativity is a classical theory in that it does not take the uncertainty principle into account while partial theories depend on quantum mechanics. In the last

years of his life, Einstein was looking for a uniform theory that would not have to be adapted to facts by selecting any constants to solve individual problems and that could not be calculated of solved due to knowledge available then. Paradoxically, it was Einstein himself who did not believe in the reality of quantum mechanics even though he played an important role in its creation. However, it seems that the uncertainty principle expresses the fundamental characteristic of the Universe in which we have been living for a long time.

The string theory started to be promoted in 1984. According to this theory, basic objects are not particles occupying individual points in space but rather objects that, devoid of other dimensions, have the length only and resemble infinitely thin strings. Such strings can have free ends and are called open strings or they can create loops or closed strings. A string always occupies a section of space. Its history in the space-time as a line of light creates a two-dimensional surface called the surface of light. The location of any point in that space can be determined by providing two numbers to determine the time and to specify the place on a string. The surface of light of an open string is a strip whose edges are trajectories of the end of the string in the space-time. The surface of light of a closed string is a cylinder whose section is a loop presenting the string at a particular moment.

A single string can divide into two strings; in the case of closed strings, it resembles the connection of "two trouser legs". According to the assumptions of string theory, particles are considered as waves moving along the string. The emission or absorption of particles corresponds to the division or connection of string ends. Theories of gravity particles present the interaction between the Sun and the Earth as the emission of the graviton by a particle present in the Sun and its absorption by a particle of the Earth. According to the string theory, there are H-shaped connection pipes in the process of the contact between points. Expectations of the string theory are the same as expectations of the general theory of relativity when it comes to large-scale phenomena. They significantly differ in small scales, smaller than a nano-micron. According to the string theory, space we live in is two-dimensional and curving depending on a situation. Assuming that we find ourselves inside a ring, on one of its sides, we will have to go around its perimeter on the internal edge of the ring. The ability to move in the third dimension, for example, along the diameter of a closed string, could shorten the path significantly. The explanation is that space is strongly curved in additional dimensions and their size is very small, smaller than one nano-micron so that we simply do not notice them; we can only perceive time and space in which the space-time remains flat. The space-time in small scales probably has ten dimensions and is strongly curved but no curves or additional dimensions can be seen in large scales. This phenomenon probably results from the fact that the space-time had a very large curvature in all dimensions in a very early period of evolution of the Universe.

So, why did time and three dimensions straighten themselves while other dimensions remain tightly coiled? We have to mention the weak anthropic principle now. It provides that two space dimensions are not enough for the development of complicated organic beings to begin. If a two-dimensional being eats something it cannot digest completely the remains would have to leave its viscera via the same route that was used to take them in. The passage through the entire body would divide such a being into two separate parts and it would fall apart. Further trouble appears when space has more than three dimensions. In this case, the gravitational force between two bodies would diminish faster with an increase in a distance than in three-dimensional space. Such a dependency of the gravity on the distance in space having more than three dimensions would make the existence of living organisms, of the Earth and the existing Universe impossible in a stable state with the pressure balanced by gravity. It is obvious that life known to us cannot exist in other areas of the space-time where time and three spatial dimensions are not related to a small size. This fact authorizes us to refer to the weak anthropic principle that permits the existence such systems in the Universe. The likelihood of the accidental arrangement of physical constants in the way they did in our Universe is incredibly low. These are exactly the values that make the emergence of life possible and, in particular, allow for the appearance of a sentient being such as humans on Earth. Minimum changes of physical constants, e.g. Planck constant, would preclude the existence of the

Universe in its current form. One version of the anthropic principle suggests that had the laws of physics been different nobody would have been able to learn them because the appearance of an intelligent observer would have been impossible. There can be other areas of the Universe where all dimensions are flat or that have different “spatial” dimensions but organisms like those we encounter on Earth could not live there.

View of time and space presented above are controversial and it would be difficult to expect them not to be. Our objective was to indicate that there is a deep connection between biology and ecology and fundamental physical regularities. If the Cosmos is a system, i.e. an organised arrangement, biological and environmental structures are its components – as objective as purely physical objects. Of course, the difficulty of the improving cognition of phenomena existing on Earth and beyond it is even greater due to the fact that mutually incompatible views have their protagonists. Views presented above were limited to the ones discussed within the limits of natural sciences. There are also those who maintain that there is no set of natural laws that would make decisions in lieu of the Creator. Could the Creator change a decision regarding the existing world? Probably not, there is an example provided even by St. Augustin who starts with the assumption that the Creator exists in time and time is the property of the Creator? These issues belong more to the realm of theology rather than science and philosophy related to it and we do not want to contemplate them here.

3. Existence Of The Universe Is A Chance For The Survival Of Biological Life

Having in mind the latest research considering the existing condition of the Earth, results of the studies of the Cosmos and especially conclusions drawn from them, we arrive at the conclusion that our biological life on Earth is in danger. We assume that the Universe is the framework of our biological life. It means that the Universe is physical, chemical and biological with man being a part of it and, for that reason, man should explain the phenomena occurring there and strive to understand them. It is a consequence of the anthropic principle, even the weak one. After the Big Bang came the inflation – a well-known economic term referring to the period of an accelerated expansion of the Universe after the explosion. Space that emerged after the Big Bang was densely packed with radiation so that no matter could be created at the beginning. The next stage involved the emergence of a quantum field with the negative pressure and devoid of matter. At the end of the inflation that lasted about 14 billion years for the Universe, the Universe broke down into a hot gas of quarks, gluons, electrons, photons and dark energy. After that, matter started to prevail and this was the next stage of the epoch in which we currently live. It is the time of the gradual cooling, forming and evolution of increasingly complex and larger structures. This is the stage we live in and whose period seems to be coming to an end; a period of an accelerated expansion will follow it again. Space will expand quickly, the Universe will become more and more diluted, it will be increasingly difficult for conditions favourable to the creation of new structures to appear and the Cosmos will become unfriendly to all living structures. If the acceleration of the expansion of the Universe is due to the energy of the void the galaxies, suns and planets generated so far are the peak of the cosmic evolution and we practically march towards the specific end, i.e. to the apocalypse (Greek: *apokalypsis* – unveiling, lifting a veil, revelation, disclosure; in the language of religion, it is a description of a special type of a prophecy referring to what is supposed to happen on the final days).

In the today's world, the density of matter and the density of dark energy are comparable. However, the entire Universe was slightly different earlier, after the Big Bang, and its density was probably more than one hundred times greater than today. To calculate its density, the cosmological constant determined by Einstein was adopted; it does not have to reflect the reality, it only offers a view of the occurring phenomena. According to the Big Bang theory, early stages of existence of the Universe were linked to the energy of radiation. With the cooling, the energy of radiation was losing energy faster than matter. After several thousand years in the logarithmic scale of time, the energy of matter prevailed. This change initiated the dominance of the era of matter and conditions

favouring the existence of living beings emerged thanks to it. This view contributed to the generation of the theory of quintessence linked to the theory of additional dimensions and, at the same time, hypothetically offering a different dimension of biological life on Earth in comparison with the duration of the Universe. One could offer various explanations of the emergence of quintessence; however, its dynamic dimension allows us to feel calmer about our existence in the Universe and direct our attention to the expansion of the Universe at the moment of the appearance of sentient beings.

This approach encourages the conclusion that matter and dark energy are related and that laws of the thermodynamics of irreversible processes offer the view and explanation of the existence of processes taking place in the Universe and on Earth. However, they do not explain the phenomenon of life and its continuance in the Universe. There is a theory by Martin Rees and Steven Weinberg maintaining that our Universe is one of many Universes, having an optimum value of energy of the void, in which living beings could come to existence (Rees, 2000, Weinberg, 1997). Another theory assumes that the speed of cosmic expansion determines the interdependence between the density of matter and radiation and this is the transition from the prevalence of radiation to the prevalence of matter, which is the reason for changes taking place in the Universe. According to the Big Bang theory, the energy of the Universe was mainly contained in radiation at early stages of its existence. With the cooling of the Universe, radiation was losing energy faster than matter. Considering changes taking place in the Universe, the energy of matter prevailed in the logarithmic scale of time, which was the reason for the dominance and emergence of the era of matter and the shaping of the contemporary Universe. If we adopt this theory the emergence of living beings and changes taking place in the quintessence representing the cosmological constant will no longer be a coincidence (Ostriker, Steinhardt, 2003).

A problem that remains is how to determine when the history of the Universe begins. Science still cannot prove it as the latest deliberations concerning time suggest that time has existed before the Big Bang. For the sake of these deliberations, let us assume that time came into existence after the Big Bang with its one-way method of expansion to the future. In this case, the Universe differs from space that stretches in all directions. The Universe expands continuously. Dark matter that surrounds galaxies, constituting 99% of the total mass of the cosmos, and dark energy that accelerates the expansion of the Universe are still a secret. The birth of first stars and protogalaxies initiated the formation of the structure of the Universe. Within that structure, somewhere in the Universe, the Milky Way came into being and, at its end, the Solar System emerged with the planet Earth on which life started to take shape. Man took a special place in this life and, additionally, is even trying to transform the world. Man and the entire community defined as the humanity acquired the hope of survival believing in the eternal life transferred beyond the physical reality. Quantum mechanics sets limitations for the normal life, not for the eternal one. At the same time, such reasoning offers a possibility to form space-time tunnels so that living beings could circumvent the speed of light barrier and enter a new, different parallel Universe and reconstruct themselves there. However, it is extraordinary that, with such limited knowledge, we are aware of the existence of our fascinating Universe and how our fate is linked to it.

For the sake of these deliberations, we can even adopt the views of Shermer (2004) who, while analysing the soundness of monism and dualism, reaches the conclusion that each moment, each feeling and each human being encountered counts, especially if death is the final end. When we realise the marginality of the section of time and space in which our existence is contained, such awareness elevates us to the heights of humanity and humbleness and allows us to use our time on the proscenium of the Universe in better ways. As we think about the likelihood of the complex nature of the Universe and its concentration expressed in the formation of nebulae, galaxies and star systems, there is a real likelihood of the emergence and formation of life in a specific area of the Universe. As opposed to the concentration, the process of the Universe expansion creates the likelihood of conditions favouring the demise of life. Does it mean that, according to Boltzmann's law, nature strives to go from a condition that is less likely to a more likely condition? The process has to be a consequence of these laws when we analyse the phenomenon of the concentration or

expansion of the Universe from the perspective of the thermodynamics of irreversible processes. As a biologist or, in a broader sense, a naturalist looking at changes taking place on Earth and the life existing on it I can safely say that every life is the passing reconstructing itself in a new, slightly different form. While interpreting these changes in the course of life with the use of the second law of thermodynamics, we can say that life is a certain form of energy that never ceases to change. We need the phenomenon called time to make such statements. Time pertinent to each life process occurring on Earth and in the Universe varies and indicates changes taking place in it (Wawrzyniak, 2003). With this assumption, we can still reach the conclusion that the expanding Universe stretches in parallel to the civilizational and cultural development of the humanity. Therefore, we can formulate a hypothesis that the development rate of the Universe is in parallel to the development rate of biological life on Earth and to the development of human civilization and culture. Cultural development entails the development of a civilization and civilisations appear cyclically every time and rule the humanity utterly in various places on Earth (the civilisation of the Olmecs, Pre-Columbian, Mayas, Incas, etc.) as written by Znicz (2002). Human intellect formed in a specific civilization has invented tools appropriate for the intellectual level of leaders of that civilisation. Intellect is also characteristic for other organisms, not only for humans as animals such as dolphins, apes and even insects building complicated communities that use peculiar tools and “subintelligence” also have it. A community built by animal organisms is not the same as the community formed by man. In the case of animals, no civilization is built. Civilisations are not formed incidentally and are not based on simple tools. For a society to emerge, its citizens need to have appropriate intelligence and consciously use their intellect. However, animals do not have the intelligence equal to humans, the intelligence that has always been organizing the civilization that creates machines replacing arms, legs, ears, eyes and the entire human being. It is thanks to intelligence that knowledge is created – knowledge that led our civilization to the insight into the composition of an atom or organized space flights. All these things were created by the human brain that has machines, computers, programs and artificial intelligence invented by it at its disposal. Integration is the necessary condition of the success and survival of such a civilization. Small organisations such as social groups create tribes out of which a nation is formed; nations form states that, in turn, create states, unions or federations. Likewise, in the organisation of life and technical progress, factories, holdings, national and supranational (global) concerns were developed out of small economic societies. Contemporary economic activity and politics aim at the globalization. If we look at the development of man within each civilization and on changes taking place on Earth in this manner we can believe that each new civilization on Earth is nothing else but an acceleration of the Earth’s evolution.

In the light of the presented thoughts, in the perspective of the expanding Universe entailing the disappearance of solar energy and departure of particles of matter, a Solar System comes into being somewhere in the Milky Way at the end of the Universe and life has formed there, on one of the planets called Earth. Time belonging to the Universe also started to count down the progress of changes in the life developing on Earth. One can assume that the life formed there is nothing else but a process similar to the formation of stars and their life spans. Researchers of the Cosmos often communicate that the development of the Universe is not uniform just like life on Earth because the development and evolution of life on Earth is accelerating similarly to the speed of development of the Universe. Adopting the above-mentioned outlook on the formation of the human evolution and development, one has to conclude that human consciousness at the disposal of man is contained in a well-designed, well-built and functional body. However, the physical body dies while consciousness and intellectual achievements as well as intelligence as transmitted to next generations. A question arises whether the material form of consciousness has a chance to survive? Perhaps it survives certain unfavourable conditions in the Cosmos and this is why it is reborn in a new and different world? The entire consciousness of a human being is contained in the brain. The maintenance of such a complex and costly “equipment” indicates that it was “created” to be used for particularly difficult tasks. Had our psyche been of a non-material origin, the maintenance of such a costly and difficult to operate “apparatus” would have been a biological absurd. Even more,

if humans at their current stage are able to assemble a fully functional artificial cell, perhaps they will soon could create organisms suitable to populate the Universe. Even more so, as Dean Hamer (1999), an American geneticist, managed to discover the “God gene” in the human brain, a biological mechanism responsible for our spiritual life.

4. Is The Existing Reality The Activity Of The Universe Or Is Life Only A Product Of An Imagination

The psyche and feelings of humans and, as we can assume, animals and the existing reality seem to be in a constant conflict; however, they build everything that is linked to the human consciousness. One conclusion can be drawn from these deliberations. Irrespectively of whether we talk about the evolution of an organism, gene or meme, the understanding of the meaning of our inquiries has to be based on the reality. We can perceive the phenomena occurring in nature through the eyes of a physicist, chemist or biologist. One can assume that there is hope that life and the way for it to survive will emerge from the existing, contemporary world in which man lives. The vision of the thermodynamics of irreversible processes is one of the universal perspectives related to this philosophy of life.

The source of life is energy that had to find a place of stillness or the place of a “decision” and possibility of transformation; matter had to come into being in this case. It is matter that cumulates the energy of the Universe in itself. Even though it contains a part of the energy of the Universe, it continues to shape the Universe while permeating, changing its form, forming nebulae, milky way’s, stars, planets and moons called natural satellites. Such cumulated energy is emitted by the star called the Sun to the planet called Earth. An appropriate surface of the planet, the time of its formation, the quantity of energy acquired by the Sun and the shape of the Universe or the Nebula and Milky Way, the Galaxy modelled the place in which energy is transformed into life. Elements have been emerging from stars for a long time and, later, merged with one another in great determination to create first compounds; such compounds were merging with one another and started to model life or create a situation that is absurd from the perspective of the logic and, additionally, less likely. It turned out that the lower likelihood of entropy becomes a creative tool for the conservation of energy. The lower likelihood of entropy the more creative it is. Atoms, electrons, nuclei and quanta needed to find their place of stillness. Matter is such a source along with the compound accumulating energy on Earth, i.e. water (an interesting thing is that it occupies nearly $\frac{3}{4}$ of the Earth surface). Life as we perceive it is linked to water – this is where it formed. Water determines the survival of life. Water is a simple compound that is a component of living and, in part, also inanimate organisms and accumulates energy. Entire environmental bio-systems that continue to exist in time: aquatic, terrestrial and mixed ones emerged for direct users of the space-time or living organisms.

In this case, the Universe with its reality presents the sense that is very rational in our human, real world surrounding us as we have to assume that something irrational would not have been able to form in the Universe. God’s hand cannot be rejected in this activity but it seems that we would have to go beyond the Universe if we wanted to get to know Him. Therefore, the Universe cannot be defined, measured, its limits cannot be defined, there is no algorithm defining it even more so that the very concept of the Universe has undergone a huge evolution. It was believed in ancient Greece that the Universe was a centre with the circulating Sun and Moon, in Newton’s times, the Universe was understood as a star system and now, our imagination reaches the limits of the Universe. The branch of science called cosmology deals with such issues; it verifies various theories and hypotheses concerned with the range, nature and functionality of the Universe. People continue to look for something, e.g. dark matter that fills the Universe in 70% even though we still do not know what it consists of.

Our passion is to look for the meaning of life with which one has to struggle along and this meaning cannot be found in other abstract beings that we will explain to ourselves, to God or to future generations. Psyche and feelings, here and now, have to be understood as great, creative and

“moral” energy. However, the future of the Universe continues to emerge as a decision not yet made, which we will reasonably consider by continuing to uncover it, discovering new phenomena, laws and changes occurring in it, striving for the apocalypse or the continuous cognition of the Universe we are a part of. No matter how one looks at it, we are a part of matter with retained energy, using energy existing in the Universe, cognizing the world existing around us.

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