

ON THE ROLE OF HUMAN OBSERVERS IN THE EVOLUTION OF THE UNIVERSE

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Abstract.-This short article reminds us that the universe has been evolving in the same direction throughout its entire history, and has been doing so without human observers observing that directional evolution. This has consequences of the utmost importance for certain classical hegemonic interpretations of quantum mechanics.

Keywords: evolution of the universe, human observers, quantum mechanics, Copenhagen interpretation.

Note: Hereinafter, the word universe will always refer to the observable universe as observed by human observers.

1. Introduction

In this article, I will refer exclusively to human observers of Earth, since we have no evidence of the existence of other observers in other parts of the universe (although it is possible that they exist). Regarding human observers and the reality of the universe, it is very common to find expressions such as the following in contemporary quantum physics literature:

- It is the act of observation that causes the wave function to collapse.
- Subatomic particles are in a superposition of states that only collapses into one of them when they are observed.
- It is acts of observation that create reality.

As a geologist, I have always been struck by the lack of references in these texts to the unobserved history of the Earth or the universe, for the simple reason that human observers have existed for a very short time compared to the age of the Earth and, even more so, that of the universe. And, obviously, these histories include an enormous vastness and variety of quantum processes that have occurred exactly as they had to occur according to the supposed directional evolution of the universe, a directional evolution marked by the irreversible increase in its total entropy, and without human observers observing that evolution. This article analyzes this **DETAIL**, which, as will be seen, is more important than it might seem. The discussion takes place in the formal setting introduced in the following section.

2. The Formal Framework

It is impossible to construct any science, whether formal or experimental, without the use of axioms (in the case of formal sciences) or inductive principles, also known as fundamental laws, in the case of experimental sciences. The reason for this impossibility is the Theorem of Formal Dependence, demonstrated in this section. For the case of experimental sciences, I will make use of the following:

Principle 1 (of the Directional Evolution) *The observable universe always evolves independently of its human observers and in the same direction of increasing its total entropy.*

In my opinion, the concept of entropy should be replaced by that of isotropy, which is clearer and less controversial. I use the concept of entropy in the statement of the Principle of Directional Evolution to emphasize its kinship with the Second Law of thermodynamics. A notable aspect of the Principle of Directional Evolution is the inclusion of human observers in its statement, which is fully justified because for most of the history of the universe (billions of years), there were no human observers observing its evolution, yet the same processes occurred, forming the same physical objects. This is widely proven by the existence in the universe of trillions upon trillions of such physical objects of vastly different ages.

Although apparently unrelated, the Principle of Directional Evolution allows, among many other results, the demonstration of the following three formal results:

Theorem 1 (of the Consistent Universe) *The universe evolves under the control of a unique set of invariant and consistent physical laws.*

Proof.- If the physical laws governing the universe's evolution were not a unique set of invariant and consistent laws, changes would occur with equal frequency in all directions, and no progress would be possible in any of them. Thus, directional evolution would not be possible, which contradicts the Principle 1 of Directional Evolution. Therefore, the universe evolves under the control of a unique set of invariant and consistent physical laws. □

The statement of this theorem could have been chosen as a fundamental principle about the universe: its statement would be confirmed empirically by the existence in the universe of the same objects of all ages.

Theorem 2 (of Formal Dependence) *No proposition proves itself; no concept defines itself; no object or physical process is the cause of itself; and no cause is the cause of itself.*

Proof.- If propositions proved themselves, then any proposition could prove itself, and consistent sets of laws would be impossible, which goes against Theorem 1. If concepts defined themselves, their meanings would be inaccessible to human knowledge, and they could not be used to establish the natural laws that we can only define through them, which again contradicts Theorem 1. If physical objects, processes, and causes were their own causes, then anything could exist and anything could happen, making directional evolution impossible, which contradicts the Principle 1 of Directional Evolution. □

Corollary 1 (of the First Cause) *To explain the origin of any physical object or phenomenon, there must be a first cause that cannot be explained in terms of other causes deduced from our knowledge of the observable universe.*

Proof.-It is an immediate consequence of Theorem 2 of Formal Dependence, and of the impossibility of knowing the first cause of an INDEFINITE sequence of successive causes. □

(Another very short proof of this Corollary is given in [2]).

3. Evolving without human observers

As is well known, quantum mechanics was born from a radical shift in perspective regarding the nature of electromagnetic energy. With M. Planck, it ceased to be regarded as continuous and began to be considered discrete: there exist minimal and indivisible quantities of that energy (energy quanta). What was initially a provisional hypothesis (not much to its creator's liking) eventually gave rise to a highly successful physical theory in the atomic and subatomic world: quantum mechanics. A theory with remarkable experimental success, though open to different theoretical interpretations of the physical world, because although quantum mechanics successfully calculates the probabilities of experimental outcomes, it remains compatible with different interpretations of the physical world as the source of those results.

Of all interpretations of quantum mechanics, the most widely accepted since its inception has been, and still is, the so-called Copenhagen interpretation, formulated in that Danish city between 1925 and 1927, mainly by N. Bohr and W. Heisenberg. The core idea of this interpretation is that quantum objects, such as subatomic particles, naturally exist in a superposition of different physical states as long as they are not observed, and that they collapse into one of those physical states only when subjected to experimental processes of observation/measurement. Consequently, in any unobserved region of the universe, those particles should always exist in a superposition of quantum states. In this regard, scientific literature includes statements such as:

There is no object in spacetime without an observer observing it [1, p. 60].

Or:

Intelligent observers are necessary in the formation of matter [3, p. 109].

In my view, the problem with the Copenhagen interpretation (and with other interpretations of quantum mechanics) is that, throughout most of its history (surely more than 13.8 billion years), the universe has been evolving directionally (Principle 1 of Directional Evolution) without human observers observing that directional evolution, only to eventually produce precisely—among many other entities—those human observers who supposedly collapse quantum objects with their observations and experiments. But these quantum objects have always been part of the universe, and they must have existed in the concrete states required by the corresponding physical processes that make the directional evolution of the universe possible. Therefore, the directional evolution of the universe would constitute fundamental evidence of the evolutionary autonomy of the universe with respect to its possible human observers.

This compels us to reflect on the Principle 1 of Directional Evolution of the universe. Its statement is a variant of the Second Law of Thermodynamics, a fundamental law extensively confirmed across the entire physical world explored by humankind. As such, it is assumed without formal proof, though sufficiently corroborated by empirical knowledge of the physical world. The inclusion of human observers in the statement of the Principle of Directional Evolution is quite reasonable, since for most of the universe's history human observers did not exist. Moreover, beyond being reasonable, it is very useful for addressing arguments that involve acts of observation/measurement, such as those mentioned above concerning the collapse of quantum states.

Once the Principle 1 of Directional Evolution is assumed, it becomes unavoidable to accept its formal consequences, among them the Theorem 2 of Formal Dependence, the Theorem 1 of the Consistent Universe, and the Corollary 1 of the First Cause. As noted above, the formal consistency of the universe is also empirically confirmed, since it contains trillions of objects of the same class (from subatomic particles to galactic superstructures) of all ages, confirming that under the same conditions the same processes always occurred with the same final results, precisely what one would expect from a physical object that always evolves in the same direction under the control of the same consistent set of physical laws.

One consequence of this brief argument is that the origin of the universe cannot be known solely through the use of the fundamental laws of logic and the science extracted from the universe itself. About that origin, speculation is the only option, but speculation is not even scientific hypothesis: it cannot be confirmed. Another clear consequence is that the directional evolution of the universe has been, and continues to be, completely independent of human observers, who—literally—have just appeared in the history of the universe. As human observers, we can only interact with the universe and modify it (very) locally in some of its physical aspects.

The formal necessity of an unknowable first cause for the origin of the universe is an unexpected formal consequence of the Second Law of Thermodynamics, here extended by the inclusion of human observers and termed the Principle of Directional Evolution of the universe. A principle that, expressed informally, asserts the impossibility that all the gas released when uncorking a champagne bottle would spontaneously return into the bottle, no matter how long we wait for it to happen. If that is true, then so too is the conclusion that the cause of the universe's origin is unknowable to human science.

Naturally, there are alternatives to the Copenhagen interpretation, although all of them are developed using the same inconsistent infinitist mathematics. Some of these alternatives consider the existence of two levels of reality, as in the case of D. Bohm's implicit/explicit order, W. Heisenberg's realm of Potentia, E. P. Wigner's quantum foam, or G. Hoof's cellular automata. I will attempt to point out the possibility of a new direction for seeking a discrete and finitist model for the universe, also with two explanatory levels of reality, based on cellular automata like models (CALMs).

Bibliographical References

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