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# Chapter 16:
# Does the Universe have a physical, biological or psychological nature?

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**Abstract.** Democritus regarded that the Universe consists from atoms and the space between them. Nowadays, it is a popular belief that atoms are the more fundamental one. In the last four hundred years, due to the development of physics, we learned to conceive the Universe as a clockwork, and recently, as a computer. Quantum physics describes space as a seething ferment of virtual particles manifesting throbbing energy and vitality. We show that the real existence of virtual particles is experimentally well detected. Moreover, virtual particles create all mass and govern all interactions. The spontaneous creation of virtual particle pairs presents a quantum freedom that opens the door to biological determinations. We show that ultimately it is not physics but biology that governs the Universe. We argue that living organisms are in a most intimate connection with the cosmic vacuum. We show that virtual particles themselves are created by cosmic consciousness. As a result, we obtain that the Universe is, most fundamentally, a conscious living being.

**One sentence summary:** We show that the unseen part of the Universe, the space, is full of creative activity, life and consciousness so that the Universe is, ultimately, a living, conscious being in intimate connection with our everyday activities.

## Heavenly aether was the tool of soul

Heaven and earth have a long and, in some fundamental respects, uncharted history. Ancient world conceived the whole Universe as a living being, and so, heavenly aether pervaded the terrestrial realm of man, including human bodies and brains. According to ancient beliefs, this *heavenly aether was the tool by which the soul maintained bodily life*. In ancient India, China, and Mesopotamia it was common to think that aether (Prana, chi, Empyrean Heaven) permeates the Universe and is its ruling principle. In India, Akasha was the name of the all-permeating rarefied ethereal substance, the vibrating energy of which physical matter consists of. In Chinese philosophy, chi was the name of the ethereal substance, the basic component of everything. Early Daoist philosophers and alchemists regarded it as a vital force or soul. Heavenly aether was the tool of human willpower to act upon our bodies in realizing all our vital actions. Moreover, it was heavenly aether that assisted in thinking[1].

Breaking with the tradition of the all-permeating, vital aether, ancient Greeks already

[1] Xenophanes; Grandpierre and Kafatos 2013

conceived that the terrestrial realm is radically different from the heavens. The Aristotelian scheme divided the Universe into the supralunar (the celestial) and the sublunar (earthly) realms. The four terrestrial elements were subject to change and moved naturally in straight lines. In contrast, no change had been observed in the celestial regions and the heavenly bodies moved in circles. In Aristotle's system aether had no qualities, like the terrestrial elements (was neither hot, cold, wet, or dry), was incapable of change (with the exception of change of place), and by its nature moved in circles, and had no contrary, or unnatural, motion. The division of the world into heavenly and earthly parts having radically different nature led to exile the aether from the terrestrial world of man. The Aristotelian idea was echoed by St. Paul's distinction between celestial, heavenly or "spiritual" bodies and earthly "physical" bodies: "All bodies are not the same...there are celestial bodies and there are earthly bodies. The glory of the celestial is one. The glory of the earthly is another." The supralunar or heavenly realm consists exclusively of a wonderful substance Aristotle named aether: an undifferentiated essence radically different from sublunar essences.

**The heavenly aether became desacralized**

In the Middle Ages, it was still widely believed that different laws prevail in the sublunar and the supralunar world. The corruptible sublunar world was the world of mortals, suffering and disorder. In contrast, in the eternal and immutable heavens the supralunar spheres were driven by angels, and the stellar sphere by God. Yet, for the end of the fourteenth century, the idea of a break between the sublunar and supralunar realms became more and more untenable, and the Copernican idea of a heliocentric Solar System disrupted the fundamental duplicity of these worlds. This drastic change destroyed the basis of the idea that the heavens consist of a radically different substance, aether. The sphere of the stars had lost its cosmic function transmitting divine power from the high skies to the earth. With the desacralization of heavens the aether, the substance of cosmic space, became also disenchanted.

The final revolution, which led to the abandoning of the Aristotelian doctrine of dual heavenly and earthly essences, came in the work of Isaac Newton. He was able to show, in his law of universal gravitation that the fundamental laws that operated on earth causing the fall of the apple to the ground also guided the motion of bodies in the heavens causing the Moon to accelerate continuously towards the earth on its circular orbit, instead of escaping and follow the straight line of inertial motion. With the law of gravitation, it became obviously unnecessary to postulate different kinds of heavenly and earthly essences. With the unparalleled successes of the modern physics developing from the Newtonian ideas, there is an increasing, and, for many, irresistible tendency to think that the Universe has a fundamentally physical nature.

**Aether became alienated from man**

Let us look at the problem of space from a slightly different angle. Democritus claimed that nothing exists except atoms and empty space; everything else is opinion. In other words, the Universe consists of atoms and the void between the atoms. Dividing the dynamically changing Universe to atoms and space has important consequences. *There are atoms, and everything that exists between them, involving their interactions, their relations, and their organization* - as modern science also

agrees. This means that physical laws governing the behavior of atoms belong in this regard to space. Since biological laws also exist, they must belong also to the space. According to the division of Democritus we have to classify structure, complexity, or dynamic couplings between atoms into the category of space. Moreover, life and consciousness are not atoms; they also belong to the second category, space. If so, the space between atoms is full of fervent, vital activity. When, as an aftereffect of the Copernican turn, the fundamental role of space in physics changed, it brought along changing the place of life and consciousness in the Universe. The Newtonian picture portrayed the universe as endless empty cold space with stars scattered randomly in it. There was no particular place for humans, no place for God, and no explanation of the Universe's origin. Man became radically alienated from the Universe and space.

**The turn of quantum physics: space becomes fundamental**

Nevertheless, due to the development of quantum physics, the picture about the cosmic space, again, drastically changed. One of the most surprising predictions of modern quantum theory is that the vacuum of space is not empty. When Heisenberg published his discovery of the famous uncertainty principle in 1927, he thought it expresses only the uncertainty of measurements. Indeed, if one wants to measure the position of an atom under an electron microscope, an electron must hit the atom, and thus the position of the atom will change due to the measurement process itself. In the same year Paul Dirac published his paper founding quantum electrodynamics. Quantum electrodynamics rests on the idea that charged particles (e.g., electrons and positrons) interact by emitting and absorbing photons, the particles that transmit electromagnetic forces. These photons are “virtual”; they cannot be seen or detected in any way because their existence violates the conservation of energy and momentum. The photon exchange is merely the “force” of the interaction. Interacting particles change their speed and direction of travel as they release or absorb the energy of a photon, and when these photons “collide” or interact with particles, they exert a force. The picture of electromagnetic interactions as the exchange of virtual particles has been carried over to the theories of the other fundamental interactions of matter, the strong force, the weak force, and the gravitational force, leading to the development of quantum field theory. The fundamental uncertainty relation of Werner Heisenberg allows a discrepancy in energy to exist for an extremely small amount of time, provided that their product of is small enough. The energy of the exchanged photon can thus be thought of as “borrowed,” within the limits of the uncertainty principle (i.e., the more energy borrowed, the shorter the time of the loan) and used to excite a molecule in a process of spontaneous excitation.

The fundamental entities of quantum theory were no longer the atoms themselves but particles even more elementary than atoms - electrons, protons, and a few others - together with fields of force that surround them, like the familiar fields that surround magnets or electric charges. By the mid-1970s, it had become clear that *the fundamental equations of the best physical theory, the so-called “standard model” do not deal with particles and fields, bu*t *with fields of force alone*; particles are just bundles of field energy. It is even more remarkable that the *elementary particles*, instead of being the ultimate building blocks of the material universe *themselves receive their masses from fields in virtual processes (due to virtual Higgs particles*). What is more, virtual processes govern all their interactions. This means that not only all physical forces arise through virtual particles, but also that the elementary particles

are themselves produced by virtual interactions. We can add that the visible matter of the cosmological models represents only 5% of its mass. The remaining 95% is due to so-called “dark matter” and “dark energy”, both of which are in close relation with vacuum energy of virtual particles.

Although the key of quantum physics is the uncertainty relation, and it opened the door to the real existence of virtual particles, it still presents a question in which many physicists have definite but mutually antagonistic opinions. As the distinguished cosmologist Dennis Sciama was fond of pointing out, when it comes to the interpretation of quantum theory 'the standard of argument suddenly drops to zero'. According to the recent Scientific American article “One Thing Is Certain: Heisenberg's Uncertainty Principle Is Not Dead” the interpretation of the uncertainty relation still presents new challenges.

**Experimental results proving the real existence of virtual particles**

No doubt the real existence of virtual particles is a problem unsolved in many respects. First of all, the problem what exists ‘really’ and what not, may seem to be something that cannot be solved within the framework of physics. We think it is possible to solve the problem when ‘real’ is defined as any process or object that can cause (elicit) physically *measurable consequences*. Accepting such an approach, we can conceive as “real” physical objects invisible for the naked eye like electrons, or virtual particles like the recently discovered Higgs particle.

In fact, quantum theory predicts that the vacuum teems with virtual particles flitting in and out of existence. Although initially a curiosity, physicists quickly realized that these vacuum fluctuations had *measurable consequences*—for instance, producing the tiny but observable “Lamb shift” of atomic spectra and modifying the magnetic moment of the electron.

In 1953, Willis Lamb measured this excited energy state for a hydrogen atom and found it slightly different from the one expected in the absence of virtual particles. This effect is now called the Lamb shift. The energy difference predicted by the effects of the vacuum on atoms is so small that it is only detectable as a transition at microwave frequencies. The precision of microwave measurements is so great that Lamb was able to measure the shift to five significant figures. He subsequently received the Nobel Prize for his work. No doubt remains that virtual particles are really there.

Quantum theory predicted that virtual particles could emerge in pairs in the vacuum spontaneously (the name of this process is “vacuum fluctuation”). Vacuum fluctuations also have observable mechanical effects in macroscopic physics. The archetype of these effects is the Casimir force between two mirrors at rest in vacuum. After Hendrik Casimir predicted this force in 1948, different experiments soon confirmed its existence. Recent experiments have reached a good precision, in the percent range, which makes possible an accurate comparison between theoretical predictions and experimental observations.

The *spontaneous*, temporary emergence of particles from a vacuum is utterly commonplace in quantum field theory. Nevertheless, the confusion regarding the real

existence of virtual particles and their permanent production by so-called "vacuum fluctuations" did not disappear. The philosophical implications of quantum theory were always troubling to many prominent physicists. Frustration with the indeterminacy intrinsic to quantum mechanics was famously expressed in Albert Einstein's assertion "God doesn't play dice." Observing that there are apparently insurmountable difficulties in the interpretation of quantum physics and physical reality, especially the *indeterminism* introduced by the uncertainty relation, led to a general pragmatic position not to ask deeper questions just use quantum physics as a tool to calculate. Asking what actually happens at a measurement played no role in calculating the outcome of measurements. The puzzle of indeterminism hadn't gone away, but it was safely marginalized. But 1964 brought, in a certain sense, a reversal of fortune. Indeterminacy, until then an apparently unpleasant feature of an indispensible theory, suddenly opened the door to *new, yet unexpected quantum freedoms* implicit in the theory. John Bell discovered one such freedom, the possibility of nonlocal correlations, in 1964. A few years later, in 1981, Alain Aspect and his co-workers proved the reality of these nonlocal correlations. Following their lead, Yakir Aharonov of Chapman University discovered that a second type of quantum freedom also exists, and this type of freedom (the possibility of "determination from the future") can be used to construct his famous "weak measurements". Aharonov's corresponding results already led to many successful technological applications.

**The reality of aether: matter and interactions are created and maintained by virtual particles**

These types of effects due to vacuum fluctuations are now central to our understanding of Nature. However, the above-described vacuum effects provide only indirect evidence for the existence of vacuum fluctuations. From early on, many physicists discussed whether it might be possible to observe more directly the virtual particles that compose the quantum vacuum. In the 1970s, Gerald T. Moore, Stephen Fulling and Paul Davies suggested that a mirror undergoing relativistic motion could convert virtual photons into directly observable real photons. Later on the phenomenon received the name *dynamical Casimir effect,* and, in 2011, the Swedish physicist Cristopher Wilson and his group detected it. The real existence of virtual particles is now detected in many independent respects, so we can regard it as having a status above any doubt.

Let us recall that Democritus was thinking in terms of atoms and the space between them. Nowadays, we know that atomic nuclei have a size 100 000-fold smaller than atoms themselves. This means that the ratio of atomic nuclei' sizes to that of atoms is comparable to the ratio between the radius of the Earth and the Sun-Earth distance. The atomic nuclei consist of protons and neutrons. Each proton (or neutron) consists of three quarks - but the individual masses of these quarks only add up to about 1% of the proton's mass. Quantum chromodynamics, the theory of strong interaction between quarks tells that the force that binds quarks together, the strong nuclear force creates the remaining 99%. In quantum terms, a field of virtual particles called gluons, randomly popping into existence and disappearing again, carries the strong force. The energy of these vacuum fluctuations has to be included in the total mass of the proton and neutron. Recent calculations indicate that *most of the mass comes from virtual quarks and gluons fizzing away in the quantum vacuum*. And even the rest 1%

is due to vacuum effects occurring through the Higgs process.

The recent discovery of the Higgs particle adds a new weight to the importance of virtual particles in creating our world. The Higgs field creates mass out of the quantum vacuum too, in the Higgs process. At the Moriond Conference in March 2013, the ATLAS and CMS collaborations at the Large Hadron Collider presented preliminary new results that further elucidate the particle discovered last year. They find that the new particle is looking like a Higgs boson, the particle linked to the mechanism that gives mass to elementary particles. Because these accurate calculations agree with laboratory measurements, we now know, rather than just believe, that the source of mass of everyday matter is the energy of these vacuum fluctuations present in spontaneously emerging virtual particles.

**Virtual processes responsible for the origin of the observable Universe**

Besides all interactions and matter, vacuum fluctuations of virtual particles are responsible also for initiating the Big Bang, according to the theory of Tryon. His idea is developed into the inflationary model of the early universe by Alan Guth and, later on, by Stephen Hawking. It is no wonder that such outstanding physicists like John Archibald Wheeler or Paul Davies considers that the vacuum holds the key to a full understanding of the forces of nature. In the last decades, it became increasingly clear that biological (and cultural) evolution has been an important part of cosmic evolution on Earth, and perhaps on many other planets. Indeed, Paul Davies argues[2] that the long-held prevailing view claiming that living systems had no particular significance in the cosmic scheme of things is "profoundly wrong." Moreover, the ability of living organisms to construct a computational representation of the universe makes them capable of manipulating their environment on a large scale. Therefore, as Paul Davies concludes, "life ... and mind is a key part of the evolution of the universe".

**Inconsistencies in the scientific world view: violation of energy conservation and causality**

The term '*spontaneous*' in the case of the term 'spontaneous virtual pair creation' indicates that this process is not due to physical causes. Therefore, according to general views, energy conservation is violated, but only for the brief particle lifetime permitted by the uncertainty relation. As Paul Davies expresses it[3]: "In the everyday world, energy is always unalterably fixed; the law of energy conservation is a cornerstone of classical physics. But in the quantum microworld, energy can appear and disappear out of nowhere in a spontaneous and unpredictable fashion." This means that spontaneous creation of virtual particle pairs would violate the cornerstone law of physics and, at the same time, this very same process would violate another cornerstone of science: causality. Although every other physical process must have a cause, the spontaneous creation of virtual particle pairs is regarded as an exception, being 'acausal'.

Since virtual particles create (through Higgs particles) physical matter, and they

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[2] Davies 2009, 383.

[3] Davies 1983, 181.

realize all physical interactions, certainly they must be generated, within suitable conditions, by physical causes (in such cases, the creation of virtual particles is not spontaneous but physically caused). We think that fundamental physical laws must be able to generate virtual particles. Moreover, the virtual particles generated by the physical laws (ultimately, by the physical principle), must not have a completely random character in all respects, since they must result non-zero physical forces. But if the Universe has not only physical, but also biological and psychological laws, then these laws must also be able to generate virtual particle pairs in order to realize biological and psychological effects. This means that the biological principle must be also able to create virtual particles. Certainly, the virtual particles created by the biological principle must have a biological character, making it possible that biological forces (like the ones by which cells change their state) can arise. Moreover, if living organisms can themselves decide at least about some aspects of their behavior, and so influence their behavior by autonomous decisions, then they, too, must be able to generate virtual particle pairs in the quantum vacuum.

Let us now proceed towards the ultimate depths of Nature. We regard a precisely formulated principle as a 'first principle' of Nature if and only if all the fundamental laws of the given fundamental branch of natural sciences (i.e. physics, biology or psychology) are derivable from it. The least action principle is one single principle that in a compact form contains all the physical laws that govern the behavior of all the physical objects of the Universe. It is useful to know that the first principles of physics and biology are already mathematically well formulated (these latter ones by Ervin Bauer).

It is a breath-taking fact of Nature that all the fundamental physical laws, including that of classical and quantum physics, are derivable from one single, deeper law: from the least action principle. We can formulate the least action principle in the following form: within a given initial and endpoint, physical systems change in a way that minimizes the physical quantity termed as 'action'. 'Action' in physics is a number expressing the product of energy with time (the lengths of the small time intervals multiplied by the corresponding average energy of the system characteristic in the given time interval), summed up for the given process. This means that 'action' looks like a cost function in terms of energy and time investments. If so, the least action principle sounds as the popular cost functions so basic in economics. Indeed, Maupertuis, who invented the least action principle three hundred years ago, considered that the principle of least action is his most important achievement in philosophy, giving an incontrovertible proof of God.

Cost in economics is the value of the inputs used to produce the output. This means that 'value' seems to be present in physics just at its very core. It is that aspect of the least action principle that is the most exciting for a philosopher, since it tells that Nature knows values. At the same time, it is the aspect that contradicts to the basic assumption of many philosophers claiming that value is not (and cannot be) present in physics.

**Holes at the bottom of the scientific world view**

Today, as a philosopher of science Jaegwon Kim formulates it, the dominant opinion is that since all living organisms consist of material particles that are governed by

physical laws, there is no room at the bottom for any non-physical causes. Nevertheless, as we understand now, at the very bottom of the physical world physical indeterminacy offers a room to spontaneity in the form of physical, biological and psychological creation of virtual particle pairs. We understand that there are serious theoretical difficulties related to virtual particles, especially if they are thought of as representing a kind of reality. For example, in the Feynman interpretation of quantum physics, based on the least action principle and its path integral approach, virtual particles map the whole universe instantaneously to secure the path corresponding to the least action. Such processes seem to be incompatible with the theory of relativity, in which the speed of light is the highest possible physical speed. Nevertheless, we think that since the effects of virtual particles are detected in many independent experiments, the observational background is confirmed without any doubt.

In the philosophy of science, one of the popular basic assumptions is the thesis known as the 'causal closure of the physical causes'. This thesis claims that all events of the physical world must be caused only and exclusively by physical causes. In 2007, the philosopher David Papineau wrote that sometimes it is suggested that the indeterminism of modern quantum mechanics creates room for sui generis non-physical causes to influence the physical world. However, even if quantum mechanics implies that some physical effects are themselves undetermined, it provides no reason, as Papineau thinks, to doubt a quantum version of the causal closure thesis, to the effect that the chances of those effects are fully fixed by prior physical circumstances. And, Papineau adds, this alone is enough to rule out sui generis non-physical causes. Yet we object that although the chances of elementary non-physical interventions are, indeed, limited, their *individual* occurrences are not fully fixed by prior physical circumstances. Moreover, individual deviations from statistical averages of quantum events average out to zero only in case of independent events. Yet in living organisms biological processes are not independent at all, every event is coupled to every other event by biological organization. Therefore, suitable biological organization can be effective in adding up systematically deviations of individual events from their quantum physically expected average values[4]. As the saying tells, little streams make great rivers. If so, non-physical but natural, i.e. biological and psychological causation can be effective in creating virtual particle pairs to realize biological and psychological decisions. If so, the popular assumption shared by Papineau claiming the causal closure of the physical fails. Instead, *we suggest the causal closure of the natural*, claiming that *all natural phenomena must have natural (physical, biological or psychological) causes.*

**Brain, mind and the cosmic vacuum**

Our proposal seems to be capable to explain how the mind governs the brain. The answer is that mind works on the brain through virtual particles of the vacuum. This solution is suitable to explain how can we decide about moving our arms by a suitable scientific theory. But our solution has other important side effects, too. In 2012, Baumeister published that research programs that have been pursued for the past two decades led the researchers to bring back the Victorian notion of willpower as a

[4] Grandpierre and Kafatos 2012

limited supply of energy that is used for control and self-discipline - and several other important phenomena, including making decisions. If living organisms can initiate movements of their voluntarily muscles and can decide about at least some of their actions, like move their leg, than their will represent a certain kind of energy. Definitely, such energy must be physical, because living beings without any physical energy cannot move their leg. But if they are able move their leg according to their willpower, than that physical energy must be transformed into a biologically governable form. If so, the energy of the will to act can cover the energy cost of creating virtual particles from the vacuum. Moreover, the will to move arise as the real cause of the arising motion.

**How to make the scientific world view self-consistent?**

By our solution, biological or psychological actions can act on the possibilities left open by quantum indeterminism that allows non-physical causes to act on the quantum vacuum and create virtual particle pairs. In living organisms, *quantum freedom* is fundamentally open to biological determinations. *Our theory can explain not only how the mind moves the body, but also, at the same time, also how to reassure the universal validity of energy conservation as well as causality*.

**Does the Universe have a biological nature?**

It is a basic fact of Nature that living organisms have ultimate *biological aims* to maintain and flourish their lives, within any external condition. This ultimate biological aim is not mechanical, does not exhaust in realizing certain concrete, previously fixed patterns of processes. Instead, even within a constant environment, and independently of it, the ultimate biological aim urges living organisms to cope with any circumstances and flourish. Life demands not only to survive the given situation to the next one, but also to act in order to maintain and regenerate in its fullest sense the ability to act like a living organism. Living organisms must be able to contribute to the determination of the endpoint of their vital processes, securing their ultimate biological aims: to survive and flourish. This ultimate property of living organisms therefore radically differs from that of physical systems that cannot contribute to change their behavior. Living beings regularly succeed deviating in a systematically increasing rate from their physically expected behavior for the sake of their conceptually deep aim: to live. For example, the endpoint of a falling stone is given by its initial position, velocity, and the boundary conditions (when the drag of the air is negligible, the boundary condition determining the endpoint of the falling stone is the position and shape of the ground). In biology, the final states of the vital processes of the organisms cannot be determined by the initial state and the physical boundary conditions, since these must be determined by biological aims. This means that it is necessary to generalize physics (namely, its first principle which is the least action principle expressing the general inertial nature of physical systems) to make it suitable for allowing genuinely free endpoint determination. This means that the *quantum freedom* we described above must be accessible for *biological determinations*.

In the practical life of living organisms, numerous tasks and problems arise that cannot be solved on the basis of evolution and physical laws alone. For example, when a fish is thrown back into the river, nature’s command is short: survive! This

command does not inform the fish in terms of physical details and spatial coordinates what to do, such as to turn left or right. The fish must be able to solve that problem and all the innumerable others. Such problem solving requires biological autonomy. Organisms commonly have alternative means of performing the same function; therefore, they must decide between biologically equivalent alternatives, the differences of which would not depend on evolution. Therefore, the crucial property of all living organisms is the ability to decide for the sake of biological aims. This ability is termed here as *genuine biological autonomy*. The basic fact that living organisms exist allows us, according to our arguments, to conjecture that biological autonomy must exist.

Biological autonomy is, by its very nature, committed to the ultimate biological aim to flourish. The natural tendency of all living organisms to serve the ultimate biological aim is formulated by Ervin Bauer in the form of a principle, which we regard as the *first principle of biology*. Somewhat simplified, Bauer's principle tells that the living and only the living organisms continuously initiate such changes in their structure that act against physical equilibration. The state of complete physical equilibrium within the organism is, for a living being, the state of death. The first principle of biology requires that living organisms mobilize all their available energies against equilibration. In other words, the basic command of the Universe to living organisms is: mobilize all your energies against inertia! You have to mobilize all your inner resources against passivity! In this sense, Bauer's principle expresses an eternal command of Nature, the victory of life over death. Bauer was able to formulate his principle in a mathematical form, and was able to derive all the fundamental life phenomena, including metabolism, growth, respiration, and death from it. We had shown that the Bauer principle can be formulated in the form of the greatest action principle. Therefore, we think that Bauer's principle can be regarded as the first valid, scientifically acceptable formulation of the long-sought-upon life principle. This means that Bauer's principle is a universal law of Nature, and so, similarly to physical laws, prevails everywhere and every time in the Universe, even if in a different degree, depending on local conditions. As a corollary, the Universe does not exclusively physical, but, simultaneously, biological nature.

**Does the Universe have a psychological nature?**

Since the task of a conscious agent is to decide what to, when, where, and how, this means that biological autonomy and consciousness are closely related. The relation between "consciousness" and biological autonomy is that while "consciousness" is a metaphysical, philosophical, and scientific concept without a generally accepted definition, heavily laden by history, having many different meanings, biological autonomy is defined here in a strict scientific context. *We consider that biological autonomy as spontaneous organismal decision-making is the first exact definition of the operation of consciousness in living organisms.*

Everything that the organism can decide about belongs to mental content, in other words, to the sphere of autonomy. Mental operations can be regarded as preparing decisions and decision-making. Biological autonomy is a general term, valid for any type of living organisms, including cells, plants, animals and humans. In humans, we can speak about "free will", which we consider as a highly developed form of biological autonomy assisted by the vast resources of long-term memory stored in the

brain. The relatively large size of the human cortex allows the developments of a memory with a relatively large size, capable to store tens of thousands of cognitive patterns, learned and habitual knowledge.

It is biological autonomy that is referred to in everyday language as the conscious subject, who decides about what to do. In this chain of events, in the first step we find the initiation of the decision by consciousness. In the second step, we find the realization of the decision with the help of vacuum processes that, from time step to time step, modify the otherwise physical behavior of all the relevant elementary particles of the organism (and a hierarchy of related biological processes) into the biological trajectory that leads to the realization of the decision. If cosmic vacuum carries all the virtual particles that realize all biological and psychological processes, the Universe has not only a physical and biological, but also, at the same time, psychological nature.

**What is the ultimate nature of the Universe?**

Life and consciousness are intimately interwoven since, without decisions, the life principle cannot be realized. Which of them plays more fundamental role in the Universe, the biological or the physical principle? We can regard as more fundamental the one from which the other can be derived. In respect to the rate of consciousness, as the ability to make autonomous decisions, the physical principle can be derived from the biological principle arising in the limit when the ability to decide converges to zero. Moreover, the least action principle can be conceived as the natural tool of the greatest action principle, since the greatest action refers to a series of processes each of which requires decisions about their endpoints. Once their endpoints are decided according to the greatest action principle, the realization of the already decided-upon processes must occur with the help of the least action principle, since only that solution offers economy that is necessary for the whole series of processes to obey the greatest action principle if the resources are limited.

Let us take an example. A company wants to build as many bridges in a year as possible, according to the greatest action principle. Yet the management must decide about when to build the bridges, where and how much of them, given the limited amount of resources. Once the decisions about these concrete details (about the endpoints of concrete actions) are fixed, the decisions should be realized with the help of least action principle, in terms of cost functions including time, money, and other constraints. This means that the least action principle is a vital tool for the greatest action principle to be realized. We found a natural relation between the final and the efficient causes: the final cause (to build the maximum number of bridges) determines the endpoints (end states) and the efficient cause (the least cost), as a second, subservient, direct and immediate cause, realizes it. Regarding the cause-effect chain, the physical, effective cause is only the effect of the biological, final cause. This natural relation between the final and efficient causes indicates a similar relation between the biological and physical principles. This means that the physical principle plays a vital but subservient role in living organisms.

Indeed, this is the case when we decide about any of our bodily processes, for example, to bend our little finger. Although the immediate cause of the finger's

motion is that the muscles contracted, the muscles contract because of the neural command reaching them from the brain. The neural command is an electric sign elicited by biocurrents that are initiated by our decision corresponding to the final cause. The biological principle acts like a mother, determining the endpoints to be realized for her children, the physical principle.

**The Universe in its full light – as a conscious, living being**

In materialism, it is usual to consider that the universe is the sum of all matter, planets, stars, galaxies etc. Yet it is not a natural law that men have to be materialists. If the biological principle is more fundamental than that of physics, as we indicated above, then the explanatory toolkit of materialism is overly short. In a wider horizon, *we can define the Universe* (to distinguish it from the material universe, we write it with a capital letter) *as the unified whole of all physical, biological and psychological phenomena, laws and first principles, together with consciousness at each level of autonomy, i.e. cellular, organismal and cosmic.*

We note that observable phenomena correspond to the manifested "surface" of Nature. In comparison, laws of Nature represent a conceptually more compact and deep level of Nature having vast (infinite) explanatory power and a moderate level of directivity and corresponding (algorithmic) complexity. The first principles of Nature correspond to the ultimate level of Nature, having a still larger conceptual depth, acting at the ultimate, creative or generic level. Correspondingly, consciousness also has three levels. The first, manifest level of consciousness correspond to "mental phenomena" like thoughts already formed in words and sentences. The second, unmanifest level of consciousness corresponds to mental forms having a certain directivity and organization but not yet formulated in words. The third level of consciousness is the creative or generic level, the ability to decide freely and creatively, which we can call as creative consciousness. The three levels of consciousness form a unified whole. Accordingly, the Universe is the unified whole of phenomena, laws, principles and consciousness.

Imagining an evolutionary scheme in which the primary, un-manifested Universe (we denote it as state 1) develops to materially manifested Universe (state 2), we have the following options: 1. In state 1, non-manifested Universe consists of principles, and consciousness. Yet one can ask how the first principles of natural sciences can exist if they are not manifested as phenomena. The other option arises when assuming that even laws and first principles of Nature are created by universal consciousness: 2. In state 1, un-manifested Universe consists of consciousness. This second option (2) in principle may allow that cellular and organismal consciousness co-exist with universal consciousness; let us denote this case as (2a). The other option is that non-manifested, primary Universe consists of universal consciousness; cellular, as well as organismal, consciousness develops later on (case 2b).

Since the physical principle prevails everywhere and every now in the Universe, its mother principle, the biological principle must also prevail everywhere and every now, universally. Therefore, our conjecture is that the Universe, being both physical and biological, considering its causal structure, has a fundamentally biological nature. Now when biological autonomy is considered from the first person perspective of activity and corresponding decision-making, than we can identify it with subjective,

un-manifest consciousness. In other words, it is the conscious subject that makes the decision. All the decisions of the conscious subject act on the quantum vacuum at first, and, with the help of virtual processes, act upon matter, eliciting voluntary movements, influencing our feelings and governing our thoughts. Every voluntary motion we make, every thought we think is realized through the quantum vacuum permeating all the spaces in the Universe. Each action we make, each breath we take is a contact with heavenly cosmic powers that move everything.

Since the biological principle is inseparable from consciousness, we can say not only that the Universe is fundamentally biological, but also that the Universe is fundamentally conscious. If the Universe is a conscious living being, then it has its own sphere of decisions, and it consciously contributes to realize its decisions. A vast realm of science opens before us, in which the Universe is seen in its full light.