Journal of Physics:
Conference Series

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Journal of Physics: Conference Series **2877** (2024) 012058 doi:10.1088/1742-6596/2877/1/012058

Was there time before the Big Bang? Philosophical enquiries

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Abstract. The aim of this paper is to show the reasoning behind a "Might have been" answer to the question "Was there time before the Big Bang?" Before addressing the question, the assumptions on which this question is based will be highlighted and the debate on the relationship between time and change will be briefly presented.

Figure 1. This image called the Hubble eXtreme Deep Field (XDF) combines Hubble observations taken over the past decade of a small patch of sky in the constellation of Fornax.

1. Introduction

The reader may wonder what philosophy can say about the question: "Was there time before the Big Bang?" The way in which a philosopher approaches the question is different from that of a scientist: whereas the latter provides an answer based on empirical data (see figure 1), the philosopher approaches the question from a theoretical perspective, shedding light on what the assumptions behind the question are and testing our conceptual abilities in providing an answer.

Before trying to answer the question, it is worth noting that the question "Was there time before the Big Bang?" is based on certain presuppositions. It assumes that (1) there is time (i.e. instants of time that follow one another in a series) and (2) there was a Big Bang (or to put it another way, there was a beginning of the Universe, a first instant of time when the Universe began). These presuppositions are not uncontroversial and can both be debated: it can be argued that the notion of time consisting of instants succeeding each other is inadequate, that time is unreal [1] or that time is very different from how we think of it [2]–[4], and, it can be argued that even if there is a time, there was no beginning of the Universe and what we call the Big Bang followed a Big Crash which in turn followed another Big Bang going backwards in time to infinity (e.g. the idea that time is without beginning and that the Universe itself had no beginning was defended by Aristotle in the *Physics* [5]).

If these assumptions are not accepted (i.e. if it is assumed that time is not as commonly thought or that although time exists as expected, there is no beginning to the Universe), the question of interest here becomes nonsensical and cannot be answered. In what follows, these assumptions will be accepted because although they are not obvious, they are not clearly inconsistent and are therefore acceptable for philosophical analysis. The question that will be considered can therefore be stated as follows: "Assuming that there is a time of passing instants and that the Universe had a beginning, was there a time before the beginning of the Universe?" (see figure 2).

There is a long tradition of philosophers who answered "No" to the question because they believed that they had an argument for concluding that it is necessary for time to have begun with the Universe. Among the philosophers who have argued that time had a beginning of necessity, it is worth mentioning the Islamic Kalām school who offered arguments for the finitude of time in the 9th century. These arguments were reviewed and defended by the American philosopher William Lane Craig [6] and by him together with Quentin Smith [7]. There are also relevant arguments by the British historian of science Gerald James Whitrow [8], by the British philosopher Pamela P. Huby [9], by the British philosopher David A. Conway [10] and more recently by the philosopher Henrik Zinkernagel [11].

However, there are philosophers who tried to oppose the above negative answer and even if they did not arrive to claim a conclusive "Yes", they offered arguments for a more modest 'It might be', which is the reasoning that will be considered here. The mere possibility that there is time before the beginning of the Universe requires one to carefully consider certain taken-for-granted conceptual assumptions. This paper will propose the consideration of a way to argue in support of the possibility of there being time before the beginning of the Universe and will aim to highlight what assumptions need to be made to accept this possibility.

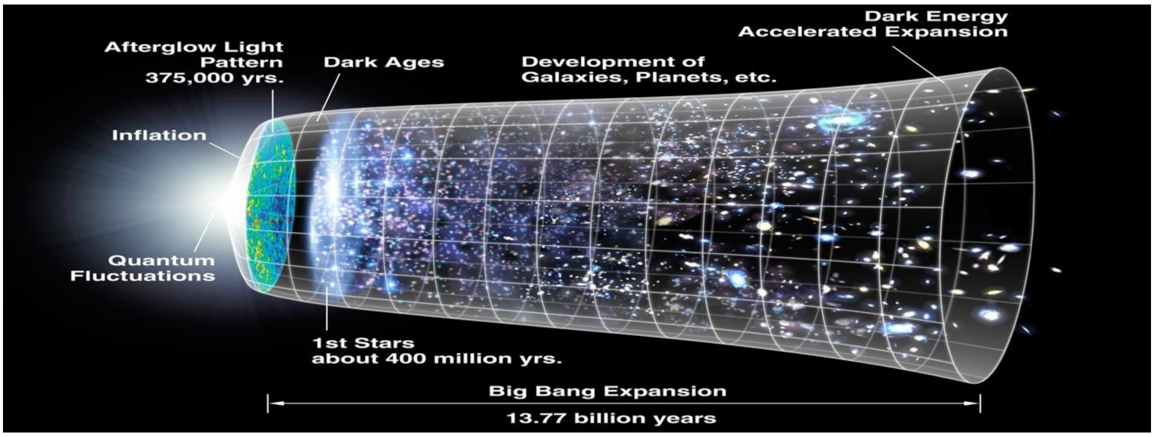

Figure 2. Timeline of the expansion of the Universe, where space, including hypothetical non-observable portions of the Universe, is represented at each time by the circular sections.

2. Relationism and Absolutism

To understand the debate between the supporters of the negative answer and the proposer of a possibilistic answer to the question under consideration, it is indispensable to consider an important distinction between two ways to conceive the relation between time and change which first emerged in the debate between Plato and Aristotle, were but clearly stated by Isaac Newton and Gottfried Leibniz [12], [13] (see figure 3).

The relation between time and change is crucial for the question under consideration, the reason being that the Big Bang is a first event which introduced a very important transformative change in

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what exists; before the Big Bang nothing existed, from the Big Bang onwards the Universe started to exist and with it, change was introduced. When one considers whether time may have existed before the Big Bang, one is considering whether time may have existed before change was introduced. It becomes therefore evident that the question concerning the relation between time and change is crucial for the question under consideration.

And philosophers do not agree about such a relation. According to Aristotle and Leibniz, among others, it is necessarily true that there is no time without change; or to say it in other words, necessarily time requires change to exist. This idea characterises the position called "Reductionism with respect to time" or "Relationism with respect to time" [14]. It is therefore no surprise that the supporters of the negative answer to the question under consideration are Relationists about time: they maintain that had the Universe (and change with it) a beginning, time began with it.

Newton, among others, claimed instead that there can be time without change (or time does not imply nor presuppose change). According to this view, time is like an empty container in which events and changes can occur, but time exists independently of things and events happening in it [15]. This position is called "Platonism with respect to time" or "Absolutism with respect to time" or "Substantivalism with respect to time" (although this position is called "Platonism", it does not seem correct to attribute it to Plato [16]).

The plausibility of Absolutism is the starting point for arguing that there could be a time before the beginning of the Universe, i.e. the idea that there could be a time when nothing existed and consequently no change occurred. In what follows this paper will consider how the plausibility of this position has been defended against Reductionism, but before that it will consider how Reductionism can defend itself.

Figure 3. Gottfried Wilhelm von Leibniz (1646-1716) (left) and Isaac Newton (1642-1727) (right)

3. An argument for Reductionism

Let us begin by considering an argument that can be produced in favour of Reductionism. This will clarify how the idea of Absolutism can be defended.

It is easily recognised that: if there were immutable intervals of time, then it would not be possible to know that there are. And one might be tempted to conclude that if something is unknowable, there is no reason to postulate it. Let us consider the argument in more detail. It is generally acknowledged that we become aware of time through change (we become aware of time through changes that occur around and within us, in our bodies and minds, and we measure time through changes that we consider to be uniformly repeated). Furthermore, it is quite impossible to experience time without change. Suppose, for example, we experience a period of time without anything changing around us and without even moving ourselves; in order to experience this period of time we must at least experience

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changes in our mind, we experience that different qualitatively indistinguishable experiences are taking place and thus we experience different contents of our mind. We are therefore unable to experience time without change and this impossibility of experiencing time without change has led some philosophers to conclude that we cannot know or conceive of time without change.

The argument presents a problem that can be easily discovered. The fact that one cannot experience time without change does not mean that one cannot conceive it. To give another example: we cannot experience a world without life and consciousness, but this does not mean that we think such a world is impossible. Instead we believe that after the Big Bang there was a Universe without life and consciousness for a long time before life appeared and we can assume that the Universe will exist without life and consciousness in the distant future. Therefore, the fact that we cannot experience time without change is not in itself a reason to believe that it is impossible for time to exist without change. To put it briefly, the fact that time without change cannot be experienced is not a reason to conclude that it is impossible.

The point now at issue is how we can consider unchanging time a reasonable option and what the necessary preconditions are for doing so, which will be considered in the following sections.

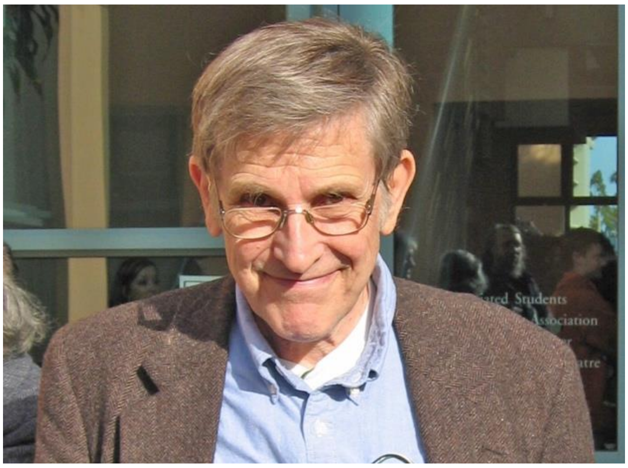

Figure 4. Sydney Shoemaker (1931-2022)

4. Shoemaker: an argument for time without change

Sydney Shoemaker (see figure 4) gave an example of a world in which people can be led to believe that there is a time without change even if they do not have direct experience of it [17]. He argued that in such a possible situation, even if we cannot have direct experience of time without change, we are in principle able to know or at least reasonably conjecture that there is a time without change and even to conjecture how long it lasts. His argument is a thought experiment, a type of argument that is quite common among philosophers and which it is useful to explain.

To understand a thought experiment, it may be useful to point out the main difference between an empirical scientist and a philosopher. An empirical scientist collects some empirical data and develops a theory that explains the data. A philosopher, on the other hand, is interested in what is necessary or not, depending on our conceptual and logical tools. The thought experiment is therefore an experiment not intended as a verification of empirical data, but as a verification of our concepts. The general structure of a thought experiment consists of asking the recipient to consider a story (a story that is known for certain to be false and in this case, a story that is known for certain to be incompatible with physical laws) and to consider how we react to it given our conceptual capabilities. What is useful in considering the story is therefore not to consider whether the story is physically plausible (which it is not), but how we would react if the story were true. The reaction is understood as a clue to our conceptual capacities.

Some might argue that if physical laws were different, our concepts would change with them. It may be that our concepts are in part determined by the way the world is and the physical laws we naïvely or scientifically attribute to it, but it may still be interesting to observe how our concepts would change if our world and the physical laws we attribute to it were significantly different.

Let us now consider the story presented by Sydney Shoemaker and imagine a world consisting of three relatively small regions that he calls A, B and C. The three regions are separated by natural boundaries, but it is possible for the inhabitants of this world to move from one region to another. Periodically a phenomenon called 'local freezing' happens in this world. During a local freeze, all processes that take place in one of these regions come to a complete halt: there is no movement, no growth, no decay and so on. At least this is what the inhabitants of regions without freezing observe in the region with freezing. During a local freeze it is impossible for people from the other regions to enter the region with the local freeze, but immediately after the local freeze has ended it is possible to enter the region with the freeze and observe what is happening there, and observe that eggs laid just before the freeze are fresh and that a glass of beer tapped before the freeze started still has its foam and so on.

The people who were in the region during the freezing will initially be completely unaware that the freezing period has passed in their region since they do not notice anything during the freezing, but they begin to suspect that something has happened when they observe what has happened in the other regions; they observe all the major changes that have occurred instantaneously in the other regions: people and objects seem to have moved discontinuously. After listening to what the people in the other regions say about what they have observed and more importantly, after observing the changes in the other regions, they eventually come to believe that a local freeze has occurred in their region. Now let us grant that this example of a local freeze is not in itself sufficient to argue that there can be time without change. In this case, even if there is a region where there is no change for a period of time, there is change in the other regions.

Let us now continue with the story and imagine that the inhabitants of this world discover that local freezes always last the same amount of time (say exactly one year) and that they occur at regular intervals: let us assume that local freezes occur in region A every three years, in region B every four years, and in region C every five years. Having noted this, they can calculate that there should be a global freeze (i.e. a freeze in all three regions) every sixty years.

Now it is quite evident that to assume that there is a total freeze in a universe consisting of only the three regions A, B and C is equivalent to accepting that there can exist time without change. If one accepts that there can be time without change, one can assume that there can be time before the Big Bang (i.e., the beginning of the Universe). To be explicit, saying that there could be time before the Big Bang is not the same as saying that there is necessarily time before the Big Bang, but only that it is conceptually and logically possible that there is time before the Big Bang.

Since the possibility of a total freeze in the universe we are considering is so relevant to the issue at hand, it is very important to consider the possible objections that could be raised to the hypothesis that the universe under consideration has a total freeze and how the defender of absolutism can respond to these objections.

5. First objection

The first objection that can be raised is that the situation thus described does not allow the assumption that there is neither local freezing nor total freezing. It can be argued that even if measuring instruments do not detect any changes during local freezing, this leaves open the possibility that better instruments are able to detect very small changes even during local freezing. Therefore, it can be argued that the inhabitants of this world have no reason to believe that there is a time without change (as long as they leave open the possibility that better instruments could find changes even during local freezes).

The objection is designed to show that one cannot consistently assume that there are local freezes, contrary to the evidence that leads one to believe otherwise. The argument has a verificationist

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assumption: the idea is that we can only assume what we can directly verify empirically (see figure 5). If we cannot directly verify the existence of local freezes, it follows that there cannot be local freezes (and therefore that we cannot assume that there are). The argument is fallacious because it tries to deduce what is impossible from what is impossible to verify, a fallacy already considered when pondering an argument in favour of Reductionism (in Section 3). This argument is parallel to the following fallacious argument: suppose that from the fact that it is impossible to verify that two things are equal in length with exact precision, someone wishes to conclude that it is impossible for two things to be equal in length. It is evident that if we are unwilling to accept the second argument, it follows that we cannot accept the previous argument either.

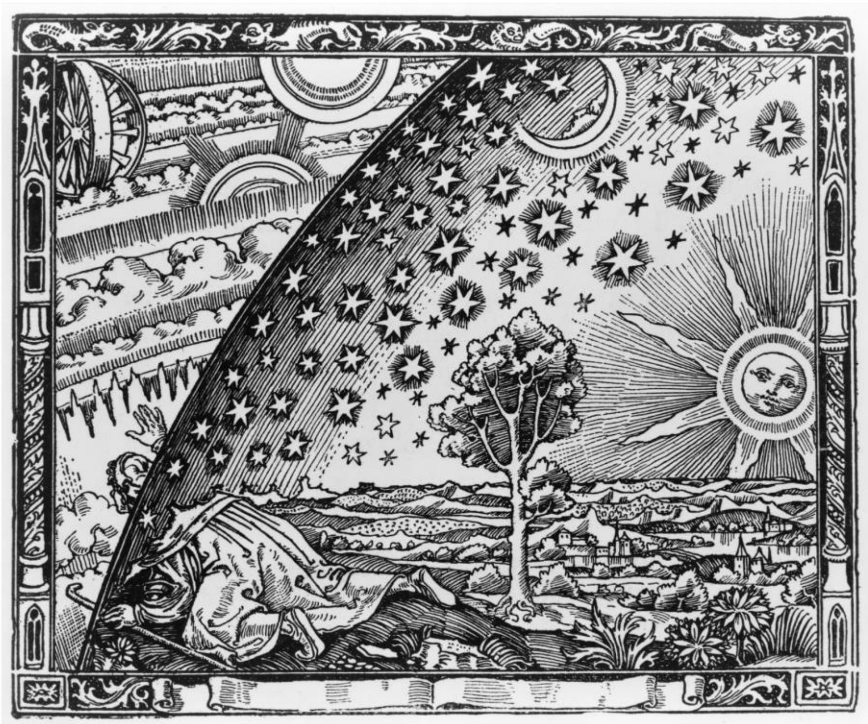

Figure 5. Illustrated plate taken from "L'atmosphere: meteorologie populaire" (Paris 1888) by Camille Flammarion. It is entitled: "A medieval missionary recounts that he has found the spot where the earth and the sky touch".

6. Second objection

Let us now consider a second objection: even if one accepts that there are local freezes, one has no reason to generalise to a total freeze. There are two equally available generalisations that can be adopted: (i) the first is that there are recurrent local freezes, but that every sixty years there is a block of freeze, i.e., every sixty years all three regions miss a freeze; (ii) the second is that after sixty years there is indeed a total freeze. Why should one adopt generalisation (ii) instead of generalisation (i)?

It is generally agreed that if two hypotheses are equally compatible with the same data, one should choose the simpler one. Now, the hypothesis of a total freeze is generally available through a standard inductive procedure. Therefore, it cannot be said that the hypothesis of unchanging time is not to be adopted without evading the possibility of a simpler hypothesis.

The idea of this objection is comparable to that of those who wish to deny an instant of time when everyone is deeply asleep. The fact that time is not verifiable when everyone is deeply asleep does not lead to the conclusion that there is no time in this case. It is more appropriate to assume that time exists even when everyone is deeply asleep. Similarly in the situation at hand, it is easier to generalise that a total freeze occurs every sixty years because this is a fact available through an inductive procedure.

Figure 6. *The Ancient of Days* by William Blake (1757-1827)

7. Third objection

A third objection can be raised against the generalisation of total freezing. The objection depends on the question: how can processes and events start again after freezing? What causes change to begin after a freeze? The question is very important because the resistance one may have to total freezing may depend on the resistance one may have to the inadequacy of the explanation one can give for the beginning of change after freezing.

Let us try to explain the difficulty. Our pre-theoretical notion of causality requires that every event has a cause and that the cause is contiguous with the effect, i.e., we generally assume the following principle of causal necessity: no event is without a cause (see figure 6).

If there is time without change before the Big Bang, one cannot explain how the Big Bang happened and if one cannot explain the Big Bang, the principle of causal necessity is called into question. Let us try to explain why causal necessity is called into question in Shoemaker's thought experiment: if there is a total freeze and an event E occurs immediately after the freeze, then there are intervals of time preceding E that do not contain a causal condition for E. Nothing happens in a short interval preceding E and therefore there seems to be no causal condition for E.

What, then, can be a causal condition for E? Two possible answers can be given.

7.1 First answer
The first answer is that the entire freezing interval is itself a causal condition for the existence of E. This is the answer proposed by Shoemaker. According to this answer, it is the entire interval without change that is causally effective without any event in it (in fact, there is none) being causally effective.

This answer is not inconsistent and is therefore a possibility to be left open. There are reasons for resistance to this response. As William Newton-Smith noted [18], we are reluctant to accept that an interval of time is in itself sufficient for an event to occur. The reason is that an instant of time does not seem explanatory in any sense to us. Whenever we say that an instant of time is the reason why a certain event occurs, e.g. when we say that the bells are ringing because it is four o'clock, we do not assume that that specific instant of time is the cause of the ringing of the bells, but instead assume that there is a mechanism that moves the bells that is synchronised with a particular instant of time. It is generally not considered that the instant of time is in itself causally efficacious for an event to occur. Therefore, even if there is no apparent inconsistency in assuming that an instant or interval of time is the cause of an event, we have a strong resistance to doing so.

7.2 Second answer
The second possible answer one can give to the question is that there is no cause for any event immediately following a total freeze (this is the option considered, though not adopted, by Newton-Smith [18] and more optimistically pondered by Swinburne [19]). This second answer is not inconsistent even if it is strongly contrary to our expectation - dictated by the principle of causal necessity - that every event has a cause. If one is willing to admit the existence of causeless events, then one can admit that any event immediately following a total freeze is causeless.

7.3 Pondering the two answers
This paper adds a consideration that may be useful in evaluating the two answers to the reasonable objection dictated by the principle of causal necessity. It is important to note that even the philosopher who gives a negative answer to the question "Was there time before the Big Bang?" has the same task of explaining the beginning of the Universe; even such a philosopher would have to admit that the beginning of the Universe together with the beginning of time cannot be explained causally. It is therefore a fact that both philosophers who admit time without change and those who deny it have problems explaining the beginning of the Universe.

Figure 7. An example of ma, understood as 'emptiness full of meaning', used in art: Shōrin-zu byōbu - left part of a diptych by Hasegawa Tōhaku, c. 16th century.

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8. Concluding remarks

In summary this paper has considered the question "Was there time before the Big Bang?". The question is not neutral and requires certain assumptions to be granted. Once granted, the question can be answered in a negative and a possibilistic manner. The paper has considered the reasons in favour of the “Might have been” answer. It has presented a thought experiment that allows for the assumptions underlying such an answer: the thought experiment allows for there to be a beginning of the Universe because it allows for untestable instants of time, it allows for induction to be a good reasoning principle and it allows for there to be either uncaused events or events caused by the existence of immutable intervals of time (see figure 7). These are interesting and challenging hypotheses that help to evaluate the answer under consideration.

Acknowledgements

This research was funded by the Department of Philosophy “Piero Martinetti” of the University of Milan under the Project “Departments of Excellence 2023-2027” awarded by the Ministry of University and Research (MUR) - I am grateful to Alfredo Tomasetta and Giuliano Torrengo for reading an earlier version of the text and providing useful suggestions.

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