

What Kind of a Problem is the Problem of Time?

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Abstract

Aristotle begins his famous discussion of time in Book Δ of *The Physics* by asking whether time belongs to “the things that exist.” In this paper I argue that Aristotle’s apparently ambiguous answer to this question holds one of the keys to clarifying contemporary philosophy of time. First, I argue that the metaphysical and meta-philosophical presuppositions underlying most philosophy of time are deeply flawed. Second, that Aristotle provides us with a much more plausible alternative set of presuppositions about the nature of time. The Aristotelian conception of time as part of the subject matter of physics or “the philosophy of nature” is particularly illuminating. Finally, I examine several issues about the nature and reality of time often raised in the context of contemporary physics and show how the Aristotelian perspective can resolve those puzzles.

Aristotle begins his famous discussion of time in Book Δ of *The Physics* by asking whether time belongs to “the things that exist”(τὰ ὄντα).¹ He concludes that it does not or does so only in a tenuous or obscure fashion. Oddly enough, he follows this with an extensive discussion of what time *is*. If time does not exist, then how can it be anything? The answer to this conundrum is that Aristotle is an anti-Platonist but not an anti-realist about time. More generally we should understand that time exists as a mode of those things, for Aristotle substances, which exist in a fuller sense. This Aristotelian way of thinking about time has vital importance for a philosophy of time mired in Platonistic and metaphysical ways of addressing the problem of time. Even as the debates in the philosophy of time have moved away from an obsession with “the big kill” metaphysical argument, philosophers have continued to accept a meta-philosophical position that classifies the problem of time as a problem in metaphysics.² In this paper, I argue that the general acceptance of this meta-philosophical position is the fundamental mistake bedeviling contemporary philosophy of time.

By assimilating the problem of time to metaphysics, one commits to a particular conception of the kind of thing that time could be. Specifically, one commits to a conception of the reality of time such that in order to be real, time must be, in some sense, metaphysically necessary. However, I find this formulation of the problem of time as a fundamental problem in metaphysics deeply obscure. It seems clear to me that being in time is a particular way in which more metaphysically fundamental elements of the world exist. I suggest that we return to the beginning and ask, or re-ask, the most fundamental question of all: “What does it *mean* to say that time is ideal (real)?”

In the next section, I examine three typical modern arguments against the reality of time, McTaggart’s paradox, Kurt Gödel’s argument from general relativity, and an argument against presentism in the style of Craig Callender and Yuri Balashov.³ I find it difficult to make out the force of these arguments. That is, I find myself thinking in each case, “OK, that works, but so what?” All of these arguments take as their supposed conclusion that time is in some sense “ideal” or “unreal.” In what sense? Here we return to our core question. I will argue that in each of these cases, we will discover that the answer to this question embedded in each of these arguments is profoundly implausible. My point here is not that these arguments do not prove what they set out to prove in the sense that they are invalid, but that what they do prove does not tell us anything very interesting about *time*. This is because modern philosophy of time is fundamentally mistaken about the very nature of the phenomenon it investigates and thus applies to it

inappropriate Platonic criteria of reality. The problem of time does not, to use the classical terms, belong to metaphysics, but to physics or the philosophy of nature.⁴

The alternative to such a Platonic understanding of time can be found in Aristotle's *Physics*. When Aristotle claims that time does not belong to "those things that exist," he is clearly not opting for the Eleatic alternative position, which claims that temporal awareness is fundamentally deceptive about the nature of the cosmos. This, at least, should be perfectly clear from Aristotle's refutation of Zeno at *Physics* VI. Rather he is staking out a middle ground, as he so often does. In section three, I offer an interpretation of *Physics* Δ:10-14, influenced by that of Julia Annas, that articulates the senses in which time is and is not real according to Aristotle.⁵ In the final section, I argue that these basic criteria remain appropriate even though our basic physics is so different from Aristotle. Moreover, according to these criteria time is real even though it is perfectly possible that our universe could have been atemporal.

§2 Time and Metaphysical Necessity

It is reasonably clear what it means to say that David Hume or Immanuel Kant believed that time was ideal. Hume explained time as a structure of relations among various Ideas; Kant as a part of the fundamental structure of human consciousness imposed on our representation of the world. There are certainly difficulties regarding the precise

interpretation of both Hume and Kant, but the core differences between Humean skeptics and Transcendental Idealists, on the one hand, and metaphysical realists about time on the other are reasonably clear. However, in modern philosophy of time the parallel distinction is rather more obscure. What is being denied when defenders of a block universe claim that time is an illusion? What is the force of the “unreality of time” or the “ideality of time” ?

Apparently, it must mean something along the following lines—that we represent the world as having certain temporal structure that it does not have. Consider McTaggart first. His argument seems to be the following:

M1: To represent something as being in time is to represent it as having, sequentially, the various monadic tense properties.

M2: Those monadic tense properties are mutually contradictory.

MC: Therefore, nothing can have those properties.

There are many issues related to McTaggart’s paradox, most of which have been well-rehearsed in the literature.⁶ Here I raise one I am not familiar with: *what advantage could possibly make M1 even a plausible candidate for the nature of time?* Consider just one of the truly odd consequences of M1. If, as McTaggart seems to accept, the particular tense property possessed by a temporal element, instance or event, is correlated with its distance from the present and if time is at least dense, then any such element has an infinite number of different properties over every finite temporal segment. Consider a time one week ago. Over the next five minutes, over the next 1 second, it will possess an infinite number of such monadic tense properties; and a different infinity of them over the next second. Whether or not this system of tense properties is logically coherent, it is bizarre in exactly the way that gives metaphysics a bad name. Yet, in addition to being

attacked by McTaggart, it is seriously defended by Richard Gale and in a slightly different form by Quentin Smith. The question we need to ask is: why?

Before answering this question, it will be worth examining two more examples.

Consider Gödel's argument mentioned above. Once again reducing it to skeletal form, we have:

- G1: Time is real if and only if the past-future evolution is defined along a space-like foliation of the space-time.
- G2: Time is real if and only if it can be defined in all physically possible space-times.
- G3: There are solutions to the Einstein Field Equations(EFE) that have no space-like foliations.
- GC: Therefore, time is not real.

Again, this argument has been extensively discussed in the philosophical literature.⁷

Here, however, the focus will be on G2. Again, the fundamental question has to be: *what reasons could one have for believing this?* Consider. General relativity tells us that the structure of space-time is massively contingent. Gödel space-time is far from the most bizarre solution to the EFE. Among them, for example, are space-times with closed null geodesics in which you would see your own back.⁸ If space-time is contingent, why should time not be? Why should there not simply be some space-times in which there is time, and some in which there is not? Given general relativity, this principle seems at least as plausible as G2.

Consider one more example. I will associate this argument with Craig Callender, but he is certainly not the only philosopher to endorse it.

- C1: Time is real if and only if presentism is true.
- C2: Presentism is the doctrine that only what exists now exists at all.

C3: Modern physics makes it unlikely, at best, that presentism is true.

CC: Time is probably not real.

C3 is almost certainly true and thus presentism is almost certainly false. So, what?

Presentism is a philosophical theory about time, not a background assumption that theories of time have to satisfy. Any adequate theory must be able to make sense of the difference between past, present and future things, and any theory that claims that there is no difference between them would be a theory that makes an important part of temporality ideal. However, C2 is a stronger claim than this; it is the claim that the past-future distinction only counts as a real distinction if made in terms of a metaphysically thick conception of tensed or momentary existence. And, this puts the cart before the horse.

All three of these arguments have been largely beaten to death in the literature. However, they have two quite significant shared features; features which have together served to distort debate in analytic philosophy of time in a significant way. First, all three arguments depend on substantive metaphysical premises. While M1, G2 and C1 might be true, they clearly outrun anything given directly by the phenomenology of temporal experience. Consider G2 for example. In what way could my experience of temporal flow and becoming be the experience of all possible models of the Einstein Field Equations? It may be the case that my experience does represent phenomena common to all such models, but my experience is of this world, not of bizarre and modally distant worlds. By failing to distinguish the contents of temporal experience from the metaphysical implications of that experience, the evidentiary and argumentative structure of philosophy of time becomes deeply muddled.

The second shared feature of these metaphysical premises is related to the first, but is, if anything, more pernicious. The fundamental consequence of these characterizations of time is to separate the reality of time from any particular concrete contents of the universe. Thus, pure determinations of tense which are a fundamental determination of material beings; a feature of space-time which must be independent of the actual distribution of matter and energy in space-time; a definition of existence that serves as a fundamental constraint on the nature of material existence, or even existence generally. What they have in common is that they all insist that time can be real only if it belongs to the $\tau\alpha\ \omicron\nu\tau\alpha$, to the fundamental ontological structure of the cosmos. What all of these have in common is that they commit us to a Platonist conception of time; a conception of time as an ontologically independent component of the universe. However, as Aristotle pointed out a very long time ago, time simply does not exist in this way.

§3 Aristotle's Anti-Platonist Definition of Time

In the remainder of this paper, I will argue that there is a non-idealist alternative to the Platonist conception of time. On this conception of time, our phenomenology of time represents actual facts about the contents of the world and thus allows us to claim that the world is temporal even though there are both physically and metaphysically possible worlds that are not temporal and in which any temporal elements of experience could properly be described as illusory.

As Julia Annas has argued, such a position is at least implicit in Aristotle's treatment of time as the measure or number of change (or motion) in Book Δ of the physics. While this discussion is notoriously obscure, Annas effectively argues that the most coherent interpretation flows from the realization that Aristotle intends his argument to rely on and

parallel his anti-Platonist argument regarding numbers in *Metaphysics I* (cf. 1053b10ff.). Roughly, Annas claims that just as Aristotle claims to be able to explain the use of numbers via an appeal to acts of counting, thus avoiding appeal to abstract Platonic numbers, he can explain our experience of time via our acts of measuring or counting the amount of change undergone by certain processes as compared to other processes.

However, Aristotle is neither a radical nominalist about numbers nor an idealist about time. Consider a field containing five cows. On the Platonic account of number the fact that there are 5 cows in the field involves more objects than the cows. Generally we would say that it involves the cows, the set or collection of cows and the abstract object, FIVE, with which either the cows or the set of cows stand in some relation. At *Metaphysics I* Aristotle argues that we can make perfectly adequate sense of the fact that there are 5 cows in the field using only 5 cows and the fact that we can count⁹. There are five cows in the field because when we count the cows in the field we get to five and then run out of cows. In one sense, it seems clearly correct to say about numbers, as Aristotle says about time, that without anyone to count or to measure numbers do not exist.

It might therefore be tempting to think that Aristotle advocates a subjectivist or idealist account of mathematics. That seems inadequate, however, because Aristotle seems committed to the belief that counting does discover objective facts about the world. Whether or not anyone counts the cows, anyone who chooses to count cows will discover that there are five of them. The objectivity of counting depends at least as much on the “cooperation” of the world as it does on the existence of people to count. If the world did not contain any individual substances, the act of counting would not tell us anything true

about the world no matter how much we divided the world up into countable units. Consider, for example, “That which is other in species is other than something in something, and this must belong to both; e.g. if it is an animal other in species, both are animals.”¹⁰ I take it that at least part of the point of these and related passages is to establish that unities and contrarities on which counting depends are, in fact, to be found in the things counted.

Now consider time as the number of change. The parallel Platonist, although probably not Platonic, picture of time depends on the idea that the objectivity of our use of, for example, clocks to measure the rate of change of various other processes depends on the movement or flow of some “abstract entity” TIME, which contains all of these processes and which we approximate by various processes that bear particular relationships to that entity. As with numbers, Aristotle intends to explain the objectivity of temporal measurement without recourse to spooky platonic entities. He begins with the basic idea that we are aware of a wide variety of processes including our internal psychological processes and various external processes of alteration, locomotion, generation and corruption(218b20ff.). Consider a single process of locomotion, ball moving from point A to point B. To measure the change in the location of the ball, we must be able to identify the ball throughout the process of change and “mark” the ball at point A as a beginning and the ball at point B as the end(219a11ff., 219b24). This provides the concepts of before and after; the idea of changing from a beginning state to an ending state. However, not quite the full account of time because the single process does not provide any idea of the rate of change from A to B. That arises from comparing distinct processes(220a1ff.). For simplicity consider two balls collocated at A. The first ball again

moves from A to B, while the second ball moves from A to C, further from A than B is. Thus, we say that the second ball moves faster; its location changes more during the movement of the first ball. We live in a world in which self-identical beings changing their states and doing so in ways that allow comparisons between them are simply ubiquitous. We also discover that certain processes, for example cyclical astronomical processes, are particularly useful as a stable backdrop against which to judge the rates of other processes(220b15ff).¹¹

As with numbers Aristotle seems correctly to say that without someone to do the measuring and the comparisons of various processes, those comparisons do not really make sense. Once again, however, we should not allow this to mislead us into associating Aristotle with the Eleatics. When Aristotle claims that time depends on temporal awareness, he is not claiming that time is constituted only by temporal awareness, and that our objective description of the world can dispense with it as a pure product of human subjectivity. It is just as true that Ball 1 moves faster than Ball 2, whether or not it is observed, as that there are five cows, and not six, in the field.

To recap, Aristotle's definition of time as the number of change allows him resist Platonism about time; he need not admit time to the ranks of "those things which exist," while also managing to avoid full-fledged Eleatic denial of the objectivity of temporality. He is able to do this because he recognizes that temporal awareness is merely the awareness of certain characteristics of the processes that constitute the cosmos.

§4 A neo-Aristotelian Alternative

What characteristics of those processes does temporal awareness report? What is the "factual" content of temporal awareness? Alternatively, what does our temporal

awareness represent the world as being? Only once we can answer this question can we determine whether the world actually *is* the way that temporal awareness represents it. From Aristotle's discussion, we can extract the following: our temporal awareness represents the world as (i) containing coherent processes (ii) that evolve in single direction from "earlier" states to "later" states and (iii) such that the states of parts of those processes earlier than us at any time are determinate and later ones are not. I will discuss each of these conditions in order. The first is fundamental to temporal awareness because only this allows us to make sense of a connected ordering of states into earlier and later. That is a "coherent" process is one that we can identify across a variety of changes, such that the idea of evolution from one state to another makes sense. In Aristotle, the paradigm case of such a process is that of a single substance undergoing a process of generation or corruption, of natural change. Even if we do not want to commit ourselves to a substance-based ontology, time does represent the world as a collection of substances undergoing processes of alteration. Of course, the most fundamental such process to our own awareness, the immediate home of temporal awareness, is our awareness of ourselves as a self-identical person undergoing psychological alterations.

The second condition is the requirement that it be possible to order the processes in the universe in terms of before and after. The fundamental constraint here is the existence of a "markable" distinction between some states that precede other states. Some classes of processes must occur in only one direction, for example, life, or in Aristotle's terms generation and corruption. If everything in the universe resets itself, our temporal awareness is illusory. Finally, if there is no coherent distinction between past and future events, we could certainly claim that our temporal awareness is illusory.

Moreover, this is just the way that our universe is. Our universe does contain many things with “long, skinny world-lines” including us. Many of those things undergo sequences of irreversible changes. Moreover, there is a distinction between our past, in this case our past light-cone, which is determinate, and the indeterminate rest of the universe.¹² But, note that nothing about the fundamental nature of being means that our universe must be this way. Our universe is temporal, but that fact is neither a metaphysical nor a physical necessity.

There are of course differences between the Aristotelian conception of time and any neo-Aristotelian account compatible with contemporary physics. The most important such difference arises from relativity theory. Reduced to its essentials, the Aristotelian definition treats that mode of material beings as participants in natural processes such that the various rates of those processes are measurable. However, in the special and general theories of relativity the rates of processes are determined by the proper time along their world lines. Here we come to the first fundamental difference between the Aristotelian and neo-Aristotelian pictures. Aristotle clearly believes that the local time generated by particular processes can be extended univocally to provide a global measure of time allowing straightforward comparisons of *all* processes (219b10). I have argued elsewhere that we have good reasons to accept that proper time is all that we have, in some sense, really been experiencing and that the conception of global time is inferred from that experience.

Perhaps, the simplest way to grasp the force of these criteria is to consider some possible universes where time might appear to be real without being real. Consider three physically possible models of the universe such that we would say that a being with temporal awareness much like ours was deceived about the nature of their universe. First, consider Gödel-type space-times or others with significant acausal structures, closed or almost closed time-like curves. There are some well-behaved world-lines in some such universes. There might be regions of such a space-time where a sentient being with something like our temporal awareness could evolve. Such a being might represent their small well-behaved piece of the universe as temporal, and believe that this true of the universe as a whole, only to later discover their mistake. Especially as we move away modally to space-times where e.g. all of almost of the *null* geodesics are closed. In such a universe it is perfectly possible that the limit of our vision is our own back. However, we have no evidence that our universe is one of the possible universes containing significant acausal structure.¹⁴

Second, consider the dust models of general relativistic cosmology. The stress-energy tensor of these models, which encodes the space-time distribution of matter and energy, is a scalar function. This models a space-time filled with a smooth distribution of non-interacting dust of varying density. The simplest such models have not merely scalar but constant stress-energy tensors. Such a universe does not contain “coherent processes undergoing evolution” in any meaningful sense. In such a universe, a sentient being

might develop a time sense based on the apparent stability of their local environment. However, this would be a purely parochial way of relating to what is in reality simply a smooth homogeneous mass.¹⁵

It was once thought quite likely that our universe was one of these universes with a fundamentally homogeneous distribution of matter throughout space and time. Astronomers once thought that stars were roughly evenly distributed until the discovery of galaxies. Then that galaxies must be, until the discovery of clusters and super clusters. Now, it appears that structure appears everywhere we look and every scale. The discovery by COBE of variations in the microwave background radiation of the universe indicates that The Big Bang itself must have possessed internal structure.[ref]

Finally, consider a classical model—the simple solar system models of classical celestial mechanics. In such a universe there may seem to be but are not really any irreversible processes, in fact by the classical recurrence theorem the entire universe resets itself on quite accessible timescales. Again, this too is a universe in which time might seem to be real, because of the parochial perspective of particular sentients, but which it would be perfectly reasonable to say is in fact atemporal.

However, once again, our universe *is not one of those universes*. Our universe contains a predominance of spatio-temporally localized processes, many of them undergoing massively complicated, apparently irreversible chemical and thermodynamic processes. We have no grounds for even suspecting the existence of significant violations of causality. It seems obvious that our temporal awareness represents our world to us the way that it actually is, and that therefore, in the only way that makes sense, time is real.

Notes

¹¹ Aristotle, *The Physics: Books I-IV*, ed. G. P. Gould, trans. P. H. Wicksteed and F. M. Cornford, vol. I, *Loeb Classical Library* (Cambridge, MA and London, England: Harvard University Press, 1929), 373(217b29ff.).

² On the move away from “the big kill” see Craig Callender, "Shedding Light on Time.," *Philosophy of Science* 67, no. 3 (2000).

³ Yuri Balashov, "Enduring and Perduring Objects in Minkowski Space-Time," *Philosophical Studies* 99, no. 2 (2000), Yuri Balashov, "Relativity and Persistence," *Philosophy of Science* 67, no. Supplement (2000), Yuri Balashov and Michel Janssen, "Presentism and Relativity.," *British Journal for the Philosophy of Science* 54, no. 2 (2003), Callender, "Shedding Light on Time.," Craig Callender, "The View from No-When.," *British Journal for the Philosophy of Science* 49, no. 1 (1998).

⁴ On the conception of the philosophy of nature as standing between natural philosophy and metaphysics in terms of generality see Jacques Maritain, *The Philosophy of Nature*, trans. Imelda C. Byrne (New York: Philosophical Library, 1951). On the parallel usage of “physics” see the Introduction to Aristotle, *The Physics: Books I-IV*.

⁵ Julia Annas, "Aristotle, Number and Time.," in *Philosophical Quarterly* (Blackwell Publishing Limited, 1975).

⁶ Thomas Baldwin, "Back to the Present.," in *Philosophy* (1999), Ferrel Christensen, "McTaggart's Paradox and the Nature of Time.," in *Philosophical Quarterly* (Blackwell Publishing Limited, 1974), Heather Dyke, "McTaggart and the Truth About Time.," in *Philosophy* (2002), John Earman, "Thoroughly Modern McTaggart: Or, What McTaggart Would Have Said If He Had Read the General Theory of Relativity," *Philosopher's Imprint* 2 (2002), Richard Gale, *The Language of Time* (London: Routledge & Kegan Paul, 1968), Josh Parsons, "A-Theory for B-Theorists.," in *Philosophical Quarterly* (Blackwell Publishing Limited, 2002), William Seager, "The Reality of Now.," in *International Studies in the Philosophy of Science* (Routledge, Ltd., 1999).

⁷ Mauro Dorato, "Kant, Goedel, and Relativity," in *Proceedings of the Invited Papers for the 11th International Congress of the Logic Methodology and Philosophy of Science.*, ed. P. Gardenfors, K. Kijania-Placek, and J. Wolenski, *Synthese Library* (Dordrecht: Kluwer Academic Publishers, 2002), Alasdair M. Richmond, "Goedelian Time-Travel and Anthropic Cosmology.," *Ratio* 17, no. 2 (2004), P. Yourgrau, "On the Logic of Indeterminist Time," *The Journal of Philosophy* 82, no. 10 (1985), Palle Yourgrau, *The Disappearance of Time: Kurt Gödel and the Idealistic Tradition in Philosophy* (Cambridge: Cambridge University Press, 1991).

⁸ John Earman, *Bangs, Crunches, Whimpers, and Shrieks: Singularities and Acausalities in Relativistic Spacetimes* (Oxford: Oxford University Press, 1995).

⁹ The example is mine, but the conclusion seems clearly implied at 1054a12ff. and elsewhere.

¹⁰ 1057b35. References to *Metaphysics* are to the W. D. Ross translation in Aristotle and Richard Peter McKeon, *The Basic Works of Aristotle* (New York,: Random House, 1941).

¹¹ See Sarah Waterlow, "Aristotle's Now," *The Philosophical Quarterly* 34 (1984). for an extensive discussion of the role of such kinetic processes in Aristotle.

¹² I argue for this in detail in [ref.].

¹³ I argue for this in detail in James Harrington, "Local Time: Foundational Studies for a Theory of Temporality in a Relativistic Universe" (Ph.D Dissertation, The University of Illinois at Chicago, 1998).

¹⁴ It may even be possible to turn a "well-behaved" universe into one in which the existence of time is, at best, problematic. See Robert L. Forward's *Timemaster* where the discovery of a natural source of negative energy matter allows the creation of large numbers of macroscopic wormholes and breaks down the distinction between time and space.

¹⁵ See, for example, Chapter 27 of Charles W. Misner, Kip S. Thorne, and John Archibald Wheeler, *Gravitation* (San Francisco: W. H. Freeman and Company, 1973).