# Relations between the Universe and the human mind, philosophical issues (draft) original (French)

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# Introduction

This document presents an interdisciplinary work combining theoretical physics (relativity, quantum mechanics, cosmology) and philosophy (epistemology, metaphysics) on our existence in the universe.

The philosophical approach presented is an example, the author explores different topics of this multidisciplinary approach. This is intended mainly for providing elements for stimulating the curiosity of mind's reader on this subject.

The author does not claim to reveal to him any "doctrine" that would be imposed, this choice belonging to each individual.

The aim is for the reader to exercise his criticism and discernment on the ideas presented by the author.

As this document is the result of the merging of several articles, many redundancies exist.

# 1-Theory and experience, reason and reality

## Preliminary: Bachelard's analysis

Before explaining the ideas set out in the introduction, it is useful, first, to recall some of the foundations of any reflection of this type. G. Bachelard in "The New Scientific Spirit" debates the relationship between the theory that he associates with rationalism (reason) and the experience that he associates with realism (physical reality)[1]. We quote some significant excerpts from it in connection with the problem that arises. He begins his book with the quotation from Bouty that we have already mentioned:

"Science is a product of the human mind, a product conformable to the laws of our thought and adapted to the external world. It therefore offers two aspects, one

subjective, the other objective, both equally necessary, for it is as impossible for us to change anything in the laws of our mind as in those of the world."

He comments on this quotation as follows:

"A strange *metaphysical statement that can lead to a kind of redoubled rationalism that would find, in the laws of the world, the laws of our mind,* [1bis] *as to a universal realism imposing absolute invariability 'on the laws of our mind' conceived as part of the laws of the world*!"

In these remarks, two "dual" interpretations are posed. Should we choose one of them or are they at least partially intertwined?

If we could think until the dawn of the 20th century that we could study the two options independently to study scientific thought, today the problem seems more complex and, as the philosopher says:

"When pushing nature to its ultimate limits, humans discover strange footprints.

They are hers! »

Indeed, our mind is not external to the world we are describing. This leads us to think that, while the study of the nature of knowledge is desirable at all levels of scientific development, it becomes unavoidable, including all the knowledge we have acquired about the functioning of our brain, in modern physics (relativity, cosmology, quantum field theory, quantum mechanics, etc.) where all our familiar concepts (time, space, determinism,.. ) are shaken up, in an attempt to push back the limit.

## On Realism and Rationalism (Experience and Theory)

*"It would not be difficult to show, on the one hand, that in his scientific judgments, the most determined rationalist accepts daily the instruction of a reality with which he is not thoroughly acquainted, and that, on the other hand, the most intransigent realist proceeds to immediate simplifications, exactly as if he were admitting the informative principles of rationalism. Suffice it to say that for scientific philosophy, there is neither realism nor rationalism, absolute, and that one must not start from a general philosophical attitude to judge scientific thought... Thus, as soon as one meditates on scientific action, one realizes that realism and rationalism exchange their advice endlessly... This duality results from the fact that the philosophy of science is a philosophy that applies itself, it cannot preserve the purity of a speculative philosophy. »*

Bachelard argues that one cannot make an exclusive choice between the two, because they are not totally separable. He explains this point of view:

*"The instruments are only materialized theories. Phenomena emerge from them which bear the theoretical mark on all sides. After having formed, in the first efforts of the scientific spirit, a reason in the image of the world, the spiritual activity of modern science is concerned with building a world in the image of reason."*

Access to physical reality, realism, requires instruments and protocols to measure the different parameters and confront them with the predictions of theories, rationalism. Faced with the complexity of the phenomena, formal tools and complex instruments, adapted to these phenomena, are necessary.

To be relevant, they must integrate the "imprint" of the phenomenon described by the theory [2]. It should be noted that, in return, the structure of these formal tools and instruments informs us about the nature of the reality apprehended, which allows us to better understand them and to perfect these formal tools and instruments to make them even more adapted. This is an example of a virtuous iterative cooperation process between realism and rationalism. The adequacy of formal mathematical tools generally translates into the fact that it is with these tools that the formulation of the theory is the simplest. On the assumption that this results from a structural morphism, we can then, from the constructed structure of the tool, also attribute it to the object, which allows us to know it better. Examples exist in relativity [3] and quantum mechanics.

## On the Nature of Scientific Thought and Its Scope

*True scientific thought is metaphysically inductive: it reads the complex in the simple, it says the law about the fact, the rule about the example. But the transition from Newtonian mechanics to relativistic mechanics shows that we have followed a transcendent and not an amplifying induction because nothing in classical mechanics prefigured relativistic mechanics and the convergence as a result for low-field, static approximations is only possible at the cost of mutilation and abandonment of relativistic physics.... Science does not only aim at the assimilation of things among themselves, but also and above all at the assimilation of minds among themselves. »*

This is another essential aspect that is invoked in this statement. Scientific knowledge is only of interest if it is shared and if there is consensus, at least among what is called the scientific community.

The observation is that, indeed, the great refutable scientific physical theories such as relativity and quantum mechanics are the subject of a broad consensus in the world. As history has shown, these theories are not definitive. They are considered to be the most complete common reference of the moment, the one whose

predictions of results are in the best agreement with the experimental verifications that can be made of them.

These theories can be considered to be the scientific heritage of humanity. It has its conservative institutions (sometimes, too much), academies of sciences, colleges, etc[4]. Its teaching is generally provided in the curriculum of higher education in science. This ensures its dissemination and facilitates the adhesion of minds.

This consensus was not at all obvious because humans, and scientists in particular, are rather individualistic. If adhering to a scientific heritage is beneficial for society, it should not be made a dogma. The example of general relativity has shown how this can hinder the introduction of theories that break with the existing corpus.

It should also be noted that this consensus is not unanimous. There are different theories and approaches whose proponents denounce this state of affairs as oppression, on the grounds that it stifles initiatives and can thus hinder the progress of this knowledge.

Here again, there is no universal solution, discernment must remain the primary criterion, the difficulty being that in the face of a proliferation of theories, most of which are fanciful, it is not easy to exercise it effectively!

## Relationship between physics and mathematics

Since physical theories are written in mathematical language, it is natural to wonder what the relationship is between the two. This is another way of understanding the realism-rationalism duality, as analyzed by Bachelard

Theory is a pure product of our mind, unlike physical reality, which is something that imposes itself on us, whose primary perception is empirical and confused, in which we try to find an order. Our mind therefore makes the assumption that this physical reality has a hidden order that must be discovered.

Note that one could defend the idea that physical reality has no hidden order and that it is our mind that arbitrarily attributes one to it.

But then one might ask how a nature without order could give birth to spirits that have one, unless what we call an order is simply constituted by the relations that bind us, by "filiation", to our "mother" nature?

Maybe there are universes without laws and without consciousness and ours would be an exception, but this debate remains open.

Of course, we should also be interested in the nature of laws in physics and the way in which humanity has gradually become aware of them and has tried to identify them, but this is a subject, in itself, that has given rise to many reflections, see R. Feynman's book "The Nature of Laws in Physics", for example.

For example, if Wigner finds it surprising that mathematics is so effective in describing empirical physical reality, it is because this order, specific to mathematics, does not necessarily seem to him to be inherent in the laws of nature.

Let's stick to the first hypothesis, which is generally accepted, and see how it has evolved.

Galileo thought that the physical world (phenomena related to celestial and terrestrial mechanics at the time) that he called "Nature" was a "book" written in the language of mathematics.

In the middle of the 19th century, the idea was rather that these phenomena were governed by a book written in the syntax of mathematics but whose meaning, the semantics, was a matter of physics.

Indeed, if the mathematical syntax is well defined, the mathematical semantics that would refer to a mathematical realism is less obvious because, as Bachelard indicates:

*"The measure of mathematical realism is taken on the extension of notions rather than on their understanding: Thus the geodesic line has more reality than the straight line. The keystone of evidence is therefore the algebraic form. In short, algebra collects all relations and nothing but relations. It is as relations that the various geometries are equivalent. In other words, again, it is a question of relational qualities and in no way substantial. »*

This definition of mathematical realism is the best that mathematics, which has no substance, can give to our mind: A synthetic set of relations adapted to the description of a phenomenon. The hypothesis, which seems natural, of a morphism between the physical reality of the phenomenon and the associated mathematical realism, implies that the information of the mathematical formalism describes what we can know about the phenomenon (reality as it appears to us).

**********

An edifying example of the latter is given by the group of spatial rotations in three-dimensional space. From the definition of vectors in three-dimensional Euclidean space, we define the group, which is called SO(3), defining the relationships between the three generators (one per dimension) of the rotations of these vectors. This group shows that we find the initial state of a vector in this three-dimensional space after a rotation of $2\pi$ (360°). Which seems natural.

We write the Lie algebra of this group SO(3) and we try to see if there are other groups that satisfy this Lie algebra. A two-dimensional group, called SU(2) satisfies it. The study of this group will reveal that it is more fundamental than SO(3), and that it is the latter that should be considered as the group of rotations in three-dimensional space. It shows that to return to the initial state, we must rotate by $4\pi$ (720°), twice the previous case. This may seem surprising, but physics shows that it is indeed this group SU(2) that has a physical reality.

This reveals that the structure of the three-dimensional Euclidean space is less obvious than it seems and that it is the algebra that reveals it, so that it is this algebra, which deals only with formal relations, that contains the most complete and relevant information about these rotations!

## Physical reality

If mathematics does not describe physical reality, how can it be defined?

For Bachelard: *"The metaphysical function of the real is the conviction that an entity goes beyond its immediate given and that we will find more in the hidden real than in the obvious given."*

Regarding what is called substance, what elementary objects, like elementary particles, would be made of, [5] he states:

*"Either substance is a logical subject of indefinable qualities and relations, or it is a being in itself, indefinable, unknowable. The existence of substance is characterized by the fact that it acts on the world: "quod non agil, non existit" (Leibnitz).*

## Mathematical Realism and Physical Reality

If mathematical realism, which produces only relations, is the syntax of physical reality, the problem of the incorporation of this syntax into physical reality arises. This is formulated by Bachelard as follows:

*"But if it is not the objects that possess in them the root of relations, if these objects only later receive properties with the imposed relations, we must ask ourselves all the more carefully whence these relations come."*

This introduction, which extracts some of Bachelard's words from his book, may seem a little long, but it was difficult to amputate it any more without degrading the richness of his thought.

After these general considerations on what can be expected from a reflection on science, it is appropriate to return to the subject of cosmology, its history has shown that the main difficulties encountered by scientists who have endeavoured to develop it were of a conceptual nature.

When Einstein published his theory of special relativity, he was far from imagining all the consequences of his work. As is often the case, the work goes beyond its creator! It was only as it developed that these consequences appeared, the most destabilizing being the destruction of universal time and absolute space for the benefit of space-time, a new concept that is totally counterintuitive, but without which the paradoxes of this theory are inexplicable.

General relativity, which takes up these concepts, generalizes them and incorporates others, is the foundation of modern cosmology.

It is proposed to start by commenting on this theory of relativity in order to better understand the physics that is underpinned by these theories, before focusing on problems that are very specific to cosmology, the theory of the universe, a single entity which, moreover, includes the one who thinks it, a very particular situation.

This chapter is an excerpt from the book "You Said Big Bang".

## Notes on this chapter

[1] Bachelard is obviously not the only one to have taken an interest in the subject that has caused a lot of ink to flow, but his synthesis is quite representative of the ideas generally put forward.

[1bis] Taken to the extreme, this hypothesis suggests that it is our mind that would give its "coherence", by structuring it, to an "amorphous" physical world by laws specific to our mind? These laws, which are, then, the way of apprehending the structures that have been conferred on it, are found in the structures, which would be the key to the success of this approach. We find what we have put into it.

Being part of this world and made up of the same elementary bricks and subject to the same fundamental interactions, we would then have to ask ourselves what would have conferred these laws on our mind while the physical world would seem to lack them. This is conceivable, because our mind is the result of a combination and an apparently very complex assembly of these elementary bricks and the associated fundamental interactions. It remains to find a "motor" to constitute such an assembly, the history of life on Earth being able to offer a model.

This complexity of living things is made possible by physical laws, in particular quantum mechanics. Electromagnetic interaction allows a great diversity of molecules of very diverse complexities. In interaction with its environment, through a Darvinian process of selection, the most efficient configurations, in particular in the appropriation of energy resources, will emerge. This is part of a context of survival, reproduction and domination. How have other specificities, beyond the essentials, developed and prospered? One possibility is that it began with tools, which were initially simple, because as it amplified the action of mastering the environment, it is part of the Darvinian scheme. This required a certain capacity for abstraction which was able to develop and lead to machines, at first simple and increasingly complex, leading to an increase in the capacity for abstraction, observation of nature and its practical use. Nourished by the curiosity of minds and perhaps also by their greed, little by little, progress of the "utilitarian" type implied a refinement of thought that could take as its object elements (art, science, etc.) that were not necessarily utilitarian a priori.

As these elements were likely to strengthen those who practiced them, they gave them an advantage which, through the competition aroused, contributed to raising the level of the societal world.

This was not done without conflicts, but either the more evolved societies could have an advantage or this advantage was acquired by the other party as for example, Tamerlane, who massacred the entire population of a city that resisted him, but spared them and appropriated the scholars and scholars of the "mastabas": bloodthirsty tyrant but not mad.

This closed parenthesis, another more classic hypothesis for this proposition in G. Bachelard's remark, is rather restrictive in nature.

Our knowledge of the laws of nature is limited by the mind of the physicist. The image we have of the world, our theories, is then governed by our mind. The world itself is undoubtedly more complex, as described for example by Plato's allegory of the cave. Of the sea we perceive at best only foam, of reality than shadows.

The fact that the use of laws to apprehend the world is quite effective, which is an observation, even if it is not perfect, although we only manipulate shadows, could

come from the fact that these shadows are attached or at least correlated to "physical reality" and that by manipulating shadows we also manipulate, at least partially, this reality...

[2] A typical example of this is the search for the Higgs boson, which required the construction of a gigantic particle accelerator (LHC), where all measurements were directed towards this target.

[3] For example, the Newmann-Penrose formalism, in general relativity, based on zero coordinates (associated with light, which is not trivial) considerably simplifies the description of the black hole family.

[4] This organization is typical of those found in organized societies, in different fields.

[5] The fact that the ultimate knowledge that can be acquired about the elementary constituents and interactions of the physical world is in terms of relations and only relations is corroborated by modern theories. The theory of quantum fields, consisting of quantum electrodynamics, the weak interaction, the electroweak interaction, which is the unification of the two previous ones, and the strong interaction, is based on symmetries described by the mathematical groups U(1), SU(2), SU(3) and combinations of these groups, and by the Lie algebra associated with these groups. The link with matter, described by quantum mechanics, is made by local symmetries, called gauge symmetries, which describe the coupling of these fields with matter. It should be noted that gravitation, described by general relativity, which is a classical, non-quantified theory, although also a gauge theory, has a formalism of its own. Attempts to unify the two formalisms have not been successful for the moment.

# 2-Paradigm, essence, existence, creation

## Motivation for reflection

"Classical" science is based on concepts of time and space that appear to us to be inherent in the nature of the world and in the way we apprehend it (immediate data of our consciousness). As such, they are the natural and necessary framework for its description and understanding. However, modern theories show us that this is not the case.

Relativity shows us that time and space must be abandoned as fundamental concepts in favor of a more synthetic concept, "space-time," of which space and time are reduced "at best" to mere shadows.

Quantum mechanics, beyond the mutilation of our understanding linked to the abandonment of determinism, but perhaps in relation to it, presents us with a strange world, of which we cannot really give a coherent interpretation.

The difficulty is that our mind works in space and time, which is undoubtedly the cause of all this torment, and that when we make commendable efforts to abstract ourselves from it, time and space are too often underlying it without us always being aware of it.

The purpose of this article is to try to give elements for reflection and above all to encourage reflection, because such a task requires the cooperation of minds, in an attempt to break this straitjacket that veils the intimate nature of nature and, consequently, that of our own nature.

We become aware of the difficulty of the task, since it is our own nature that must analyze and determine itself.

The hope, however, lies in the fact that, as an element of nature in the most general sense, the universe in its most global extension from the microscopic to the macroscopic, we can by observation of this nature (which is "external" to us) appreciate certain characteristics of it.

We must therefore use as paradigms (see the definition in a later chapter) the strange properties of modern theories to guide us in our quest.

## Position of the problem, some fundamental reminders.

## The universe has no history, because, in fact, it is history!

## The universe has a history!

This model is generally described as a space expanding from an initial singularity "The Big Bang" considered to mark the temporal and spatial origin of the universe. It would have emerged *ex nihilo* or something else pre-existing.

## The universe has no history, because it is history!

Einstein's equation applied to cosmology describes the universe as a whole, in all its spatial and temporal extension. The space-time it defines includes space, time and motion. There is no need to define another space and another time outside this space-time that would define its beginning and course. To consider that the universe has a history is a useless hypothesis of an anthropomorphic nature!

## The Big Bang is not the creation of the universe, it is a singularity that is part of it!

As James Peebles pointed out after his Nobel Prize in 2019, the term Big Bang, which connotes a creation of the universe in a place at a given time which, as is implicitly assumed, refers to our perception of space and time in our universe, has no meaning since our universe is a space-time (which is made explicit by its mathematical modeling).

Indeed, relativity teaches us that space and time do not have an individual physical character, contrary to the Newtonian and common conception, because they are only shadows of space-time, the only concept to have a physical meaning.

Let us remember that a space-time does not need to be located in time and space to be endowed with the concepts of time and space since these concepts, as we perceive them, are the shadows of this space-time, and therefore are internal to our universe!

## Background

The standard model of cosmology, called the big bang theory, is based, in an observational way, on the observation of the flight of galaxies (around 1929 by E. Hubble).

The farther away the galaxies are (from us), the higher their rate of mutual recession (they move away from each other). We can therefore think that in the past they were extremely close, ultimately in an extremely condensed state.

Let's not forget that we are and are part of this universe that we seek to know. We see it from the inside.

We know that, because of the speed of light, which is a limit, the more we look at distant objects, the further they are in our past because light took longer to reach us.

Their image is the one that corresponds to their state when the light was emitted.

This was theorized, by making hypotheses of homogeneity and isotropy supposed to be realistic on a very large scale, in the framework of Einstein's general relativity, by Friedmann as early as 1922 and then Lemaitre in 1927 and 1932.

The result of this modeling is a **space-time**, a solution obtained by applying Einstein's equation with a form of metric, generally Robertson-Walker associated with a certain layering of this space-time, in time and space, and an energy-momentum tensor associated with the physical part of the universe (matter, light, energy sources).

Let us remember that this layering, however practical it may be, (matter-energy is co-mobile with expansion) is arbitrary, because in relativity there is no absolute time.

Indeed, in relativity time and space have no physical character, only space-time has one (dixit Minkowski -1907).

This model has evolved according to observational data, because its dynamics depend on what it is made of "physically" (matter, energy).

But, apart from a few manual additions of "quantum mechanics" (quantum vacuum fluctuations) and a period of inflation that will dilute these fluctuations producing an almost scale-invariant power spectrum, the theoretical framework has remained the same.

Today it is a model where, in the lamination adopted, space is almost flat in expansion (dark energy), the majority of which is of unknown nature (dark matter).

Despite some tension over the value of the Hubble constant, where we find incompatible results by different methods, this model is the best (or least bad) available today.

## Philosophical aspects

## Creation of the universe

In this model, an "age" of 13.7 billion years is assigned, this being measured in what is called "cosmic time" associated with a certain layering of space-time (Robertson-Walker metric).

As this time is arbitrary, this creation would be postponed to the infinity of our past if we took our current own time as time.

Indeed, we will never be able to observe this creation through our instruments, no matter how efficient they may be.

What is the real time then? Answer: from a formal (mathematical) point of view, all of them are equal for the equations, they differ only in aspects of simplicity of implementation! But, because there is a "but"...

## Physics ends where metaphysics begins

The (human) physicist considers as physical everything that can be verified by experiments.

He does these experiments in his present, so with his own present time, as such the two approaches are not equal. Only the one that would allow experimental validation is of a physical type for him.

As such, he can declare that the "Big Bang" is not of a physical nature, because it cannot be observed, this event, if it exists, would be of a metaphysical nature.

The same can also be said of "space" below the horizon of a black hole, for example, where no information of an experimental type can reach us.

Although very precisely described by the equations, its nature is metaphysical, because it cannot be observed.

We knew that physics does not accommodate infinities, but also other situations, which can, implicitly, imply infinities.

All of this must be kept in mind throughout this document, even if it is not repeated at every opportunity.

## Does considering space-time instead of space and time resulting from a leafing through the pages change this appreciation of the limit between physics and metaphysics?

In fact, when we say that we make an observation in time and space, it is inaccurate. Light follows geodesics of space-time. An observation invokes space-time, so what has been said applies to space-time.

Let us remember that a space-time is the "primordial" synthetic concept, time and space are "shadows" (reminder according to Minkowski) resulting from a particular layering of space-time into time and space.

Thus, the expansion of space is an internal phenomenon of space-time resulting from this layering, in time and space.

Space-time, itself, is not expanding, nor does it have past, present or future. It does not need to be immersed in anything, it is self-sufficient to describe itself totally by internal elements and to deduce the internal dynamics from them.

Its property is to exist (or not) and we see that it exists. If it did not exist, there would be no one to see it. This is in line with the philosophical position of existentialism. Existence cannot be deduced, cannot be proved, it is observed.

If we ask ourselves the question: was space-time itself created? We will see that for a space-time, the term "immanence" should probably be preferred to "existence", the latter term being able to connote a creation.

One may wonder if this question has any meaning and if it would bring additional information to its existence. Other chapters will explain this point: see "cosmic censorship".

## A look back at the position of J. Peebles (Nobel Prize 2019) regarding the term BIG BANG

He said he didn't like the term "Big Bang" because it connoted an event in a given place and time, which implies a structure, at least of time and space.

This would bring the problem back to that of creation to the existence of a predecessor, namely, the pre-existence of this structure (space, time) whose events would be dated (what frame of reference, origin?), in this predecessor.

It should be noted that J. Peebles does not deny the standard cosmological model, to which he contributed, he simply rejects the interpretation of the creation of the universe, (Big Bang).

## Sudden creation

Thibault Damour had proposed this term, which was not successful, but which describes a different situation.

Space-time is created when no structure of time and space exists. Hence the term "sudden creation".

He adds that time and space are created on this occasion.

He developed his theory within the framework of string theory, which is different from general relativity, which can be obtained by consulting an AI.

## Is the universe included in something from which it is derived?

Supposing that our universe is included in an entity, endowed with these parameters of space and time, which would contain it and which would confer them on it (which some theories postulate, but this only transfers the problem to this entity, where does it come from, how was it endowed with these parameters?), would the term Big Bang, thus thought, be adequate?

This hypothesis only postpones the problem

## Space-time and singularity

For the Standard Cosmological Model, Einstein's equation defines a spacetime with a singularity, which is not trivial, because there are manifolds modeling singularity-free spaces (the surface of a sphere is a compact manifold without singularity).

Can we associate this singularity with the creation of the universe?

This is tempting, but knowing that this singularity does not belong to our space-time (at least in its modeling by a manifold) this is problematic because it seems that there is no continuity between the singularity and space-time, which is what we call an "open", (mathematically we can get as close as we want to the singularity but we cannot reach it).

Curiously, if we examine the radial free fall equations in a black hole (another solution of general relativity), we reach the singularity in a finite eigentime (if we start from a finite distance of the singularity).

However, this point is interesting, because although there is no continuity, it does not mean that there is no influence.

For example, in relativity, in black holes, all the mass that conditions the associated infinite space-time is "in" the singularity which, however, is not part of it, even if it is infinitely close to it.

In the end, the existence of singularity is, perhaps, more an opening for a reflection on the existence of the universe, to which it would be interesting to associate this reflection with that of the "cosmic censorship" that encapsulates singularities of this type and allows a reasonable physics without violation of causality, than a rejection.

# Elements of Plato's Philosophy: Essentialism,

## Essence precedes existence.

Plato defines essences or ideas, which are the eternal and perfect intelligible forms, archetypes and models of sensible things which are apprehended by phenomena in our physical world, which are only unstable and imperfect reflections of them. It is these ideas that give meaning to phenomena, in particular that define the laws of nature.

## Allegory of the cave

Plato illustrates his arguments by describing a situation where prisoners in a cave see only the shadows, projected on the wall of that cave, of the outside world. Can they imagine that these are only shadows of something more complex (ideas) and reconstruct them from the shadows, or are they reduced to considering these shadows as reality? If a prisoner claims that these shadows are the only existing reality, can he be proven wrong?

In this description, the cave represents the sensible world in which we live, and the shadows are the phenomena as we observe. The outer world is the perfect world of ideas.

Let us then add that the Platonic "reality" of which only shadows can implement concepts that we do not know and of which we have no idea, possibly breaking our habits of thought. Thus, the quest for creation, which torments us so much, does not necessarily take place for reality. Even if it shocks our understanding, we must not lose sight of these possibilities.

*It should be noted that Plato's objective was not to say what he thought himself, what were the answers he had given to the most fundamental questions about what it means to be a man, but to teach them to think for themselves in order to find their own answers to these questions, because he knew that in this matter, neither he nor we would ever have definitive answers and that everyone had to build his life and live it according to Socrates' motto: "Know thyself"*

## The paradigm.

The paradigm is what is shown by way of example, what is referred to as that which exemplifies a rule and can therefore serve as a model. In Plato, it has a pedagogical meaning: the paradigm is the "easy" object on which one exercises

before dealing with an object similar to the first, but more difficult. Bachelard illustrates this by emphasizing that thought is essentially inductive, it reads the complex in the simple, the law in the example.

## Existentialism

The notion of **existence** in philosophy experienced a fundamental development thanks to **Kierkegaard** in the 19th century and then, in the 20th century, with **Merleau-Ponty** and **Sartre**, where, contrary to Plato, existence precedes essence. Existence cannot be deduced, it is observed, it is experienced:

**Sartre**: "... by definition, existence is not necessity. To exist is simply to be there; the existents appear, allow themselves to be encountered, but they can never be deduced." The essence, then, is constructed in existence.

If this philosophy was developed essentially to deal with the existence of the human, given that our existence and that of the universe are inextricably linked, it is interesting to consider it in this context as well.

### Only the existence of the universe has a meaning?

As the success of the Big Bang model, assuming a creation of the universe, shows, the assertion "only the existence of the universe has meaning" shocks our habits of thought.

However, a creation poses no less of a problem than that of existence, because one can ask how something can emerge spontaneously?

Remember that the quantum vacuum is not nothing, so it is part of the universe, so, if there is creation, it is part of creation. An eternal universe is not a good solution either, because eternity, which does not allow us to locate a point in an unequivocal way, is not a physical concept.

Those who are interested in a pre-Big Bang are only postponing the problem of the existence of what was before.

All these hypotheses are based on an external vision of our universe and an external time and space in which it would be situated. In fact, in relativity, time and space do not exist, because only space-time, resulting from Einstein's equation, exists and moreover the perception and knowledge we have of it is from the inside.

As we have developed in the book, and recalled in this document, space-time defined by general relativity needs nothing but itself to exist and infer all the phenomenology that we observe from within the universe where we are and of which we are a part.

Existentialism then seems the most appropriate philosophy to describe our relationship with this universe.

## Paradigm for a creation?

The purpose of the arguments developed above about our existence involving that of the universe [1] is to make an objective state of a physical situation. However, they leave in our minds a feeling of dissatisfaction or even frustration, because they do not deal with the problem of the origin of this existence. This problem of origin (creation) cannot ignore an inescapable part of metaphysics.

## Concept of: "creation"

First of all, let's start by clarifying the concept of "creation".

We call "creation" the fact that something appears spontaneously (without any apparent cause), somewhere, when it did not exist before! We see that if we apply this definition to the universe, this definition refers to a space (place where creation appears) and to an oriented time (before, at the moment when this creation occurs, after).

This presupposes a pre-existing space and time of reference, which are generally a framework, at the very least, simply provided with the essential elements of its existence, which would implicitly be eternal, because otherwise its creation would also have to be explained. Note that if it is eternal, and therefore was not created in the sense in which it is understood, then its existence must be postulated! This is a manifestly Newtonian approach, where time and space are independent and eternal.

But, above all, this approach is fundamentally incorrect, because what we must consider is a **space-time** which is a more synthetic concept than those of space and time, which are only "shadows" (dixit-Minkowski who was probably referring to Plato's allegory of the cave) [2]. Plato's idea is that, since **reality** (the real object) is of a fundamentally more synthetic nature than its shadows, it is impossible to want to define it extensively by its shadows!

A question that arises then is: can we conceive of the "creation" of a space-time with the definition we have given of creation (the concept of which is an independent space and time)?

The answer is clearly that we can't! The conceptual tools associated with the concept of "creation", which we use, are inappropriate to deal with this problem. We have to look for (and find?) something else, look for another paradigm.

## An example of creation?

Without prejudging the creation of the universe, let's try to find an example of creation corresponding to the definition we have given. Concerning our own existence. Before our conception we do not exist. But our birth, which can be considered as a creation of a new being, does not start from nothing. Our body had all its constituents already present before in nature, it is an arrangement of these constituents and a development according to a pattern related to our DNA that will be carried out. It is not a creation "ex nihilo". Matter generates matter, even if the latter is reputed to be more organized (there has been an abundant literature on this, especially invoking entropy). On the other hand, our intellect, which makes us a unique individual, independent and above all aware of well-being, seems to emerge "ex nihilo", because it is a property of another nature that can be considered more synthetic than matter, in particular consciousness [3] which we cannot interpret by a strictly materialist and reductionist approach.

As our definition of the paradigm (a formal model to guide us in understanding a problem) offers us, the example cited is a schema which, provided that it is considered as a paradigm, and therefore without reducing it to an example, can lead us to a constructive reflection on the subject.

## And the history of the universe?

The history of the universe is very similar to our history. This is not surprising since made by human spirits, an anthropomorphic character is always underlying. Let us give a few elements.

In a "reductionist" analysis of the universe in its ability to have produced humans like us, we find the same thing, matter and interactions will exist.

It should be noted that supersymmetric theories propose to unify the two.

We can see that an important element is symmetry. The quantum vacuum, for example, does not generate matter alone, but always antimatter pairs, a particle with its antiparticle that will quickly annihilate each other in the case.

Why then are there matter and photons, for example, and not just photons or matter?

It's a long story where, basically, let's say that the interactions (between the different constituents), 4 in number, including gravitation, which provides the logistics (large structures, housing and energy) will intervene.

The strong interaction will bind quarks to make particles (protons and neutrons among others), the weak interaction will allow them to change their nature, other particles such as the electron for example are elementary, etc. Electromagnetism is the source of the complexity that will allow life in atoms with nuclei made up of protons and neutrons with a procession of electrons.

These interactions are the DNA of the evolution of the universe in the classic scheme of the Standard Model of cosmology, where a scenario will unfold to produce beings like us.

As with our birth, there is a context where there are the bricks (matter) and the dynamics via interactions (which play a role in DNA) that govern evolution for us to appear.

This scheme is ultra-simplistic, many parameters are not mentioned, but shows a similarity. Concerning the existence of the universe, the Standard Model speaks of a "big bang" creation and an evolution, but we can just as easily imagine and develop an alternative approach that since the universe is a space-time, only its existence makes sense, which is more in line with general relativity, Einstein's equation defining a space-time.

This debate remains open for lack of convincing arguments on both sides. A beautiful subject for reflection and a challenge to the ability of the mind to surpass itself could result.

## Our position in the universe: constraint or solution?

An essential point to take into account in our reflection is that, being a part of the universe, our analysis, our theories and the verifications that could be made of them, are exercised from the inside. The example of our galaxy (the Milky Way), illustrates how the fact of being inside an object complicates our knowledge. Indeed, as much as the shape of our neighboring galaxies appears to us clearly in our telescopes, that of our galaxy is deceptive (a white trail on the celestial vault).

Remember that what we see in the night sky is the projection on a spherical 2-dimensional surface (the celestial vault) where we see the stars, among other things, which we locate by angular coordinates. The distance of objects is not directly accessible to us. It is by using the physical properties of celestial objects, of which we know certain characteristics, that we understand the distance. For example, for the Milky Way, where we are in an "arm", it is by observing statistical

overdensities (which are attributed to our galaxy) in the stargazing on the celestial vault that we estimate its shape and dimensions.

The exercise is quite acrobatic, as evidenced by the many corrections to the results over time, but it is useful.

## Can this example be a paradigm for the quest for our existence?

Since, concerning our reflection on our existence and that of the universe, we are in the same situation (inside and subject to its laws and constraints), this approach must inspire us in our quest. It is certainly from within that we must therefore build our reflection, especially since, let us repeat, the possible verifications of our hypotheses can only be done from the inside.

Paradoxically, if we adopt this point of view consisting of considering the universe from our position and its context, in the present, then modern cosmology shows us that our past has no limit and that the singularity in this space-time, commonly considered to be the beginning of the universe, called the "big-bang", is rejected to infinity from our past, therefore inaccessible to our instruments, however efficient they may be [4], which denying any possibility of observation, excludes it from the field of physics.

## Cosmic censorship: a physical phenomenon or an artefact of our minds?

Since infinity is a concept that has no physical reality, we witness a "censorship" of nature when humans ask it essential questions.

This, which is not fortuitous, is of the same type as the case of the black hole where nature encapsulates the central singularity under a sealed horizon to confine their nuisance and thus allow reasonable physics to be available outside the horizon.

In the case of the black hole, if a human crosses the horizon, which is possible, assuming that in the limited time he has left to live, he can make observations, he cannot transmit them to other humans outside the horizon and knowing the fatal fate that awaits him, he takes them to his grave. This information is lost.

What is undeniable is that both of these types of censorship seem unavoidable, which seems to ruin any chance of a physical answer to the questions they evade.

So, although the theory predicts phenomenology below the horizon of a black hole, we have no way of verifying it, in situ, because no information can emerge from the horizon. This phenomenon is non-physical since it is unverifiable!

### Cosmic censorship, a timely response to unanswered questions

Faced with the surprising but "very opportune" nature of this censorship, we can ask ourselves if nature is really like this or if it is our mind that introduces this "filter" to preserve its coherence!

We must admit that it is in an almost miraculous way, a very practical answer, as soon as a phenomenon defies understanding, (singularities), it tells us: "I do physics, I must be able to verify the facts, when I can't it's metaphysics, it's irrelevant!" In other words, "move around, there's nothing to see!

In the face of this, we can consider, either that these questions do not make sense, what nature would make us understand by evading any possibility of an answer, which would result in clear limits to our thinking, or, although our thinking certainly has limits, that we do not approach the problem correctly and that progress is still possible.

As in other scientific fields (relativity, quantum mechanics) we have succeeded in overcoming difficulties that seemed, a priori, insurmountable to our understanding, any hope of overcoming or circumventing these annoyances, to go further, is not lost!

## Notes on this chapter

[1] The order is willing. It is because we think about the universe that we develop these theories. As already indicated, not taking into account the one who thinks the universe in its description can only lead to an incorrect analysis.

[2] While it is difficult for our mind to imagine a hyperbolic, 4-dimensional space-time as modeled in the framework of general relativity, its mathematical description, which is very precise, tells us that it is totally "autonomous" and self-descriptive. By this we mean that it needs nothing but itself to exist and be described. In particular, it does not need to be included in something else to exist, which means that all the mathematical tools used for its description are "internal".

For example, we can define the curvature of a well-known spherical surface in two dimensions by equations that refer to only two dimensions (Gaussian curvature - intrinsic curvature) or by the radius of the sphere which refers to the

three-dimensional sphere (extrinsic curvature). The 2 formulations describe the same physics but in different ways.

The physical counterpart is that its phenomenology must depend only on properties internal to this space-time.

[3] This has always been felt, empirically, by humans. Generically, it was called the soul, a concept that was very successful. The pharaohs would have been the first to benefit from it, (a divine character was attached to it). But in their great meekness, and also to calm the spirits, they generously granted it, very gradually, to the other social categories. The tradition has endured.

[4] This point is explained in detail in the book.

# 3-Space-time as a paradigm of our existence: beyond eternity!

## The mystery of our existence

On this site (see Philosophy (25/9/25)-24 items), we have shown at length that the justification of the existence of the universe and of our existence leads to tautologies. The consciousness of our existence justifies that of the universe of which we are an integral part. We are also an all-encompassing structure of the universe, through our thought, which allows us to consider it in its totality.

Does it take a consciousness that considers it to give existence to the universe or any other object (extrinsic existence)? Note that such an existence for this consciousness simply means that it is present in the mind of this consciousness that has taken it into account.

When this consciousness is applied to the one who possesses it (intrinsic existence), is it of the same nature? Could it be possible for a mind to be able to ascertain the existence of an external object (to integrate it into its mind) without being able to assume and deduce the proof of its own existence with its mind and thus acquire the consciousness of existing?

As our mind is constructed, it seems natural that the two are related, but we must not lose sight of the fact that, since in this argument the mind speaks for itself, the objectivity of the argument is questionable.

That's a lot of questions, the only answer, a little frustrating, that we have proposed is based on existentialist philosophy: existence cannot be explained, it can be observed. Let us emphasize the tautology because, in order to acknowledge one's existence, one must exist.

## Creation and existence

Our usual patterns of thought, based on the concepts of time and space that are dear to us (immediate data of our consciousness according to the classical philosopher), considering that the default option is that nothing exists, we assume that a creation must have intervened for there to be something.

As Leibnitz said: "**Why something rather than nothing**?" It can be objected that if there is "nothing", there will be no consciousness to see it, which is again a tautology.

Philosophy has debated at length the essential problem of our existence.

In antiquity, Plato's essentialism assumed a perfect world of ideas with its image in the sensible world (the physical world in which we live), an image that he called the phenomenon. This was summarized by declaring: Essence precedes existence, where by essence we designate the thing in itself (the noumenon)

On the other hand, the more modern representation of existentialism states that one cannot prove one's existence but only establish it. This can be summarized by declaring that existence precedes essence.

## The physical character of the human

Since, it is paradoxical that our being, which, from a physical point of view, is an assembly of atoms, can obtain relatively precise knowledge about the nature of these atoms, our ultimate constituents, in particular about their possibility of combining in such a way as to produce very complex arrangements, allowing us to produce beings like us, which is not only necessary but also consistent with our existence, we can only deduce that it is the relations, the arrangements of atoms that carry the information associated with us, even if to do so, it is necessary that there are different possibilities at the individual level, certainly at a more limited level, but combinatorics will do the rest!

## A fortuitous or fundamental structural morphism?

Faced with such a structure, we cannot avoid mentioning the structural morphism, on a macroscopic scale, with our brain, where the basic element is the neuron, which is a cell with relatively elementary functionalities, namely connections with

other neurons, some receiving information, in chemical form, other neurons connected, others transmitting, selectively (some outputs can be activated and others inhibited), information, in chemical form, to other connected neurons.

The transfer function (law between inputs and outputs) depends on parameters previously acquired by "learning", a mechanism that promotes connections that have led to successful actions, which has resulted in human pleasure characterized by the secretion of specific chemical substances. There is a feedback that will modify the activation/inhibition rules of neurons in order to promote the path followed that determined this success.

Thus, in the clumsy attempts of a baby trying to grasp an object, when he succeeds, it will favor the sequence of actions of the neurons controlling his limbs in his movements that have allowed this success, which will allow him to improve his efficiency (learning). It is clear that, as with atoms, it is combinatorics that represents information, the elements (neurons) allowing its implementation being relatively simple.

It should be noted that this simple neural structure (by learning) is proving to be incredibly efficient to the point that it is incorporated into the algorithms of the most modern computer systems.

There is a morphism between the structure, analyzed from the microscopic point of view, whose basic elements are the atoms, of our mind, of quantum mechanics, and that of our brain, analyzed from the macroscopic point of view, whose basic elements are neurons.

So, we cannot avoid considering that, since it is our mind, our brain, (with this structure) that is at work in the elaboration of the theory of quantum mechanics, the structure of nature, at the level of the atom, could be so blurred that we would be limited by the structure of our mind, thus acting as a filter imposing its ultimate resolution on the perception of the phenomenon. We can only discern what our mind allows!

As it has been said: "When humans pushed the study of nature to its ultimate limits, they discovered strange footprints, they were their own!"

## Does the field of our thinking have structural limits?

Another interesting point is, on the one hand, that we can hold this kind of completely entangled discourse and on the other hand that we can even consider other hypotheses, for example, that our analysis is biased by the intricate physical situation in which we find ourselves and the jumble of tautologies that attaches to it.

We can consider that our analysis is false because of these tautologies that make it unproductive. Even if we don't know how to get out of it, currently on the basis of Plato's allegory of the cave, which we can take as a paradigm, we can not close the door to another interpretation, considering that the sensible world in which we are (phenomena) is only a world of appearances of a reality that escapes us, at least for the moment.

This attitude is an opening that can allow us to consider another approach.

## Space-time shakes up the concepts of the Standard Model

The relativistic Standard Model of cosmology is based on Einstein's equation which defines, not a space and time, but a space-time. It is therefore not natural that it should be interpreted in terms of space and time, which are Newtonian concepts.

It should be remembered that this concept of space-time was introduced in 1905 by special relativity, even if its formulation in Einstein's articles is not explicit.

It results from a constraint imposed by the principle of relativity which states that all physical phenomena must follow the same laws in all Galilean frames of reference, which are inertial frames of reference where no stress is felt and which are all in relative motion, characterized by a constant speed.

This principle implies, among other things, a velocity invariant which, if it has a finite value, is non-zero, implies the structure of space-time. This principle has been taken up in general relativity since locally it conforms to special relativity.

See How the Existence of a Rate Invariant in Relativity Destroys Space and Time.9/26/22 and A Proof Illustrating the Heuristic Power of the Principle of Relativity 1/12/23. For example for more details.

Interpretation in terms of space-time provides a much more original and fruitful solution.

Indeed, the notion of creating a space-time, in a (pre-existing) space and at a given (pre-existing) time, has no meaning insofar as a space-time is a more synthetic concept than space and time taken separately, which are, at best, only "appearances".

In fact, a **space-time exists in itself**, independently of any other external constraint and does not need to be included in anything else, either "spatially" (would

have a container) or "temporally" which would invoke a dynamic of the type: creation-life-death.

A space-time has no **past, no present, no future**, notions that are Newtonian notions, it "exists" as space-time.

These notions (past, present, future) are internal elements of space-time, which result from arbitrary foliation (cutting), producing, as a result, **appearances**, without physical character, because of the arbitrary character of the foliation, of its structure.

## Space-time: an inconceivable notion?

Our mind, anchored, materially and conceptually, in the usual low-energy physical world, where the characteristics of space-time are not perceptible, seems incapable of synthesizing this concept (Plato's cave, we see shadows that our mind mistakes for physical reality and it is difficult to conceive of what objects these shadows are).

## Our mind has, in fact, a space-time structure?

In a classical way, time and space are considered as immediate data of our thought.

If the notion of time, idealized by classical universal time by a cosmic "clock" governing the course of all things, has lost its physical character and is relegated to a "shadow" of this reality in relativity, in our mind this time appears to us as the "dynamic" parameter of our life, implicitly dynamic because to live is, apparently, to link moments with a notion of past, present and future.

However, thinking undeniably induces a "spatio-temporal" structure.

Indeed, an **idea** is not instantaneous, it has a temporal "extension" and a spatial "extension" in our brain, it is an **entity of space-time**. It is undoubtedly the phenomenon of memory that gives it and allows this temporal thickness, and this memory is an attribute of our understanding

The concept of space-time, fundamental in general relativity, which we struggle to conceive synthetically, would nevertheless be implicitly at work in our minds?

For the past and the future we know that they have limits, (birth, death), for the human, for the human present, it is not considered as "instantaneous" but as

having a certain duration. The present has a "quantified" structure, let's call it a strand, or a granule, of time and space, which gives it a "space-time" type status.

Indeed, our knowledge of our nervous system tells us that the propagation of nerve impulses, the vehicle for the transport of information by the nervous system, between stimuli, either external through our senses or internal through our mind, is not instantaneous. The same is true in our brain where ideas are conceptualized.

Materialized by chemical reactions, ion exchange among others, it is slow within the neuron and between neurons.

The notion of the moment is then a deceptive illusion (like the concept of "continuous" which does not exist in nature), elaborated by our brain when this information reaches it and processes it.

It is characterized by a strand or rather a "nodule" containing a spatial configuration and an evolution of connections between neurons associated with the duration of the present.

In fact, in a physical way, the unfolding of a thought, its illusion of continuity, is not a "continuous thread" but rather a "braid" of small strands (the nodules) intertwined with elements of this thought, forming a "continuous" braid that gives it an illusion of continuity.

## Do we find in our representation of the world the structure of our mind?

This structure, where the "continuous" is the result of a weaving of tiny compact elements, is reminiscent of modern approaches to spin networks and weaving (structural morphism).

This opens the way to reflections on the role of the structure of our mind on the representation we have of the physical world. We would find in the physical world the structure of our mind.

In the book "**You Said Big Bang**" by J. FRIC (2020), p.135-136, this is explained as follows:

Quote from Bouty (La vérité scientifique, 1908 p.7);

"*Science is a product of the human mind, a product conformable to the laws of our thought and adapted to the external world. It offers two aspects, one subjective, the*

*other objective, both equally necessary, for it is as impossible for us to change anything in the laws of our mind as in those of the world*."

This quotation appears at the beginning of G. Bachelard's work "Le nouvel esprit scientifique, ed. 1968", which he comments on as follows:

*"A strange metaphysical declaration that can lead as well to a sort of redoubled rationalism that would find in the laws of the world the laws of our mind, as to a universal realism imposing absolute invariability on the laws of our mind, conceived as a part of the laws of the world*."

We can see that these reflections on scientific thought and its morphism with the laws of nature are much earlier than the modern discoveries (lattices, spin issage) that we have cited, where this morphism is exemplified.

## The difficulties of conceptualizing the space-time of our mind

We know that, physically, we characterize spatial (extended) areas in our brain, specialized in certain tasks, but we know that this memory is distributed (extended), because it results from a combination of an arrangement of activated or non-activated connections of neurons, which last for a more or less long time.

Would it not be appropriate to consider, then, that an idea is indeed a spatio-temporal object, in the sense of relativity, that is to say, a monolithic object, an island of space-time, represented by an intricate spatial and temporal configuration?

It may seem strange then that if the structure of our thought is, implicitly, spatio-temporal, we are not able to extract this property from our thought, to think of our thought as the object of our thought.

In other words, we must strive to model the process, to extract the structural synthesis, which we can then consider as an object of our mind that it can process in relation to its other objects.

Let us remember that this process of self-relationship is at work in consciousness (a relationship that relates to itself), in particular in our consciousness of existing. This is the very essence of the concept of consciousness.

It is therefore this mechanism that we have identified, but that we have difficulty synthesizing.

If this is true, then we can hope that we will succeed in synthesizing space-time through an intellectual effort.

## But, nevertheless, analytically describable

But, thanks to mathematics, we can analytically describe in a very precise way more synthetic concepts that not only produce these shadows but also solve physical problems, (when we are interested in high energies), that the shadows fail to describe.

Thus, the study of the different types of universe lines, geodesics, in particular, which are characteristic of the representation by general relativity of the dynamics generated by gravitation, since they describe the trajectories followed by matter and energy.

Three types of geodesics exist: (1) time-type geodesics for matter, (2) space-type geodesics and (3) zero-type geodesics for electromagnetic waves (light for example) and gravitational waves which, unlike the others, is of the "space-time" type.

This can be seen in the expression of the metric tensor ($ds^2$), which is spatio-temporal in nature, where for time or space geodesics a combination of space and time in a bilinear form is required to obtain space-time.

With a signature {-1, 1, 1, 1} for example, for special relativity, in Cartesian coordinates t, x, y, z, it is written:

$$ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$$

We see that the form is inhomogeneous since it includes time and space, which are physical entities of different natures.

The term $c^2$ is present to make the shape dimensionally homogeneous.

But this does not change the physical nature of the time parameter.

But we can write this same form in zero coordinates as used in the Newmann-Penrose formalism:

$$ds^2 = -2du.dv + 2dw.dw^*$$

The shape is then homogeneous because all the coordinates are of type zero.

The coordinates, derived from functions of t, x, y, z, of type zero are u, v, w, w* where w is a complex number and w* is its conjugate. Note that there are only 3 degrees of freedom instead of 4, the use of zero coordinates imposing a constraint.

For more details see: https://astromontgeron.fr/SR-Penrose.pdf

We can see, in particular with this example that characterizes the nature of space-time, that this difficulty for our mind to synthesize space-time is a very strange paradox, because mathematics is a human activity, a product of our mind which, if it fails in the synthesis of knowledge, succeeds in its analysis, opening the way to a synthesis by a "roundabout way".

This will lead us to define a "synthetic" knowledge where we perceive the object in its entirety and an "analytical" knowledge where the object is defined by its properties. We will compare the two types of knowledge and debate their respective values: are they equivalent or is one of them superior to the other?

Returning to the zero-type coordinates, revealed by the homogeneity of the bilinear form associated with the metric tensor, of a spatio-temporal nature, they are an example of the power of mathematics that informs us about the physical structure of space-time.

In this respect, mathematics offers us an encouraging prospect of progress in our knowledge insofar as it allows beings "perceiving" their material extension in a three-dimensional space, (a concept with 3 degrees of freedom that our mind synthesizes) whose evolution is inexorably regulated by time, a parameter of a different nature dimension of space, to describe a concept (space-time) that goes beyond this "material" condition.

## The object and the tool (the mathematical formalism used)

When comparing several formalisms associated with a problem, the most efficient formalism is the one that incorporates a maximum of structural elements of the problem into the formalism. Indeed, the action of this incorporation is to insert part of the solution to the problem which is, in fact, partially simplified, (or even totally if the remaining parameters are free parameters: initial conditions, boundary conditions, etc.).

The structure of a tool, which simplifies the execution of a task, can then be posited as a paradigm for the description of the object to which it is adapted.

# 4-Analytical knowledge and synthetic knowledge

We pointed out that our knowledge of the nature of space-time was essentially analytic in origin (via mathematics) while our minds seemed to fail to make a synthetic representation of it.

This was presented as a paradox, because what one human activity failed to represent (synthesis), another human activity achieved (analysis).

It seemed to be a great success for our minds, except that we can wonder if these two types of knowledge have the same value!

Thus, if I take the image of a painting made by an artist, I can describe it analytically, the nature of the characters, their positions, the landscape, the framing, the colors, the technique used, etc.

But, with this, do I have a synthetic knowledge of the painting?

We can doubt it because listing the list of this information (the phenomenon in physics) does not allow the viewer to access what the artist wanted to express in his painting, which is nevertheless the essential character of the work, the rest being only means to do so.

The goal (of the artist, at least we can assume it for some), beyond these means, is to arouse an emotion in the viewer to induce a reflection on the spirit of the work, beyond these appearances.

It may be the same for our scientific knowledge, we access the parameters (the list of elements of the phenomenon) but perhaps the nature of the object producing these parameters escapes us completely.

Nothing is certain, but assuming this can help us qualify the nature and depth of our knowledge, with its limits. If the argument unfortunately does not have a clear heuristic character, it nevertheless encourages rigor by framing the scope of our knowledge.

## Analytical knowledge and synthetic knowledge, allegory of the puzzle.

In the previous chapter of the document we pointed out that a concept like space-time, a fundamental concept of the theory of relativity, could not be synthesized by our minds, whereas mathematics, a human activity involving our minds, made a very precise analytical description of it.

This point seemed paradoxical to us, but we pointed out that analytic knowledge is not necessarily on the same level as synthetic knowledge. Let us clarify this with an allegory and an example.

An analytical knowledge of the object under consideration implements knowledge, which can be considered as properties of the object. Let us consider these properties as sub-objects.

One can have a "synthetic" knowledge of these properties (the sub-objects) that requires less knowledge than that of the object (less information), since they are only a part of the object that one seeks to know synthetically. Moreover, synthetic knowledge of all sub-objects does not confer synthetic knowledge of the object because, in general, the synthetic object is more than the "sum" of the sub-objects, in other words, of its properties.

From a practical point of view, we could limit ourselves to the analytical knowledge of an object, which is the knowledge of all its properties, including possible relations with other objects, because in physics it is the proper and relational properties that matter.

One could therefore consider, although it is frustrating, that synthetic knowledge is secondary.

But is this true, or just an argument to clear us of going further?

## The Allegory of the Puzzle

If you have a puzzle, you can assemble it from any first piece. You have to find another piece whose cut corresponds to this first piece and whose pattern (drawing) is "continuous" (in general) with that of the first piece and so on.

It can be long, but this method inexorably allows us to build the puzzle, without even knowing what the puzzle represents. We rely on the properties of the pieces of the puzzle.

Note that the assembly of parts, only, by their cutting may not give a single result (parts may have all or identical cutting parts).

We will then obtain several solutions for the resulting image. This will have a physical significance: the set of pieces of the puzzle gives a "superposition" of solutions, as is the case in quantum mechanics.

Is the Puzzle assembled, is the image it shows us intelligible to us?

Can our mind give it a unique meaning, when we know how it works to recognize images.

## The perception of an image is synthetic

Associated with the perception of the image of the puzzle and the modeling it makes of it, our mind looks for an image that comes closest to it (better agreement with a model that it knows and that has meaning for it), but there can be several solutions. There are well-known tests where an image can represent two different figures.

In the example below, which is very well known, our mind identifies either a young woman's face or an old woman's face and we know that we will sometimes choose one, sometimes the other, but it will never present us with a "superimposition" of the two images: it has made a synthetic choice from the same analytical information (same image) which is total.




This choice is restrictive (in terms of synthetic information) because it presents us with only one of the two possible solutions.

This is an example where analytic knowledge does not univocally define synthetic knowledge, which argues for considering them of different natures as we suggested.

## Similarity with quantum mechanics?

Note the similarity with quantum mechanics where, in a state of superposition of two eigenstates of the system, an experiment can only give one eigenstate, each with a certain probability.

Here, experience is the way we look at the image.

One look can give the young woman another look, the old woman. Studies have shown that depending on who is looking, who may be young or old, the probability of seeing the young woman rather than the old woman is different, which shows that the objectivity of the result is biased by the subjective nature of our mind.

## The undetermined case

Moreover, if our mind does not find a reference that is sufficiently close to the image it perceives, what will it do, what will it produce?

Will it have a link with some reality, to be defined, and we will have to consider it as an image of reality, whereas being a production of our mind, it can be totally subjective and aberrant.

These are some questions that can reasonably be asked.

## Where, the decomposition of space-time into space and time can be misleading!

To illustrate that the representation resulting from a foliation can be misleading, let's take the following example. The Big Bang that would have occurred 13.6 billion years ago, in "cosmological" time evaluated in a "foliation" in time and space of space-time described by the Robertson-Walker (RW) metric.

This description, which implies an origin of our universe at a finite temporal distance in our past, encourages us to consider the nature of this origin (creation, transformation of a pre-existing entity, in which case it only postpones the problem, etc.).

It is in this classical scheme that the standard model of cosmology is situated, with a creation of the universe (birth), a life (evolution in time as we age) and in general an end (death) that can be postponed infinitely in some models.

We note the "anthropomorphic" nature of this description of the phenomenon.

But when it is our (own) time, our present time (and not the cosmological time of the Robertson-Walker metric) that is invoked in this description, the big Bang, is pushed back to the infinity of our past.

This means that, regardless of our instruments, and notwithstanding the obstacles (opacity for light for example before recombination), we would not be able to see this event after a finite interval of time.

Thus the singularity, described in the RW coordinates, appears as an artefact of representation, since it is pushed back to the temporal infinity of our past in our local coordinates.

This is probably equivalent to considering that for us, there is no singularity, at least, of this type (origin of the universe at a finite temporal distance in our past).

Of course, it can be objected that infinity is a concept that has no place in physics and that it is a different type of singularity.

But this representation is more in line with the representation of our universe by a space-time, since a space-time is not referenced in space and time, which are non-physical concepts, accessory in this approach, because they result from a foliation that is arbitrary in time and space of space-time.

Like an alloy, by extracting its constituents, in general its mechanical properties (linked to the structure of the crystal lattice) are profoundly modified, which are generally not those of the constituents and are not the sum of them. How can we then be sure that decomposition in space and time does not destroy the deep nature of space-time?

If these two points of view converge towards the same description of the universe and its evolution at the physical level, in different coordinates, (the physical description does not depend on the coordinates used, which are arbitrary, for this), some aspects of the predicted physical phenomenology are different. Our point of view from our present is different from that of a cosmic observer, co-moving of the dynamics of the universe in the RW coordinates.

## Does "immanent" space-time infer eternity?

If we were tempted to say that a space-time is eternal, in the usual sense of the term, that is, located in time and space, we know that this does not make sense for a space-time, not located in time and space, for the reasons given in detail above.

For a space-time we must use the term immanence, because eternity refers to time.

In this **context of space-time**, paradoxically, we are "immanent", because, in its timeless and spatial existence, it contains everything that is located in it (spatially and temporally in "Newtonian" language) **and we are part of it**. But we must recognize that we occupy only a small part of this space-time (an island).

**In other words, when we question the origin of our existence, we do so (unconsciously, no doubt, out of habit) implicitly in the context of absolute space and time. The study of nature, the resulting physics, shows us that this approach is incorrect, we must think of it in the context of a space-time.**

As an element of a space-time that exists (in itself) independently of everything else, the human being, who is part of it, exists immanently.

The notion of creation being, contrary to what our habits of thought suggest to us, in this context, replaced by the notion of "localization" in space-time. In other words, we are asking ourselves a problem that is not the right one.

Indeed, this creation seems to appear when, by traversing a line of universe, internal to this space-time, oriented by the human's own time, we pass from an "outer" region (which does not contain our being) to an "inner" region (which contains our being).

**This offers a coherent solution to this problem in the spatio-temporal context that nature offers us.**

## Representation in space-time of our existence

We are faced with a first difficulty, because if it is easy to delimit the contours (spatio-temporal - their extension in space and time in Newtonian language) of our material region (the atoms that constitute us, located mainly on Earth at the moment), for our mind it is different.

## Does space-time call into question our destiny?

Our destiny is generally described in the context of an evolution in time and space, with a beginning, an evolution and probably an end (which we hope is not too close). For humanity, we know, in the history of the Earth, to approximate its origin, which is not very distant on its scale (at worst a few million years compared to more than 4 billion years for the Earth). More generally, this is also valid for life, all of which is subsequent to the formation of the Earth, about 4 billion of our years ago.

Analysis in the context of a space-time changes the perspective. In fact, we belong to an entity outside of time and space that exists. In a way, we are a piece of it in the same way as everything else, which could also concern other evolved species, if we qualify as evolved, structures that implement elements of great complexity, such as the combinatorics of our brain for example.

Since we look at things from our "inside" point of view, it is not surprising that we do not perceive the structure of which we are a part.

But this text shows that, if we do not perceive it, we are evoking it, which is already a beginning...

Regarding our ego, is it better to consider ourselves as the center of the world or more humbly as a part of a whole that we know only very partially?

## 5-Knowledge and truth

An essential point was the relationship between knowledge and truth.

Thus Kant declared:

"The two strains of human knowledge, which perhaps start from a common root but unknown to us; **sensibility** and **understanding**; by the first objects are given to us, by the second they are thought"

Note: By sensitivity, we must understand what is accessible to us through our senses.

and he also stated (among other things)

"Truth," it is said, "consists in the agreement of knowledge with the object. According to this simple definition, my knowledge must therefore agree with the object in order to have the value of truth. Now the only way I have of comparing the object with my knowledge is that I know it. Thus, my knowledge must confirm itself. But this is far from sufficient for the truth. For since the object is outside of

me and the knowledge is in me, all I can appreciate is whether my knowledge of the object agrees with my knowledge of the object. The ancients called **such a circle in the definition** a diallele." "

(quoted in "The Pleasure of Thought" by A. Comte-Sponville, ed. Vuibert)

Bachelard, (The New Scientific Spirit) later, described science as "impure" metaphysics because it must be accountable to experiments. In the "experimental" sciences, theories, in order to be considered, must make predictions that will be the subject of experimental verification. Any theory that does not do this is useless.

Bachelard emphasizes the duality between the "physical" world, which calls for realism (associated with the experimenter), and the image we have of it, which he calls rationalism (associated with the theorist), while noting that these two aspects of knowledge are not totally independent and cooperate by exchanging their "advice."

Sometimes it is experience that motivates the theoretician by new discoveries not explained by theory and sometimes it is the theoretician who motivates the experimenter by predictions of phenomena not yet known.

He also emphasizes the inductive nature of scientific knowledge: the theoretician reads the law in the example (paradigm)!

All these remarks show that, in fact, scientific knowledge aimed at an objective character cannot oust a subjective character intimately linked to the structure of our mind which apprehends the world. Science is a human activity.

## Paradoxically, knowledge goes beyond our existence

This is one of the paradoxes, because one might think that our knowledge is limited to the portion of space-time where humanity is present.

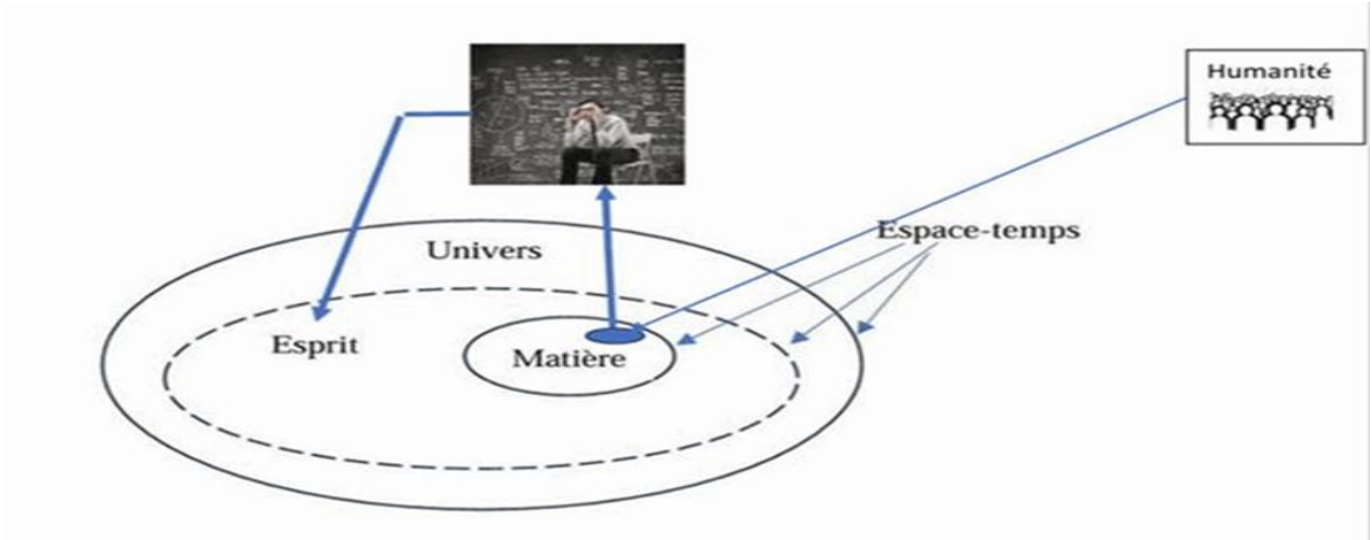
In fact, it goes far beyond in its past and even in its future, even if the increase in knowledge diminishes in quantity and quality as we move away from our region of existence in space-time.

In other words, in Newtonian language, the ability of our mind to apprehend the universe with a knowledge that, if it diminishes with distance, progresses according to time and associated discoveries and theories.

Since it is difficult to associate a boundary with knowledge, an open-type geometric structure, giving an order of magnitude, will be better suited to the description

of its extension. This extension is obviously constrained by the (supposed) limits of space-time representing the universe.

It is therefore necessary to make a double representation for humans, one for the physical part, the other for one's understanding. It can be two connected regions of space-time, or more simply, the material part included in the part associated with the spirit that contains it.




See figure above. Other "intelligent species" in the universe, which may exist in other islands of spacetime, are not shown.

## Space and time cannot create a concept that would transcend them

Concerning a putative creation in time and space, it is difficult to see how, from time and space, which are appearances of space-time, a space-time could emerge, a concept that would be superior to it [1].

Indeed, space-time is not an **assembly** of time and space but the **fundamental indivisible physical entity** associated with the theory of general relativity.

In this space-time scheme, this confirms that the evolution of the universe, the expansion of space, its (arbitrary) layering into time and space are "internal" parameters of space-time and not external parameters that would apply to the space-time universe [2].

## Space-time, a paradigm to explain our existence

Let us remember that a paradigm is a "model" reputed to be simple that makes it possible to "exemplify" a rule, a law or a phenomenon with the same "formal structure" but with a more complex appearance. Plato encouraged his disciples,

before tackling a complex problem, to train on a problem of the same nature but simpler.

From the observation that our existence can only be **observed** and that the space-time representing the universe also needs nothing else but it to exist and that we can only **note** its existence, we deduce that there is a **morphism** between the two entities.

The study of formalism, associated with the concept of space-time, which is a mathematical object accessible to our minds, can then serve as a **paradigm** for understanding our own existence.[ 3]

It is interesting to note that when our mind seems to be confronted with a conceptual limit, its formal attempt to model nature opens up a way for us to overcome it [4]. This tends to prove that it is indeed in the formal structure of nature, space-time for example, that the solution lies.

## What paradigm to define the content for space-time?

The arguments put forward to justify the existence of space-time tell us only about its existence, not about its type of content.

If we exclude the types of content that do not allow the emergence of a consciousness on the grounds that an existence presupposes a consciousness to appreciate it, a hypothesis that we make, but which seems reasonable as discussed in: "**Intrinsic, extrinsic, implicit existence. 24/03/25**", https://vous-avez-dit-bigbang.fr/?page_id=3241, then this must impose constraints on this content.

## Can the example of our universe serve as a paradigm to investigate these constraints?

In a type of object analysis, we define a static analysis where we identify the objects (in the formal sense) that will be involved in the phenomenon with their characteristic properties and the way to identify them, and the dynamic analysis that describes the history (the evolution from initial conditions) that concerns and will concern these objects, in a framework allowed by their relationships.

In the manner of a play, where static analysis describes the characters with their characters and the setting, dynamic analysis describes the unfolding of the story of these characters, depending on their characters and the circumstances, which is proposed to us.

Let us add that there is a great absentee on stage, the author of the play, who is nevertheless omnipresent in the story presented, which bears his indelible imprint even if it is subliminal.

This is the case with science which, even if its purpose is to describe nature, is a human activity and as such includes, in a subliminal way, all the prerequisites and constraints of our mind, itself subject to the same laws of nature to which it belongs. He therefore describes it "from the inside".

In the analysis we make of nature, we must never forget this, even if it is not easy, otherwise the interpretation that we will make of the phenomena will be biased. This is obviously a major conceptual difficulty that science encounters in the study of nature.

## Matter (static analysis, description of objects)

Its general characteristics include a discontinuous and finite character (even if the number characterizing the limit is very large), three families of a very limited number of elementary physical objects (quarks constituting a list of baryons-protons-neutrons-etc. and a list of leptons) with their symmetric (antimatter) characteristics.

It should be noted that of the three families, only one (the one with the lowest energy) is mainly represented in the nature we know today.

## Interactions (dynamics)

A number of 4 interactions (gravitation, electromagnetism, strong interaction and weak interaction).

These are, roughly, the data known to date.

It should be noted that under conditions of low ambient energy, electrons can bind to atomic nuclei, formed of nucleons (which are baryons) to form atoms according to the laws of quantum mechanics. Atoms identified by their number of protons, associated with a chemical property, in also limited numbers (less than a hundred stable atoms) offer a gigantic diversity of combinations in the structures they can generate.

## The indeterminacy of quantum mechanics

Without the indeterminacy of quantum mechanics, which plays a decisive role in the non-deterministic evolution of systems, our universe would not have been

fertile. Indeed, the Standard Model of cosmology, which describes a phase of inflation where quantum fluctuations will be the seeds of the large structures that will generate galaxies, attests to this. Without this indeterminacy, we would not be here. We do not see what a totally symmetrical universe could generate other than a totally symmetrical universe.

## Perfection is sterile, imperfection fruitful

If we consider the evolutionary process that led to our emergence, we see that without repeated errors, in an almost infinite number, in the transcription of our DNA, we would never have appeared on Earth. And what about the emergence of life on Earth?

Nature, through these errors, makes it possible to adapt the individuals of a species to an evolving environment by generating a multitude of new possibilities leading to a multitude of individuals modified by these errors, the environment selecting the most adapted to its constraints (Darwinism).

## All these elements seem necessary to provide the universe with a consciousness.

There is no evidence that this is enough, but it is a start to start this type of analysis.

It should be noted, however, that the fact that an assembly, even a sophisticated one, of atoms is capable of describing, with precision, its ultimate constituents, may seem paradoxical.

In fact, this shows that it is the relationships, the complex arrangements of these atoms that carry information and not the nature of the elementary parts that constitute it, provided, of course, that these parts allow its arrangements.

On the basis of these considerations about the essentiality of relationships, we can already generalize the structure we know, opening the door to other forms of life and consciousness, assuming that a consciousness can only be the prerogative of a life form, which seems reasonable, but no more proven than the rest of the argument presented.

## The limits of scientific knowledge

On the one hand, science being a human activity, it incorporates its characteristics. With regard to its objectivity, the question is: can science dissociate itself (or get rid of) totally from the constraints of our mind and claim unfailing objectivity?

On the other hand, considering that our mind is made up of the same atoms as those of the immense universe, simply arranged differently and even if in a considerably more complex way, it is conceivable that limits on the knowledge of the whole universe, by a tiny part of itself, is consubstantially limited.

Moreover, in the scientific approach, among other things, our mind not only positions itself "outside" the object it is studying but it contains it since, as Kant pointed out, in order to know we must have acquired an image of the object to be known in our mind and it is on the image of the object, present in our mind, that we forge our knowledge of the object.

But with the universe, it is the world upside down, because it is the universe that physically contains us. This poses a problem for the validity of our knowledge, since structurally our assumptions allowing the acquisition of knowledge are false!

Can we get out of this contradiction by considering the universe, by including ourselves in its knowledge?

Even if we do not escape logical difficulties because we are "inside" and "outside" and it is the "inside" that is at work, on the whole, by studying the place we hold in this universe, perhaps we will be able to extract some knowledge from it.

Our physical situation in this universe is secondary, with regard to the phenomena that govern what is called the dynamics of the universe where colossal energies are at play. On the other hand, if we consider the universe from the angle of the information it contains, the situation is very different. We can estimate the number of particles in the universe at about $10^{80}$ roughly. If we know the position and velocity (vector) of the particles we can describe the universe, it makes about $4.10^{80}$ parameters (a number with 80 digits). For brains made up of a few billion neurons, it is the combination of connections that counts.

Of course, not every neuron is connected to all the others, but if it were, we see that we would have n! combinations with $n = 10^9$. Stirling's formula, for n tending to infinity, gives a good approximation by the equation:

$$n! = (6.2832^* n)^{1/2}(n/e)^n$$

It is a number with millions of digits.

Seen from this angle, our place in the universe deserves to be considered less casually.

However, can our mind pierce the origin of its existence? Before asking this question, we must ask ourselves if it has a meaning in the universe, which is a space-time, because it is not certain at all. This question is suggested to us by our habits of thought concerning the world around us, but can we generalize it to the level of the universe, nothing is less certain.

## A way forward?

In this document, we have proposed an interpretation of our existence in the context of a space-time, in total rupture with the traditional approach. It is physics that commands us to move in this direction. This shows that it is to the teaching resulting from the study of nature, to the acquisition of knowledge about it, even if it often shakes up our habits of thought, [5] that we must conform to, in spite of all the renunciations of thought that this invokes, so that knowledge may continue to progress.

# Notes on this chapter

[1] In theology, it is assumed that God cannot create a being who would be equal to him or, even less, superior. Moreover, this is also illustrated in Plato's allegory of the cave where, from the shadows on the wall (appearances) we ask ourselves if it is possible to reconstitute, through an assembly and a composition of shadows, reality? In the allegory cited, even if we can hope to build the "envelope of a form" (its outer surface) from shadows, as our brain constructs an image that has a 3D appearance of the object under consideration from 2 2D images, we see that this is not enough because the "beings" whose shadows we see are more than their spatio-temporal envelope which only delimits their spatio-temporal limits.

We could invoke the concept **of emergence** (we cannot totally explain a complex entity based on the properties of its constituents alone and their configuration made possible by these properties), which compromises the reductionist approach, but this principle, which seems rather an escape from our ignorance, produces only an observation, not an explanation.

For emergence, since the object alone cannot explain it, we invoke a relationship of the object with its environment, which then leads to considering the system, mind + environment, as an object: elementary objects are not isolated, they are in relation to the outside. We know how much the environment has constrained and, consequently, modified life, from its elementary forms to the complex forms we know (plants, animals, humans) for example by selecting the most suitable elements.

It would be necessary to understand how properties that objects, themselves, did not seem to have, are activated (emerge). Let us recall that at the most elementary

ultimate level, we are reduced to attributing properties of symmetries to elementary particles (quantum mechanics) and interactions (quantum field theory). It is true that if it is the relationships allowed between objects (the possible arrangements) that create diversity, the constituents must still have the properties required to allow these arrangements. Thus, a small number of atoms, with their electrons and only four (known) interactions offer a gigantic diversity of arrangements between them.

Does artificial intelligence challenge this principle? This entity created by humans seems to be far superior to it in many areas by its "speed". We can imagine that these robots will have inherited our know-how and will be able to do, much more efficiently, everything we do (and more?): reproduce, capture and produce energy for their activities, modify themselves, proliferate, probably also make mistakes, and improve and thus supplant us. They will even be able to know the origin of their existence, which can be incorporated into their data. Of course, it is difficult to say if we consider all our capacities in the comparison. But it challenges the quest for the origin of our existence.

[2] This point has been made explicit in many pages of this site.

Expansion of the universe: a misinterpretation of the solution given by Einstein's equation? 23/09/24 The Big Bang is not the creation of the universe, it is a singularity that is part of it! (rev. 2/03/25) The universe has no history, because, in fact, it is history! Expansion of the universe, inflation (6/01/22)

[3] Another edifying example is that of the Newmann-Penrose formalism. It shows how the structure of the natural phenomena studied can have been incorporated into the formalism, which results in a reduction of the parameters to free parameters only and which obviously simplifies the calculations.

[4] For quantum mechanics, it was necessary to "invent" a formalism to describe it. This formalism not only makes it possible to predict the results of experiments, but also informs us, through the morphism it incorporates, about the structure of the phenomenon of nature apprehended by this formalism. It has been said, with regard to quantum mechanics, that "When humans sought to know nature in its ultimate entrenchments, they found strange imprints: "they were his own".

[5] It takes a hard time to abandon the concepts of time and space in favor of space-time, which is almost impossible to understand.

# 6-Physical reality, knowledge and creation

## Two intertwined entities

There is no doubt that at the beginning of humanity it was in his relationship with nature, considered external but indispensable to him, that the prehistoric Sapiens built his knowledge of the world.

As such, the imprint of the world is structural in our minds. This is something that we must necessarily take into account in our analysis of physical reality and the knowledge we can have of it.

## Our knowledge of the physical world, although externalized, is a product of our mind

One of the properties of our mind is that it can take as its object the knowledge we have of a phenomenon. To do this, it externalizes it, considers it as an object external to ourselves, as a stone that we would look at and touch. It takes the phenomenon out of our mind, so to speak, when in fact it is inside (what we perceive, even if we can touch the stone, is its cerebral image).

## This impression of objectivity is a source of confusion.

It is the general problem of scientific knowledge, based on theories and validated by experiments, that gives the impression of total objectivity. In fact, all this is a production of our mind and incorporates the imprint of its limitations, some of which are "invisible" to us since their discernment could only be done with our mind, which itself incorporates these limitations. Of course, we could possibly observe inconsistencies and contradictions, but there is nothing to prove that certain limitations are totally inaccessible to us.

## A method to improve knowledge?

How to integrate the incompleteness of the tool of knowledge into its process. Perhaps some limitations are symptomatic of this, as in quantum mechanics for example.

The problem is not simple, it would already be solved if it were. It is a Gordian knot.

But in the face of the limitations that science faces today, the solution to go further, without pretending to want to solve everything, would be to explicitly incorporate the constraints and limits of our minds into the loop.

## What about information theory?

One way that seems promising is information theory because, in any case, acquiring knowledge about a phenomenon means that our mind acquires information about the phenomenon, on the one hand through theoretical models (rational) and on the other hand through experiments (realism).

In this process, since the information is measurable, it can be associated with a physical theory, which makes it possible to attribute to it, on the one hand, an overall level of complexity, and on the other hand, structural properties that the information would incorporate on the assumption that a morphism exists between the phenomenon and its modelling.

Note that this is already used, for example for the entropy of black holes, by different theories, and that for Hawking radiation the problem of information loss violates the principle of its conservation in phenomena and their evolution, which underlines its importance.

However, it should be emphasized that this use, limited to these critical cases of violation of a principle, does not take into account the information in the mind of the physicist, which we suggest to introduce in order to generalize its application.

## Knowledge and mathematics

Mathematics was considered, first, as the language of the book in which the laws of nature are written (Galileo), then it was considered that these laws were written in the syntax of mathematics but that their meaning (semantics) was a matter of physics.

Considered as a tool, mathematics provides formalisms whose supposed morphism with the laws it describes informs us all the more about the nature of these laws, since, in the end, these laws turn out to be relational in nature.

## Existence of mathematics

A key difference between physics and mathematics is that physics must be "accountable to experience," which is not the case with mathematics.

This property of mathematics leads to the debate of its existence, outside of any human consciousness.

In a Platonic approach, it can be argued that mathematics has a reality of its own that we discover as we study it.

The relationship with human intelligence is then educational: They form and structure our mind as our discovery of this reality progresses.

In an existentialist approach, it is assumed that it is a pure creation of our mind, a structuring part of our brain activity motivated by the need to adapt to the outside world.

As such, it is also evolving, but under the constraint of the external physical world.

## The impact of "modern" theories on the nature of knowledge

The previous reflections are, for the most part, prior to the 20th century. "Modern" theories such as the theory of relativity, for the macrocosm, and quantum mechanics for the microcosm, beyond the purely scientific aspects, have called into question many concepts that prevailed before (time, space, causality).

As such, they constituted a brutal conceptual break with what were considered to be achievements.

On the one hand, cosmology, which shows that we are only a tiny occurrence in a gigantic cosmos, questions us about the importance we attribute to ourselves and consequently about the aforementioned reflections and arguments. If we consider current models, our influence on the universe seems to be nil and our existence totally secondary.

## Does the Darwinian approach describe the dynamics (evolution) of the universe ?

The Darwinian approach is more an observation than an explanation: nature seems to proceed randomly and, through errors in the process, what emerges is what, in the surrounding context, benefits the most, to the detriment of others.

## In this mechanism, "errors" are creative, "perfection" is sterile!

The emergence of Sapiens (the misnamed one) and its domination over the world is a flagrant example of this: we are errors of nature. This principle, first devolved

to the living world, seems to apply in the same way to the cosmos, which may seem strange, because for the living there is competition for access to limited resources, which is vital for the species, while for the cosmos, being the whole, it is not in competition, since it is all alone, it is more like a principle generating more or less creative solutions as allowing, among other things, life. Some theories predict a myriad of universes, sterile or fertile, and let's say that if these theories are correct, we would be in a fertile one.

So, let's not be surprised to have a universe that has allowed life, as we know it, thanks to a slow evolution (on our time scale), it takes time to get to us, and also to overcome some decisive pitfalls since, otherwise, we would not be here to talk about it. If other universes exist but have no consciousness, who is going to talk about it?

This is due to the generality of the principle: in an environment, it is the one best adapted to the environment that proliferates to the detriment of the others. But this is not a given forever, because the environment evolves, hence a history of evolution. For life, given the evolution of the environment, it is in fact more the ability to adapt than brute force that wins.

## 7-Does existence require the living?

Quantum mechanics shows us that we are made up of atoms, like everything else in the universe, it seems.

Science has made it possible to unravel some of their properties (up to what limits?) which show that it is the laws (matter-interactions, in a small number) governing their assemblies that allow the astonishing complexity of living things!

In cosmology, in the universe, there is an overwhelming material disproportion between the extreme power of the entire material universe (**the inert**) and an extreme (apparent?) fragility of the **living**

From this point of view, the only notable credit for the living, on this scale, is, it seems, to describe the universe and to give *meaning **to the existence*** of the universe, at least as we **conceive** it [1] . Apart from that, we do not see what the derisory living could bring to the gigantism of the universe.

But, unless, supposing that the inert universe has a consciousness of its own, [2] it would be the living, the human among others, no doubt, that **would provide it with this existence.**

Then, life would become a necessity for our universe to exist intrinsically.

So, faced with this situation, a hypothesis would be that the predominance of the overwhelming constitution of the universe is only appearance, and that in fact, the living, even derisory and fragile, at the mercy of the power of the universe, is much more fundamental than it seems.

## What if not living was not incidental but fundamental?

Indeed, if the living is so secondary, tiny and extremely fragile in relation to the material universe, then its emergence seems very miraculous.

It is by looking at things from another angle, that of diversity and correlative of the **quantity of information** of each of the two constituents, the inert universe and life, that we discover that life, including humans, with its complex organization between the arrangements of atoms that characterizes it, incredibly surpasses the universe.

If the number of elementary particles mobilized by life is only a tiny fraction of those in the universe, estimated at about $10^{79}$ for the universe (1088 for photons), those mobilized by **the entire inert universe** generate relatively little information (independent particles with therefore little combinatorics, possibly involved in processes with maximum entropy-thermal radiation for example).

On the other hand, a **simple human brain** has a combinatorial diversity participating in a global process via a network of neural connections whose number is estimated at 1013. If we consider the information carried by such a system, each connection being either active or inactive, this generates a monstrous possibility of information $10^{1594323}$, a number with more than a million and a half digits, which most likely surpasses immensely that of the entire inert universe [3].

We could also estimate the information carried by all humans (about 1010) which would be even more gigantic.

**Seen in this light, it is life that seems to crush the inert universe with its incredible diversity.**

## Entropy of the universe

Although called into question by the entropy associated with the myriad black holes, which are deduced from the detection of their collisions but which we do not know how to quantify precisely, the cosmic background radiation is (was) its main source (there are a billion photons per nucleon). Its black-body character is associated with a gigantic entropy. In accordance with the laws of thermodynamics, it

is assumed that entropy was low after the big bang and that it has increased to its value today.

One of the characteristics of life is that its entropy can decrease [4], to the detriment of its environment, the global balance having to satisfy the laws of thermodynamics. We can see that this phenomenon of entropy decrease can only be local and has no influence on the cosmos.

## Gigantism vs. diversity

**In space,** the ratio between the size of the universe (40 x 109 al today, given the expansion, in this model of foliation) and that of a human (1.7 m) is approximately: 2.2.1026 in linear, or about 1079 in volume, a gigantic figure compared to the estimated number of particles in the 1079 universe!

We have indicated that to the material immensity (about 1079 protons) of the universe, the brain of the human being who is part of it, responds with a gigantic, immensely superior combinatorial complexity (numbers with millions of digits).

## Origin and Nature of the Material Existence of the Universe

The arguments developed deal with the relative importance of life and inertness in the universe and propose a "structure" for this universe.

Even if it is a space-time and must therefore be considered as a single spatio-temporal entity, from our point of view, and because of a history built on this space-time, its phenomenology is of the Darwinian type.

Let us then look for how a Darwinian universe built on particles and interactions with errors can "exist".

Let us remember that existentialism explains to us that existence cannot be proven or explained, but that it can be observed, which is what we applied when we evoked the need for a consciousness to talk about the existence of the universe.

Moreover, since to ask this question we must exist, and consequently we must have a universe compatible with our existence, we could stop there, we are facing a tautology.

An inquisitive mind, however, might try to go a little further.

Obviously, the existence, even those of elementary particles, poses a problem for us: We observe them, but if we assume that they are not eternal, eternity does not seem to be an acceptable hypothesis, where do they come from?

We don't see a reasonable solution except that our mind doesn't have the level of apprehension of phenomena that would allow us to respond.

The question is, can he ever reach this level?

## A mathematical model of creation? The surprising properties of anti-De Sitter space-time

This space-time, denoted ADS, which is part of the space-time with maximum symmetry, (see Anti-De Sitter space-time (14/10/23)), has an original and extraordinary property: its boundary to spatial infinity is of the time type, which implies that "**invaders" can arise "ex nihilo" from this boundary**. [5] The most interesting thing is that a De Sitter space-time is a pure **mathematical modeling** of a geometric structure, requiring no matter or energy (it is a vacuum and physically we can say that it is nothingness). So we have a formal model that has a very strange property: **at the infinity of space something can arise from beyond infinity. This is akin to a creation!**

It may be objected that what emerges from the border should, moreover, exist, but beyond the infinity of our space universe, this defies understanding!

We can therefore understand the interest of scientists in this type of phenomenon, which is manifested by the ADS-CFT correspondence in modern approaches aimed at reconciling a theory of quantum gravity and a quantum theory of fields in a theory of everything.

## Can we model the problem at our scale?

We know how to build machines and, with artificial intelligence, give them possibilities that are similar to ours. We must be able to provide them with software and a structure that allows them to move, to feed themselves (with energy), to repair and reproduce themselves, and even to modify and develop their software and that of other machines?

This in an environment the same terrestrial as ours where these machines can exploit the same resources as us. As for free will, we must be able to some basic rules that will allow its evolution and in any case, bugs will allow errors. It remains to observe the dynamics of this model to see if in its evolution it develops a consciousness and if in what it would do with it would be able to understand its origin. Supposing that we are no longer here at the time it waits for this stage, unless it

has been written in its data, it is likely not. This theme has been exploited by science fiction authors in books and films, the danger being that if they are more efficient than us, competing with us for terrestrial resources, we can guess the fate that awaits us. This solution presents some dangers so it is prudent to practice it with moderation.

### Elements that we must necessarily consider in this quest for our existence

From the arguments developed above, let us consider those that are clearly to be taken into account.

## 8-The meaning of life in the universe

### Can we escape anthropomorphism?

The difficulty comes from the fact that our mind, with which we try to understand the world, and thus our existence, and our senses, with which we are a physical entity of this world that has a degree of freedom called time, oriented, which is the dynamic parameter and an extension in a 3-dimensional space, with 3 degrees of freedom, evolving according to the dynamic parameter which is time.

This suggests that our mind, whose material support is constrained by these laws, cannot extricate itself from them, at least totally.

However, when we study the universe, with our mind and its constraints, relativity shows us that these notions of time and space have no physical character but are only appearances of a more synthetic concept: space-time.

Since the universe, of which we are a part, has a space-time structure that we know how to describe analytically, even if our mind cannot synthesize it, it seems that it would be, by reasoning in terms of space-time only, forgetting time and space, that we should conduct our analysis.

The image should be more synthetic and would undoubtedly point us towards a different interpretation of our understanding of the universe and our destiny.

Thus the temporal schema of our existence, in solidarity with that of creation, evolution and eventually the end of our universe, is isomorphic to that of the existence of the human, which is characteristic of a blatant "naïve" anthropomorphism.

## Does space-time allow us to open a breach in this vision?

The same approach in terms of space-time binds us to the universe in a more structural way because we are part of it: the existence of the universe includes our own, not in a temporal way but in a structural way. Its evolution is then a property resulting from the fact that it is described in terms of space and time (and not space-time) in accordance with our subjective feeling in our consciousness of existing: we use our "sensible" concepts to describe a universe, which yet the same consciousness, through mathematics and theory, recognizes that it is not correctly describable in terms of space and time.

## The loop as a solution to creation?

It should be noted that in some Nordic cosmologies, the image of the snake biting its own tail, suggests another hypothesis to explain cosmology, that of the loop. Indeed, a "linear" description (by an unclosed universe line) suggests an origin and an end that can be postponed indefinitely. Physics does not like infinity, but it is still necessary to specify how it is considered.

The standard model of cosmology places the "origin (the big bang)" of the universe at 13.7 billion years (a finite value, in cosmological time linked to the Robertson-Walker metric) in our past. But we know that in our current time, this big bang is pushed back to infinity from our past, which means that whatever instruments we have at our disposal that would free themselves from all the constraints limiting our vision in the past, we would never see the big bang in a finite time. We can see that the notion of infinity should be considered with caution.

## Relativity includes space-time loops as solutions.

The space-time loop is interesting at the conceptual level. In general relativity there are mathematical solutions, (Kerr's black holes for example) that include regions in space where time loops are possible) We start from a point A with coordinates x0, y0, z0, t0 and by following a time-type universe line (proper time increases continuously along this universe line) we arrive at the same point A.

## Do these mathematical solutions have a physical realization?

Assuming that these solutions are of a physical nature, or that it does not require resources that are out of reach, in energy for example as the calculations show (see Kerr's black holes and time machines) this opens up interesting perspectives.

But to go into the past, you have to exist in your present.

If we travel on a line of universes in a time loop, each point of the loop has been our present: we are still in our present and we age according to our own time that marks the loop!

In general relativity with negative energy we can travel to the past, but we must understand what this means. It is a loop in space-time, an unusual structure but which does not generate, a priori, creation.

We know the paradoxes of time: if in the past, we kill our father before we conceive, do we cease to exist?

Usual history says yes, but one of the characteristics of time loops is that they violate causality, so, if not, it calls into question the usual history, which, moreover, would ensure a better "stability" to the history of the universe and could be taken into account by introducing multiverses.

## Solutions of general relativity that open up perspectives.

Kerr black holes, where the exhaustive analytic mathematical solution includes not only time loops (CTCs) but have the structure of an infinite set of connected universes, anti-universes connected to universes, blatant violations of causality, shows quite surprising possibilities whose consequences have not been explored.

We can doubt the physical reality of these mathematical solutions because of the symmetries they require, but we must remain cautious, because let's remember that black holes were long considered artifacts of mathematical solutions, until we noticed their existence today.

## Anti-De Sitter space-time

The anti-De Sitter space-time also has astounding properties, since it allows the possibility of invaders (emerging from infinity and arriving towards us in a finite time).

The theory predicts this solution in the case of a negative cosmological constant, which does not seem to be the case, at least globally, for our universe.

However, in modern approaches, the universe is considered to be a "brane" in an anti-De Sitter type background space. The ADS-CFT correspondence is located at the boundary of a De Sitter space-time.

## Cyclic supercritical universe

A universe made of supercritical matter will expand to a maximum and then contract again. One possibility is that there is a rebound and this an infinite number of times.

We see that science offers us models that have quite extraordinary properties, the consequences of which we are far from having found and examined, especially in the context of the existence of the universe and our own.

## Notes on this chapter

[1] Existence is subjective, an object of any kind, including the inert universe, does not exist in itself, it is not an objective property, it must be a consciousness, coming from the living, to be able to observe it. The cogito being an extreme example where the individual notes his existence.

[2] This possibility cannot be completely excluded.

[3] We compare a number of particles to a number of connections, which seems incorrect (and in fact is). This is done on the assumption that particles, although interacting with others, do not participate (or so it seems) in a single organ. We have talked about nucleon-type particles, but knowing that there are about 1 billion photons per nucleon, it is the photons, overwhelmingly, that contain the information? Knowing that these photons are overwhelmingly in the RFC (CMB) which has a blackbody structure (almost, the deviation is a 10-5) to which only a piece of information "its temperature" is associated.

The small deviations over an immense set are not necessarily negligible, and its consequences are primordial (formation of large structures, and what follows) but at the level of the cosmos it has little influence on its parameters.

[4] This point was cited in the book "Cybernetics and Society" by Norbert Wiener (1947).

[5] Formally, a boundary of an n-dimensional space-time is an n-1-dimensional hypersurface. In ADS space-time a spatial section of this space-time has the topology of the interior of a hemisphere of S3; i.e., is of topology $R^3$ (and the complete space-time therefore has the topology R4).

Original properties of space-time AdS. An interesting property of anti-de-Sitter is that infinity is a time-type hypersurface. Since infinity is time-type, space is not globally hyperbolic, which does not correspond to a problem, with an initial value, well posed in terms of information specified on the spatial section, because information, coming from infinity, can always come in. Another interesting property is

that the exponential map is not on global space-time. Time-type geodesics, oriented towards the future, can initially continue radially outwards, but eventually refocus and therefore continue radially outwards again.

**ADS/CFT Matching**

Incidentally, one cannot help but point out that the time-like nature of infinity induces a remarkable property of string theory, the AdS/CFT correspondence. AdS is the anti-de-Sitter spacetime that we have presented and CFT denotes invariant field theories defined on the boundary which, for an n-dimensional AdS, is a space-time of dimension (n -1) on its right-hand boundary. The AdS/CFT correspondence suggests that, within a certain limit, there is equivalence between a theory of quantum gravity (or a supersymmetric version of it) and between an AdS background and a field theory, invariant, non-gravitational, defined on the boundary (hypersurface). Since we have much more knowledge about non-gravitational quantum field theories than we do about gravitational quantum theories, this correspondence (if it turns out to be true, which is likely, but not proven) would be of great use in opening a path to a quantum theory of gravitation.

See: http://ncp.edu.pk/docs/snwm/pervez_hoodbhoy_001_ads-space_introductory_moschella.pdf, for more information.

# 9-Further reflections on the existence of the universe

## Introduction

On this site, https://vous-avez-dit-bigbang.fr/), the theme of existence, the essence of things, including the universe and ourselves, and our particular position in relation to this problem, since we are "judge and jury", has been addressed in several articles in the "philosophy" section.

In these articles, we largely took up debates and ideas that have animated the philosophical sphere since it existed and even before, through religions.

## Unavoidable tautologies?

It also appeared that we came up against tautologies, apparently unavoidable, since in order to establish our existence we must exist and since we are an integrated part of the universe, this implies its existence.

## A "self-dual" situation

As we are integrated into the universe, let us note that we integrate it, through our mind, which models it, in its entirety, in the cosmological approach.

It's a very particular property where the content is also the container. It's our awareness of existing in something that we're trying to model that makes this possible.

## What are the implications?

On the indisputable observation of our existence, naturally this prompts us to question its nature, its meaning and also its origin. Concerning the origin of our existence, it is conditioned by that of the universe, since our material substance is formed by the fundamental elements of the universe, without which we would not exist. In the classical approach, independent time and space, the existence of the universe is generally considered as a predecessor in time and space of our existence.

In the "space-time" approach to relativity, where the existence of the universe is not located in "classical" time and space, fundamentally, this notion of precedence does not exist because the universe is the whole, the notions of precedence being an internal characteristic of this space-time that is an arbitrary layering of time and space. This is not easy to admit, but strictly speaking, this is how it should be considered.

## The standard cosmological model invokes an independent time and space.

In a chronological cosmological approach, (Big Bang theory), where the analysis is done in terms of space and time (the universe appears in a given place at a given date and its spatial component evolves over time), the knowledge we have of cosmology (constitution and dynamics) and the evolution of species shows that our arrival, with its consciousness to think it, is very late, but we do not know if, elsewhere and before, other evolved forms of structures "thinking with consciousness or/and even more efficient" exist or have existed.

These hypotheses invoke a "creation" of the universe, while the notion of "creation" (going from nothing to something) repels our minds.

Note that we are wondering about the emergence of the universe (beginning of its existence) by means of one of its structures (our consciousness) that already exists!

We understand the tautological nature of the situation.

## Is the space-time universe untying this Gordian knot?

The approach, suggested by the relativity of a space-time (where time and space are only phantoms) is more convincing since it describes the universe (we speak of a block universe) in its "spatio-temporal" totality, which includes us, and in this case we can dispense with speaking of the origin in time and space of the universe and of our late appearance, which have no physical character, since all this is part of the universe defined as the whole (in all its spatial and temporal extension in Newtonian language). In this approach only the existence of a space-time arises, the rest, whose evolution is relative only to an internal structure of this space-time.

This analysis, invoked by general relativity, a theory well verified by experience, even if we know that it is not perfect and destined to be improved, seems more appropriate to the analysis of the problem.

We will no doubt find limits to this, for it is doubtful that we will ever be able to find a perfect ultimate theory, but at least their nature will tell us more precisely about our condition in this universe.

**A first conclusion that we propose in our analysis is to note that any analysis of our existence in terms of space and time is erroneous and can only lead us astray.**

This tells us what not to do, but not how to approach the problem and even if some avenues are mapped out, the approach is arduous because it rebels to our habits of thought. Some elements for reflection.

## This is a fundamental principle for an analysis free of the concepts of time and space inherent in our thinking.

1-Existence *cannot be thought of as something that has appeared in time and space. As already stipulated, existence, that of the universe, ours, has no predecessor, this term being used in the formal "mathematical" sense, the most general, not only limited in time and space. Nothing implied existence, it does not result from anything else!!*

This resolutely existentialist assertion imposes that any analysis of our existence must respect this hypothesis.

2-Existence *implies a consciousness to ascertain it. Thus we must consider a "block" universe including what is usually (mistakenly) called all its "spatial and temporal extension", including a consciousness to think about the universe. Otherwise, we would be forced to consider that the existence of the universe (including us) begins with the emergence of our consciousness.*

## The paradox of consciousness of the existence of the universe and of ours

In this document, for example, we have shown that, when we seek to explain and found our existence, linked to that of the universe, we have found that, as in order to ask the question, we must exist, this existence is, in fact, implicitly a necessary condition for this reflection and that seeking to justify it is unfounded. Let us develop this.

We can, in fact, go further and consider that seeking to justify our existence, which leads us to suppose that it would be conditioned, would be an incoherence of our mind since it authorizes a hypothesis, which by its nature, should be inconceivable, because it is contradicted by the very nature of this research which implies it.

This leads our mind to doubt itself about the way it allows us to apprehend the world, since it blatantly contradicts itself when it attacks its existence, and thus to question some of its conclusions in a larger area.

We can consider this as a defect in our mind, which then blurs our vision of the world.

On the other hand, we can consider that our mind transcends the structure of matter, including the one that serves as its support, which would allow it to free itself on the one hand from material constraints, among others, those of our material structure (body) which is subject to the constraints evoked and on the other hand to the more immaterial functions specific to our mind, in particular our consciousness of existence which is at the heart of the paradox.

But, if its nature is transcendent, is it well adapted to the knowledge of the universe, which seems to be made only of matter?

Note that the value and validity of everything written above and even this sentence implements the paradox we are debating....

## Annexe – Remue-méninge, (Brain-Storming)

*In these additions, which must be considered as pure speculative reflections (or even fantasies, not to be taken too seriously), let us try to untie this Gordian knot.*

The aim of this article, in accordance with philosophy, is not to claim to reveal a "truth", but to stimulate reflection on the part of the reader on these themes so that he or she can form his or her own opinion.

We will see how untying this Gordian knot could be resolved, without resorting to Alexander's radical method.

## First elucubration

Let us suppose an entity that transcends us (God for example) who created the universe and ourselves. Note that in general we implicitly assume that this was done, in a given place and at a given time.

This is the point of view of a human, but it can be assumed that the divine, who has powers that we cannot even imagine, created the universe in its totality, without these contingencies: The universe is an inseparable entity in its existence.

It should be noted that this is more consistent with modern concepts of cosmology, since it corresponds to the concept of space-time of general relativity, an equally inseparable entity (inseparable into fundamental elements) of which time and space are only shadows (appearances), which needs nothing but itself to exist.

It should be noted that the decompositions into space and time carried out by leafing through space-time are no exception to this rule, because they are totally arbitrary and do not correspond to any structural division. They can only be useful from an operational point of view (to make calculations).

In this context, the notion of creation, in a place and at a time, is useless, if not impossible, since the space-time entity, which is more than time and space, which are only appearances, could not emerge from time and space, which are poorer structures.

One could object that, in this space and time, there was a more elaborate structure (space-time for example), but this does not solve the problem, it only postpones it.

In general, it is assumed that this divine entity that transcends us created the universe, which is very complex, just for us, while we occupy, at least materially, an insignificant place in it.

If we take into account our mind, the situation can be estimated differently, but our mind considers that we could have done it simpler to get to us. The Sun with

the Earth would have been enough and the chain of evolution of life on Earth could have been avoided, for example.

This can of course be disputed because let's not forget that it is our mind, with its limits and constraints, that finds the scenario complex, so considered synthetically as a single block, it can be otherwise.

It is by arbitrarily decomposing the entity into time and space, by breaking the unity of the universe, that we introduce this complexity by generating a history and a nature of the universe. This complexity would then be nothing more than an artefact linked to the limit of our thinking.

## Second elucubration: tautologies

As indicated in the introduction, in the analysis, we come up against tautologies that testify to the sterility of our reasoning.

In particular the notion of existence which would imply the necessity of a creation, a concept to which our mind is rebellious: Something cannot emerge from nothing!

There is no evidence that this is impossible. Since this phenomenon has never been observed, this attitude would result from habits of thought, for our mind is contingent on its environment and experience.

Let us recall how modern theories (relativity-quantum mechanics) have swept away many certainties that were considered intangible.

If we accept that a creation, as defined, can exist, then this Gordian disappears. We have not unravelled it, but we maintain that it is only an artifact of our mind and does not have a universal character.

## Third fantasy: our place in the universe

By virtue of our integral situation, of the necessary modeling in our mind of the cosmological fact, we seek to define our place in the universe by positioning ourselves as existing as a free entity and independent of this universe, even if we admit to being subject to its material constraints.

Another hypothesis would be that the only entity that really exists is the universe and that we are, within it, only a functional "organ" with only a limited but useful role among many others.

For example, we could have the role of giving consciousness to the universe.

It remains to determine the importance and criticality of this role [1]. A universe without consciousness, where no consciousness, which would be internal, (we do not consider an external consciousness, because the universe being the whole it can only be internal), could it establish its existence, can it exist?

Is consciousness one of the necessary attributes [2], or does it confer an advantage, for a universe?

### Fourth fantasy: What can we conclude from all this?

We leave it up to each person to draw their own conclusion.

## Notes on this chapter

[1] To draw a parallel with a human, we know that, among other things, our metabolism requires bacteria in our gut to assimilate food. Would we be in a situation of this type vis-à-vis the universe?

[2] This notion of the necessity of consciousness in physics is taken up by Wigner who, in quantum mechanics, considers that during a quantum measurement, the result of which can only be an eigenvalue, it is at the moment when the physicist becomes aware of this result that the result of the experiment exists.
You could say that the idea is that a result that cannot be predicted remains unrealized by an experiment until it is known.

But it goes further, in information theory, if this information is lost, because of the principle of information retention, this information must not have existed.

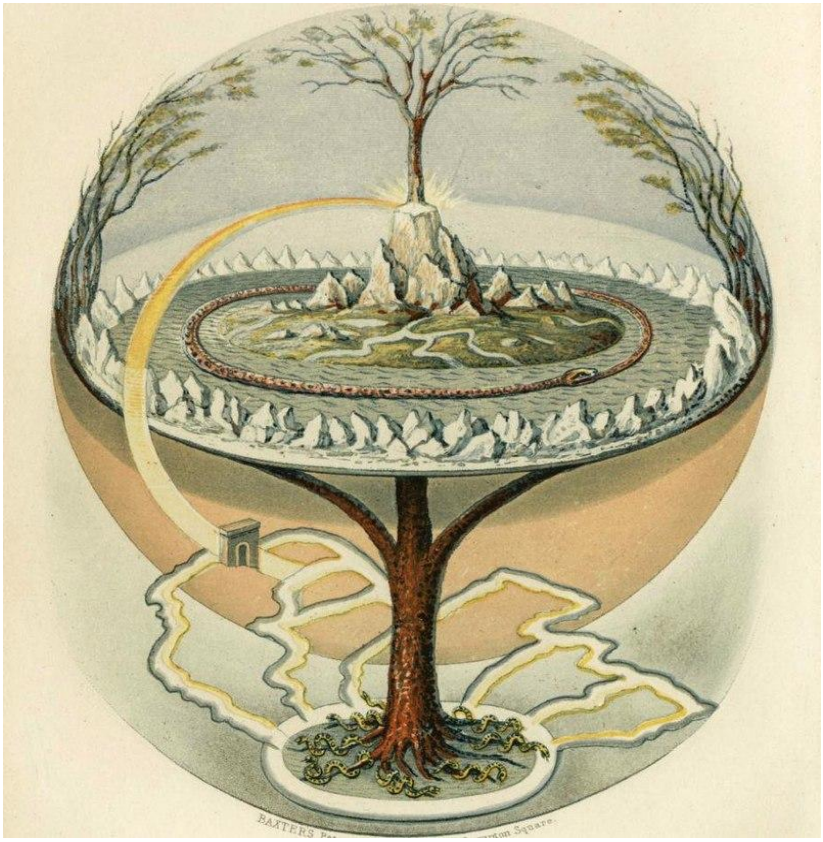
## 10- Consciousness and existence: some considerations on the subject

### Our Conscience

*"The **ego** is a relation that relates to itself" S. Kierkegaard - Treatise on Despair.*

**In his definition of the "me", the reversible nature of the subject-object relationship suggests that the subject and the object are no longer fundamental entities "in themselves", but shadows of a more complex self-recursive structure, linked to what is called "consciousness"!**

Like the snake biting its tail to close the circle, which curiously we find in Nordic cosmogonies see figure below, it is this concept, difficult to grasp, that he retains from his introspection.



*Ygdrasil, the cosmic tree, ensures the vertical coherence of the worlds of Norse mythology, while the Midgard serpent ensures its horizontal coherence. Painting attributed to Oluf Bagge*

## Self-awareness: a dissociation of body and mind

Everyone has doubtless, at some point, realized, sometimes with astonishment, that, when they looked down, they saw a limited part of a 2-dimensional surface, the spatial limit of the volume occupied, in an environment, of a 3-dimensional object, an object that was their own body.

In the space in which he was immersed, many other 3-dimensional entities existed and, among others, we can recognize other humans, whose entire surface we see delimiting them from the outside, similar to ourselves. This then allows us to understand why we only see a part of ourselves, our eyes being in our body.

Thus, even if no way to see the totality of our body existed [1], we could induce it by observing other humans and communicating with them to ask them to describe us since they see our body in totality.

All this shows the partition that there is between the "me" and the others, fundamentally different entities, and while there are many others, there is only one "me". This generates the awareness of the union of our body and mind, in our self, and that other humans are not "me" but that they have their own "me".

While we only see a part of our body, our unity concerns our entire body, which shows that our mind **externalizes itself** in relation to our material dimension since it considers our entity in its totality as if it were seeing it from the outside.

This characteristic of mind externalization is astounding, because our mind has a material support, mainly our brain which is not only part of our body, but is not visible from the surface of the body.

It is a mysterious emergent property that is difficult (if not impossible?) to understand and model, because in order to understand and model the mind one must use the mind itself, which seems to pose limits.

## Does general relativity propose a model for the structure of a consciousness?

Surprisingly enough, general relativity has characteristics that are similar to this reversible approach: As far as the universe is concerned, **the classical view is that it is the "container" of everything that is in "the content". Content and container are independent.**

But, in general relativity, what has been commonly called content and container in classical mechanics are one, in other words, they are inseparable, **because not only are all the parts of the content that define the geometry of the container, but in return all these parts are coupled with this container that they have defined and which then defines their phenomenology**!

The whole, which results from this embrace, characteristic of **non-linear** phenomena, constitutes a space-time which is our universe. In this case we have found a solution to this entangled interdependence which, moreover, accounts for (more coherently) than the classical vision of the phenomenology of the universe as we observe it.

This is likely to encourage us to continue our investigations.

## Self-duality, a principle that binds our mind to science?

Faced with this strange property of self-duality, one may wonder if this is a fundamental universal property of which our mind and the universe would be representations. This property of self-duality is considered by some authors (S. Majid - 1991- Principle of Representation-theoric self-duality) as a fundamental principle of the nature of science as our mind conceives it.

Indeed, it can be assumed that it is because our mind is constructed in this way that the theory describing the universe, which is a brain construct, incorporates this particular structure as an imprint of the designer, and, of course, vice versa.

In an attempt to find an approach to a situation that seems rather locked from within, let's start with a phenomenological examination that, even if it is peripheral to the subject (we turn around to examine it from different angles of approach), seeking to see to whom it applies, how it is implemented, what it implies, hoping that it will give us ideas about a key that could open up at least some perspectives on how to approach the problem. Let's start with the problem of our existence, a prerequisite for our consciousness.

It should be emphasized that the motivation of this document, like the method advocated by Plato, is not to reveal some universal truth but to encourage everyone to think about what best corresponds to the idea they have of the world.

## Argument: Does our late appearance prove that our existence is incidental to that of the universe?

The study of the current cosmological model, including the creation of the universe, shows that our existence, if it is permitted by the nature of the physical laws at work in the cosmological scenario [1], seems to have no influence on the cosmological model.

Our existence seems totally incidental in this process. We would not be here, things would have happened in the same way.

This is what our "late" appearance in its known history seems to attest, since for more than 13 billion years (in cosmological time), all this was done without us.

## Counter-argument: We (among others) are an integral part of the universe, not separable!

The previous argument is based on a Newtonian approach where time and space are independent, where the future does not yet exist: this is incorrect!

The covariant approach to relativity, which is the native and correct approach to general relativity, describes a space-time, a monolithic physical entity, physically indivisible, encompassing the totality of Newtonian space and time, which are only "shadows" of space-time. This space-time has no past, present, or future (in the Newtonian sense) its only "quality" is "existence": It exists!

It should be noted that this also applies to other forms of "life" in the general sense that would be susceptible, better or worse than us, of a consciousness that includes themselves as constituents of the universe. We came out of the caves not so long ago, our history is still in its infancy (at least we hope so) and probably it is difficult for us, even, to conceive of what its other forms of "life" would be and their relationship to the universe.

## Does the universe have a consciousness or does it need a consciousness?

Do we attach the term existence to an observation of a human-like consciousness? Thus, we are aware of existing and, consequently, the universe, of which we are a part, exists.

But would a universe, without human or exo-human consciousness, for it is plausible that other "intelligences" have existed, exist and will exist, exist? If none of this exists, can we say or even conceive, at the very least, that it **"is"** (without anyone to express it)?

Can we deny him, in this case, any consciousness of being? A priori, a negative answer seems to be necessary.

But is it so sure?

After all, we are a set of atoms whose organization depends on the laws of physics, on permissible interactions, which play the role of DNA for the universe.

Evolution towards humans was made possible by its constituents (protons, neutrons, electrons,..) and the associated laws.

We can see that the evolution of the universe seems to take place according to a Darwinian-type process, like life, when, perhaps, we can attribute a form of consciousness to the universe.

## Is a reductionist approach to thought possible?

This point was developed in my book "You Said Big Bang" where we explore its logical entanglement: **The subject seeks to understand a phenomenon, through a process that implicitly implements the phenomenon in question.**

Such a quest is not necessarily dead-ended, a method, for example, would invoke the treatment of the problem, subject-object jointly and not separately, by a meta-entity of self-dual structure, incorporating subject and object. The duality would be between the subject and the object.

This new meta-entity would allow a meta-analysis of the problem and perhaps reveal new concepts, such as space-time in relativity which has replaced the classical concepts of time and space.

In mathematics, such structures of self-dual algebras exist (Hopf algebra for example), but it remains to be seen what they could contribute to the solution of the problem. But we can see the limits of such an approach!

It is certain that the arrangement of atoms into molecules constituting our being is indeed permitted by the laws of quantum mechanics. It cannot be otherwise, and one may wonder the value of such a remark, which is perhaps only an automorphism of our thought: we apply this filter to the quantum world and we find it as a result! On the other hand, this does not evade the problem of the existence of atoms and their properties.

## What role for DNA?

A point that I did not mention in my book, in this reductionist approach, is the role of the DNA of living organisms, which intervenes at an intermediate level (microscopic at the level of the cell) between the atom with a few molecules and an adult human.

We know that it is this DNA, the double helix of molecules, on a microscopic scale, present in our original cell, that we will find in our cells, because it replicates during cell division, which contains all the information relating to the character of our constituents (genes) and the "assembly instructions" of these constituents (architect genes) to allow us to build ourselves with all our complexity and the vital resources necessary for its survival and that of the species.

One can only admire such a work of nature. In addition to its beauty, this work is not fixed but evolving. Indeed, we know that, through a process of mutations, under the constraint of the environment, through a Darwinian process, its evolution has reached us§

Of course, humans will, for their part, acquire a wealth of knowledge and experience over the course of their lives that will enrich the information carried by DNA.

But if this exceeds the quantity of DNA information, DNA will have made it possible by building, among other things, our brain, an organ of great flexibility, capable of acquiring and processing, from fairly simple basic structures (neural networks), but massively interconnected, the data necessary and useful for its development, making Sapiens the dominant species on Earth.

## Does DNA create us only to reproduce?

This idea, which may seem provocative, has been put forward by some. Not very flattering for our ego in its purpose (we would be a kind of cattle that we raise for our own benefit), deserves to be explored. It should be noted that this capacity of DNA, whose evolution takes place under the constraint of the environment, does not necessarily proceed from an "intelligence" or a "consciousness" but can simply be a "programmed" characteristic.

## The revolt of the human: He wants to take control of his DNA!

It turns out that we are beginning to know how to manipulate this DNA, of course first on plants, then on animals and finally on ourselves, for example to try to remedy diseases or genetic abnormalities. Nothing seems to prevent us from going further. Here again we find the myth of the "sorcerer's apprentice", because all the ethical laws governing these manipulations can, of course, be circumvented. But on the other hand, this is not also a problem for DNA, which would come under the control of humans, unless this too was written in the DNA.

## The human in space-time

If, instead of considering the chronological narrative, we focus on the concept of space-time of relativity, then we could say that human life is no longer a historical local evolution (which is our point of view, from our present) but a full-fledged constituent of the universe, which is the whole of space-time.

It did not appear mysteriously, the worm was in the fruit, because it was from the beginning, a part of this space-time, a part that will be explored by traveling through the lines of universes.

## Are we the only thinking beings in the universe?

The discovery of exoplanets in large numbers, prefiguring a gigantic number, makes it credible that other forms of life, some of them intelligent, at a level that could very well be so superior to ours that we cannot even imagine it, could exist

[2]. At the risk of upsetting our ego, the universe may also exist for others and as such would be more "of more general interest" than we think. Do these other beings ask themselves the same questions, have they overcome this? To answer, we would have to start by getting rid of our egocentric approach.

## Why ask the problem of the creation of the universe and of ours?

Since it seems that there is no need for this and that it seems to be useless, we can ask ourselves why living beings, like us, ask themselves this question.

We could therefore close the debate there, by very wisely considering that all this seems to be useless.

In spite of everything, as we are children, rather curious, of this universe and we can be seized with a doubt, in general, we consider that the question deserves to be examined, on the grounds that, perhaps, this uselessness is only apparent and hides something!

After all, we accept a creation from nothing, why not look for a reason hidden in the useless.

## Phenomenology of creation?

We have used the term "creation" which, in science, poses a problem by virtue of the famous adage "nothing is lost, nothing is created, everything is transformed".

The creation of the universe would be a mystery, because supposing that it is the transformation of something that existed before, we would only postpone the problem that ends up leading to an "eternal" existence.

It should be remembered that cosmology is a theory, and moreover it is not quantified, which is problematic about its "origin" since the standard model of cosmology evades the problem by invoking a "singularity".

Creation is a singularity in this model, move around, there is nothing to see! In our daily existence we speak of "creation", in every connection. As far as we are concerned, as mortals, we are created, which is true because before we did not exist. But our material substance is made up of an assembly, admittedly original and moreover changing, of atoms that already existed in (near) nature and which, for their elementary constituents (or almost – they are made up of quarks), protons, neutrons and electrons, for example, were (almost entirely) all created 13.7 billion years ago (in cosmological time in the Big Bang model). [3]

Since then, they have been the same as those that make us up. The protons and neutrons that make us up may have belonged to dinosaurs before us, or even to viruses and bacteria, etc. When it comes to recycling, nature knows how to do it!

Interestingly, if the theory attributes an origin to it, the proton seems "immortal", which intrigues physicists. Supersymmetric (speculative) theories predict a "life-time" limited to the proton, but this has never been observed, to the great despair of physicists.

Nature presents us with an example of 'eternity' in the guise of immortality, a very strange 'asymmetrical' concept in physics, there is a beginning but no end, which, if it can be questioned in other theories, challenges us and can shake certain convictions about our own conception of what our own creation and that of the universe could be.

## What makes us ask ourselves this question?

The essential functions of life are reproduction, survival (food) and the development of the species with the best possible appropriation of an environment that allows it, in competition with other species.

This is what many forms of life seem to limit themselves to such as viruses, bacteria, plants, animals. Some forms of life live only one day, just long enough to reproduce.

One may wonder what kind of advantage can bring a reflection on being, such as the one that the Sapiens, that we are, makes.

Another element, related to ecology, that comes to mind is that alongside competition there is cooperation, as well as synergy or even symbiosis between very different elements (our intestinal flora which allows us to assimilate food, the role of insects in pollination, its plants, etc.).

All this forms a very interconnected system with multiple interdependencies whose prudence advises to be careful not to molest it too brutally.

To return to our questioning of existence, it is because we reflect and are aware of being an individual very limited in space and time with an interior and an exterior, of our existence that we ask ourselves the problem of this existence.

Does asking this question give us an advantage over not asking it? A priori, at the level of the individual, at least so far, this does not seem to be the case. At the level of a society, we can ask ourselves questions.

Individually, it would be rather a disadvantage because of the anxiety it can arouse. Is this inspired by the fear of death, because our life being of finite duration, we are led to make an assessment and, consequently, to link it to something that gives it meaning?

If the source of reflection seems to be individual, is it an individual value to which we attach rights (human rights for example), societal or even linked to the species?

## Is creation an illusion, a concept to hide a lack of knowledge?

Our mind requires us to associate with everything an explanation for its existence and seems, by this, to exclude any existence that would not be justified. But isn't this an illusion based on habits of thought? The proof we exist and are not able to justify it, we can only note it.

## Is this reflection the prerogative of Sapiens?

Without talking about elementary living beings (paramecium, amoebas, mayflies, insects, from which we may have come), does an evolved animal ask itself the question?

It is difficult to ask them, but the study of their behavior does not seem (except perhaps for chimpanzees?) to show the signs of it. This does not prevent them from having a "social" life, either in the wild or domestically for some.

Our distant ancestors in the caves were undoubtedly aware of their existence.

Despite the dangerous context in which they had to ensure their survival and that of the species, via the first social structures (family-tribes), could they have had a confused notion of the problem.

Probably yes, if we believe the myths and religious responses that have emerged, no doubt on the fear of death, which leads to the desire to give meaning to life.

## Are the algorithms we develop (AI) a threat?

We build high-performance machines capable of great autonomy of decision and action, possibly capable of reproducing themselves (building others) and improving autonomously. But do they have a consciousness of existing?

It is true that at the beginning it was humans who built them and implemented their algorithms. But these algorithms, increasingly inspired by neural networks

that are capable of learning, therefore of evolving, can they become fully autonomous, whether it has been tried in their programming or whether it is the result of an error (bug) and (this is the great fear of some) of escaping our control and becoming totally independent.

Can these algorithms lead to giving them an awareness of existing through "feedback loops"? If so, wouldn't this be a handicap (starting to think and hesitate) or would it be an advantage?

The anxiety, which could turn into fear, expressed by some, even though they are at the heart of this work, about the latest developments (Chatgpt for example) is a sign that we are becoming aware, as the myth of the sorcerer's apprentice describes, of an adventure whose developments could escape us and turn against us.

## Is it consciousness that gives Sapiens an advantage?

At first glance, it is not obvious that preoccupying oneself with one's individual existential subjects is an advantage in terms of the efficiency of a society. See, for example, totalitarian societies (Nazism, Stalinist communism and today to a lesser extent Chinese society for example), where the individual must take a back seat to the collective.

In other words, as some advocate, these concerns are useless, futile or even harmful. In terms of efficiency, no doubt, but as it seems to be anchored in our minds, they have often ended up imposing themselves against all odds.

## Limits and trust that can be given to the brain

The big question is therefore the nature of this consciousness linked to the nature of our brain. If this organ is remarkable, it would be wrong to sacralize it, because it is only an evolution of a more primitive structure. It is remarkably efficient at dealing with the common problems we encounter in our environment, but it can only effectively process what it has learned to know.

In other words, for questions about problems that he has not been confronted with, his answers are subject to caution.

However, it should be noted, and this is a major asset, that the answers he can give are probably better than those resulting from a simple chance because it is a remarkable property of neural networks to give an answer that is not completely random if the question asked has correlations with other questions he has already been confronted with.

## Our brain: self-recursion at all levels!

Note the feedback, because it is with our brain that we foment these doubts about it... Moreover, it is also with our brain that we study it, at least its organic constitution where the manifestations of its cerebral activity have a physical counterpart, which allows us to know only a shadow of it, as in Plato's allegory of the cave.

But is this not the case with all our knowledge, even in the physical sciences, for what is accessible to us through our physical experiments are the phenomena, that is to say, the thing as it appears to us (the shadow on the walls of Plato's cave), but certainly not the reality of the thing (the noumenon) which is destined to be inaccessible!

It is in this direction that we must orient our speculative reflections: How can we look for what the brain does not know by using our brain?

We see that we are faced with a self-recursive problem that we will have to try, not to unravel because consciousness is part of this self-recursion, but to apprehend it synthetically in order to understand it in its structural complexity.

The danger is that it leads us astray without us being able to be aware of it, because as long as it is a question of physics, the universe and the physical world give us some points of reference that we must, of course, take with all the reservations we have mentioned, because it is through our interface (meanings, instruments, theories) with this physical world that we apprehend it, but when it comes to the question of existence we are in a pure metaphysics where even these landmarks, as furtive as they are, do not even exist.

Following Plato, let us leave it to each person to make up his own mind....

# Notes on this chapter

[1] This fact is a truism, if it were not the case, we would not be here. This is the subject of the "Weak Anthropic Principle", which would be more appropriate to call it a "weak anthropic argument". It is much more detailed in the book where one wonders how far in a reductionist approach one can go.

In short, for living organisms, this is made possible by the structural diversity of the electronic shells governed by quantum mechanics, which allows for very complex molecules. In fact, all physics, with its elements and its laws of interaction, is at work in this scheme.

We consider that DNA is the key to evolution and the extraordinary complexity of living things where we can only marvel at evolution from very simple structures to complex beings like us where the different functions to be carried out are carried out by specialized organs interacting with each other but also with other forms of life (bacteria, viruses).

And what about sexual reproduction where from a tiny fertilized egg, the architect DNA will build an original individual but according to a well-established plan!

But this DNA also has its DNA, which are the four interactions (gravitation, which will make the large hosting structures and contribute to the supply of energy, the strong interaction, which will build protons, neutrons and intervene in atomic nuclei, the weak interaction, which allows the change in the nature of the elements (the dream of the alchemists) and therefore their diversity, and finally, at the level of humans and their environment, electromagnetism, which governs the electronic shells and allows chemistry. It is these interactions that constitute the primary DNA, whose laws govern, among other things, our DNA. Have these interactions always existed? The Standard Model of Cosmology (MS) tells us that at the very beginning they were not separated and did not manifest (were masked). They decoupled very early on (in cosmological time from the MS) and were at work from then on.

[2] The number of planets must be gigantic, because this is associated with the mechanism of star formation. Indeed, the angular momentum must be evacuated so as not to thwart the collapse of the gas cloud that will generate the star, in the case of single stars. It is the planets, which, given their distance from the star, do this, despite their much lower mass than the star. In the solar system, if 99% of the mass is in the Sun, 99% of the angular momentum is in the planets. So the existence of a planetary system for each star is a generic phenomenon, which suggests that the number of planets in the universe is greater than that of the number of stars, i.e. more than a hundred thousand billion billion planets!

The opportunity for life to have been able to develop is important, notwithstanding the silence of the heavens! When, on our modest example, we see how life has been able to evolve from modest single-celled organisms (or even less if we incorporate viruses) to us, and by what path, we are entitled to make projections that are much more organized and complex than what we are.

Let us remember how dinosaurs represented a kind of "monumental perfection" of strength that was constantly perfecting in the expression of life a few hundred million years ago and that it took a cataclysm for small mammals to evolve until us, we wonder what the next step will be, if there is one.

We look for reasons for this, such as those evoked by the Fermi paradox and we try to quantify the phenomenon of the Drake equation, taking into account, among

other things, the lifespan of an evolved civilization, but some parameters of which are so hypothetical that it is not much better than a wet finger answer!

[3] These are called "immortal" free protons. Protons can decay into neutrons in nuclear reactions within an atomic nucleus (P + P -> deuterium + positron and neutrino reaction, via the weak interaction involving a W+ boson, in the Sun for example). Similarly, neutrons can decay into protons in atomic nuclei. The free neutron is unstable with a period of about 15 minutes. It is stabilized in a potential well, like that of atomic nuclei, in particular the helium nucleus, which has made it possible to save the neutrons that survived in primordial nucleosynthesis.

# 11-Finitude and Continuous

## Finitude of the human (among others)

In the page "Physical Reality and Knowledge 10/04/23", on this site, we argued that, assuming that a physical reality exists, which is a reasonable hypothesis, it appears to us through the knowledge we have of it.

Plato called this reality (the world of ideas in Plato) a phenomenon, as it appears to us, today we would rather say that the phenomenon is this reality as we know it.

This distinction is based on the knowledge we have acquired about the finiteness of the universe and, consequently, about our own.

## The limits imposed by this finitude (information theory)

Being an assembly of a finite number of atoms, our being cannot claim perfect knowledge (of infinite precision).

However, given the large number of atoms that make up us and the resulting even greater combinatorics in terms of information, this represents a considerable amount of information.

Concerning macroscopic complex objects, themselves made up of a combination of a multitude of atoms, thanks to this quantity of information that our mind allows: we expect to have a deep knowledge of them (large amount of information about the object).

## Quantum indeterminacy: a problem of informational inadequacy?

But in the quantum world, even if we evade the entangled nature of the operation (we seek to know the properties of a quantum system by a process that implements these properties), another problem arises.

From the classical point of view, an atom, the elementary constituent of matter, is something simple. The formidable information capacity of our understanding must have given a "perfect" finite representation of it.

We know that this is not the case, quantum indeterminacy considerably complicates knowledge. But what is the source of this indeterminacy?

Is it the entanglement related, is it a property of our mind in need of important information, a combination of the two, and are these two aspects independent?

It is customary to say that when humans try to probe nature in its most extreme recesses, they find strange footprints: they are their own!

## The Mystery of the Continuous: Perfect Knowledge

Our mind is capable of conceptualizing, rather naturally, what is called in mathematics the "continuum".

A characteristic of the continuous is that it provides a "perfect" knowledge of the object to which it applies, which corresponds, in general, even if only one or a few "generic properties of the geometric type, for example" are retained, to an "infinite information of the most complete type" on the object described. We speak of the "infinite" power of the (uncountable) continuum in mathematics!

## A flagrant inconsistency

We become aware of the resulting incoherence: A discontinuous, imperfect system, allowing, admittedly, an important but finite information, our mind is capable of generating a perfect concept integrating infinite information!!

## Origin of the concept of continuous

This concept has its source in the approximation, linked to an imprecision of the perception, that we have of nature: thus a solid that we look at or touch seems continuous to us.

## The continuous does not exist in the universe

But, this is a pure invention, because nowhere in nature and, a fortiori, in our minds, does the "continuous" exist!!

## Advantage or disadvantage of the concept

Should we consider this as an advantage, (the ability to conceptualize something that does not exist in nature and this is not the only case) or on the contrary as an illusion that leads us astray and gives us a false idea of nature?

It may be objected that when we know that this perception of the continuous is not representative of nature, we reconcile the two points of view and thus win on both counts, but this ignores the insidious character of the concept that we can use without being aware of it.

## The mystery remains

A beautiful mystery remains: How can a fundamentally discontinuous structure (our mind) conceptualize the continuous!

## The mystery of the concept of continuous, addition of 11/09/26.

As mentioned above, it is surprising that a discontinuous structure, such as a human being, composed of a limited number of atoms, part of a universe composed of these same atoms, can conceive of continuous entities, while the "continuous" is a concept of infinitely more complex power than the discontinuous of which we are constituted.

## Is the concept of continuous an aberration of our minds.

As the continuous does not exist in the physical world, could it be an aberration of our mind, but the fact remains that this does not explain how a discontinuous entity could conceive of it. Could it be a deficiency of our mind, a kind of "myopia" that would not allow us to have sufficient intellectual "resolution" to distinguish that 2 different neighboring entities are disjointed and to see only one?

This "deficiency" would be, surprisingly, creative because, instead of degrading our understanding, it would transcend it, generating a concept that transcends our discontinuous structure.

This corroborates the idea that it is errors and defects that are creative in the universe, perfection being sterile. This handicap would then create a very original and very powerful entity.

On the other hand, we can consider that we do not necessarily know nature (the universe) in all its complexity and only have a knowledge of it degraded by our senses, (cf. Plato's world of ideas vs. the sensible world of phenomena), and that we perceive only a discontinuous degraded version of it.

In this case, the fact that, despite the fact that the continuous does not appear to us in nature, we can, nevertheless, conceive of it in formal disciplines such as mathematics, in a transcendental way, remains, just as mysterious.

## Quantum mechanics, a way to reconcile continuous and discontinuous.

The problem that arose is the opposite, how to represent the discontinuous with mathematics, the high place of the continuous, with continuous functions, for example.

We have seen how the problem has been dealt with with operators acting on wave functions (formal entity of a continuous nature, for the computational purpose), offering discontinuous spectra of solutions corresponding to the eigenvalues of the process.

The Fourier transform (and its inverse), transforming, possibly, continuous entities (an analog signal) into a sequence of disjoint entities constituting the spectrum of its decomposition into frequencies that are particular continuous entities) is one of the structural keys to be analyzed more deeply to better understand this phenomenon.

## The frequency approach is not limited to quantum mechanics

In general relativity too, an alternative proposed by Newmann and Penrose, favors a "frequency" approach for certain problems.

This is related to the structural importance of zero geodesics in relativity. This results in a solution that is generally much simpler and more synthetic.

See for example The Penrose-Newmann formalism opens a way to the quantification of relativity. 25/06/25

## The possibility for our mind to ask itself this question and to debate it adds to the mystery even more.

Indeed, regardless of noticing this paradox, debating it is a further step on the subject, and so on.

# 12-Complex numbers in physics: representation artifacts or revealing structural properties of physics?

## Position of the problem

The use of entities represented by imaginary numbers may seem incomprehensible in physics or at least very strange.

Since physics is an experimental science, i.e. its theoretical formulation, whatever it may be, must be the subject of experimental verification to validate its suitability for the physical world to which a physical "reality" is attributed.

These checks concern "observables" which can be scalars, vectors, etc., to which a "real" (mathematical) value is assigned.

## Complex numbers in modern physics

If classical physics has been able to use complex numbers in an intermediate way (at the end of the calculations we found real values) (for problems of electric current phase shifting for example), in modern physics they have taken on a much more fundamental dimension.

## The case of relativity

Already in special relativity, in the metric generally used (*it's* the speed of light)

$ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2$ (1)

We see that if we consider the entities *DT*, *DX*, *DY*, *DZ*, we must in fact, consider *I.C.DT* to obtain this fundamental expression. Multiplying by c, which nevertheless satisfies the homogeneity at the dimensional level, is not enough.

This is linked to the fact that, from a physical point of view, time and space are obviously of different natures. If we consider "real" space, then time is imaginary (and vice-versa, we could consider real time and imaginary space, the choice of real space is conventional). Let's stay on the hypothesis of real space.

## Physical meaning of an imaginary time

What physical meaning should be given to the imaginary character of an imaginary time? The question thus posed does not really have a clearly conceptualizable answer.

The imaginary character of time is not an intrinsic property of time but a relational property with space: it **is in its relationship with space that the meaning of the imaginary character takes on its full meaning.**

. Moreover, spatial and temporal coordinates have no physical character, it is because we (abusively) link them to our **erroneous empirical concepts of time and space** that this poses a problem for us. The "time-type" character of a space-time interval has a physical character of time, while that of coordinates is conventional and arbitrary.

In mathematical manipulations, this relationship between time and space will lead to results that will be conceptualizable.

We must therefore consider the "imaginary" relationship as representing their formal relationship, even if this is difficult to conceptualize.

## Space-time is the key to mystery

If we do not understand this relationship well, it is because we are not addressing the problem correctly.

Relativity (special and general) is a theory of "space-time", the only entity with a physical character whereas, as Minkowski declared, space and time are only shadows of it (a reference to Plato's allegory of the cave). Time and space are only shadows (fictions) and as such non-physical characters can very well be attributed to them without this harming the coherence of the development.

## Dealing with the problem directly in space-time

By changing coordinates, we can transform the coordinates t, x, y, z into zero coordinates u, v, w, w* which are neither of the space type nor of the time type, but of the space-time type. The $ds^2$ is then written:

$ds^2$ = black.dv +dw.dw*

It is a homogeneous form in space-time.

This form is structurally more suitable for the treatment of relativity. The Newmann-Penrose formalism is a convincing example of this. The treatment of black holes of the Kerr family is thus simplified.

Special relativity in Newman-Penrose Formalism 11/26/22

## Can we conceptualize space-time?

Since its appearance, under our usual conditions, is not really visible, even if its mathematical formulation poses no problem, its conceptualization by our minds, shaped by the concepts of time and space, is not natural. We must do violence to our minds to attempt the enterprise.

But then, we have replaced one problem with another, where is the progress?

## The path to progress

Simply, progress is in the way that mathematics shows us, to continue our effort of analysis. Let us not persist on a sterile track, let us concentrate our efforts on a promising track. If we succeed, we will have taken a great step that will perhaps open the way to a better understanding of the universe and of ourselves.

# Complex numbers in quantum mechanics

## The wave function is of the "imaginary" type

The wave function, which is the fundamental element used in quantum mechanical description and calculations, is of the "imaginary" type. Under these conditions, there is no question of giving it a physical character. It is its modulus, built by multiplying the wave function with its conjugate, that provides a physical quantity: the probability of obtaining the state associated with this wave function.

## Some fundamental operators are of the imaginary type

In the formalism, see the first part of:

Quantum Mechanics Course Quantum Field Theory Course

The use of complex numbers (for example the Hermitian partial derivative operators, $i\hbar\ \partial/\partial t$, $\hbar/i\ \partial/\partial x = p_x$, are imaginary) is significant and its physical interpretation is rich in lessons!

We move from classical mechanics to quantum mechanics by substituting the operators associated with these physical quantities for the physical quantities of classical equations and making them act on the imaginary wave function.

Thus the classical **Hamiltonian** of a particle representing its total energy, which is the sum of its potential energy and its kinetic energy, expressed as a function of its coordinates and their derivatives with respect to time, is transformed into the **Schrödinger equation** of quantum mechanics by applying this process.

It should be noted that Heisenberg independently developed, on another paradigm (ignoring all classical concepts and dealing only with observables), a matrix-like approach that turned out to be equivalent to Schrödinger's. Here again, analyzing how 2 approaches that seemed independent lead to the same results is a subject of reflection enriching our interpretation of this theory.

This applies to both non-relativistic mechanics and relativistic mechanics, in which case we will have to take the relativistic Hamiltonian which will lead to the Dirac equation.

·The association of operators with physical quantities may seem conventional. In fact, it reflects a profound implication on the relationship between the nature of energy with time and momentum with space.

·Energy, associated with the variation of a quantity with respect to time, given by the relation i~~ħ~~ ∂/∂t = ε, shedslight (in arelational way) on the nature of energy and time.

· We can say that energy is the materialization of temporal evolution: there is no flow of (physical) time without the "transfer" of energy and, conversely, it is time that allows and "counts" this transfer.

·Time and energy appear as two aspects of the same entity.

·Similarly, the momentum associated with the variation of a quantity with respect to space, given by the relation ~~ħ~~/i ∂/∂x= $p_x$ , sheds light in a relational way on the relationship between momentum and space. Momentum appears as the materialization of space.

·Note the difference in structural nature (for energy, the operator i~~, ħ~~ ∂/∂t contains a term *i*.

For momentum, associated with space, we do have a term $1/i$, but the term $\hbar/i\ \partial/\partial x = p_x$, being squared in the equation ($-\hbar^2\ \partial^2/\partial x^2 = px^2$), space has a real character.

Here we find what **relativity formalizes in the signature of the space-time metric, where the sign associated with time and that associated with space are opposites**. It is these relations that relativity integrates in a more epistemological way by synthesizing them in its spatio-temporal structure, which reinforces what we have developed in the chapter on relativity.

### Quantum Field Theory

We will not expand on this chapter in this article, but we refer you to the second part of:

Quantum Mechanics Course Quantum Field Theory Course

This theory, which is based on group theory, shows how, ultimately, mathematics is the most powerful means of apprehension in our mind. We can note, in the document cited, how the electromagnetic field appears out of nowhere as a necessity to make the phenomenology of the electric field coherent (with respect to its symmetries).

## 13-The nature of mathematics

A key difference between physics and mathematics is that physics must be "accountable to experience," which is not the case with mathematics.

This property of mathematics leads to the debate of its existence, outside of any human consciousness, a debate that can be illustrated in the book "Matter to Think" between a mathematician, A. Connes, winner of the Fields Medal, and a famous neurophysicist: JP Changeux.

### Mathematics has an intrinsic reality

Alain Connes, in a Platonic approach, maintains that mathematics has a reality of its own independent of any human consciousness: it would exist, even in the absence of a consciousness. We discover this reality as our knowledge progresses.

Mathematics then belongs to Plato's world of ideas. It belongs to the perfect archetypes of all things (the essence that precedes existence) of which our perception, in the sensible world, is imperfect and incomplete.

This approach, recognizing an activity independent of our existence, has a divine character. The divine allows the relationship of mathematics with human intelligence and the operative nature of learning mathematics is then educational: This relationship shapes and structures our mind as our discovery of this reality progresses. We will qualify this position as essentialist.

## Mathematics is a pure product of our understanding

## Presentation of the problem

JP Changeux, in an existentialist approach, assumes that it is a pure creation of our mind, a structuring part of our brain activity motivated by the need to adapt to the external world. As such, it is also evolving, but under the constraint of the external physical world. We will qualify this position as existentialist.

To illustrate this, let us consider how the first humans were able to create mathematics. There is no doubt that they observed a plurality of similar or similar objects and that they realized that one could, regardless of the nature of these objects, attach to this collection of objects an entity, the number of elements, a concept that contains a part of abstraction, because it is not an intrinsic property of these objects or of any other.

## The mechanism of abstraction

One may wonder by what cerebral mechanism this capacity for abstraction is permitted.

It is undoubtedly the structure of neural networks that is the key to the solution.

We know that this mechanism, in addition to being able to deal with a problem through adaptive relationships, is also capable of elaborating other information such as correlation with other data it possesses, which allows it, for example, to respond to a problem that has never been posed to it, in a better way than a random response if a "structurally" similar problem has already been posed to it.

It is this remarkable asset that we are trying to imitate in what is called artificial intelligence.

This is indicative of his ability to extract information on the structure of adaptive relationships, resulting from a knowledge that is prima facie empirical, that he has established in his relationship with the outside world, and this is what we can call his capacity for "abstraction"!

## One abstraction calls for another to the point of making it an object of study in itself

By a subsequent abstraction, it could be noted that this number also referred to other objects of different natures or even to a collection of disparate objects.

The notions of addition and subtraction would naturally follow, since it was possible to enrich the collections by bringing together several or impoverish them by the reverse mechanism.

Division would emerge from the sharing of a collection between individuals and multiplication as the reverse operation.

Other abstractions will emerge from other needs, and then a time will come when these abstractions will "feed on themselves", take themselves as an object of study, and mathematical activity will become an activity that could be described as independent of material necessities and vicissitudes.

## What a resemblance to set theory!

It will not have escaped anyone's notice that what we have just described resembles set theory.

But it is not surprising that when we seek to found mathematics, we cannot avoid referring to the fundamentals of our understanding.

As for the foundations of even more recent mathematics (Grothendieck), they will go even further in the purity and stripping down of the fundamentals implemented!

## The quest for the foundations of our thought

As in other disciplines, for example quantum mechanics, the search for the ultimate nature of things always brings us back to ourselves.

This is not fortuitous, because let us remember that we are a material assembly of atoms, certainly very specific and very well adapted to the environment, where it

is the structure of arrangement of these atoms that is the "added" value to the inert matter.

It is conceivable that, when this structure (our thought) wants to go to the ultimate structural bottom of things, what it discovers there is something that must be correlated with the structure of our thought.

To imagine that a structure can recognize itself totally, seems possible, only, by a process invoking a meta-structure (revealing this identity), at least this is what our mind, with its usual logic, seems to impose on us. But then, this meta-structure that would emerge from this structure, where does it come from and so on?

We seem to be bogged down in an endless series of inclusions of meta-structures.

## 14-Consciousness, the key to the solution?

The phenomenon of consciousness of existing, consciousness of being an identity "the self" which is a relationship of a being to itself (the subject is also an object and vice-versa), whose emergent nature is proven, seems to be of a nature to break this chain of metastructure. It is noted, but its nature as a meta-structure escapes our understanding because it cannot be expressed in terms of logical relations between objects and subjects, in our mind.

The believer attributes to it a divine nature, the non-believer observes it and attributes to it a transcendental nature.

These considerations are not proof that mathematics is a human production, but they show how our understanding is involved in it.

## 15-Conclusion

This presentation only gives an overview of the subject and, since philosophy is not a science, we will not decide, because if the essentialist Platonist cannot prove that the worlds of ideas exists, the existentialist cannot prove that it does not exist!