

Aristotle's Four Conceptions of Time

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In this paper I will describe four theories of time that can be found in Aristotle. I will compare these four theories with modern notions of time, and propose that the ancient and modern views are substantively the same. Of course, all four theories cannot be true together. I will present four ways to resolve the inconsistencies, and conclude that the contradictions can be resolved.

1. Introduction

In the *Metaphysics*, Aristotle has a strategy of considering all of the philosophies of his contemporaries and evaluating them. On occasion he is driven to conclude that an issue is beset by problems which do not seem to have a solution. He then starts again and approaches the problem from another point of view. We see Aristotle as a very thorough thinker: this is a very good strategy for reaching the truth. This degree of thoroughness makes reading Aristotle very interesting; however, in the case of time it is also difficult to determine his final conclusions.

We can identify four different Aristotelian pictures of the nature of time. I will present these in an order that highlights the inconsistencies between them. Firstly, time can be viewed as a *blank canvas* or *vessel* in which things occur. Secondly, time is an *active agent* that *causes* things to change. This time is global in nature and originates in the revolution of the outermost celestial sphere. The contrast here is in the causal power assigned to time. Thirdly, time can be identified with particular, extended *instances of change*. This time is local and just a property of the change. Finally, time is identified with the *present moment*, a *moving now*.

Clearly there is tension if one tries to believe all four of these to be true. Some theories give time causal power, others do not. Some identify time as local and some as global. Yet another contrast is between time existing as a period, and time existing as a point. In the second half of this paper I will present four attempts to resolve this tension.

Bostock (1996) presents a deflationary solution: Aristotle just changed his mind, and the texts compiled by his students contain errors. Hacking (2001) gives us an

irrealist solution: Aristotle is engaged describing how our mind structures the world. Politis (2004) and Ross (1923) adopt a more comprehensive perspective on Aristotle's enterprise: these different theories about time represent different responses to different questions, the context involved leads to different answers. Finally, I will present two solutions to the inconsistency between continua and points that Aristotle presents. I will conclude that the inconsistencies are only apparent and can be resolved.

2. Four theories of time

2.1. *Time as a vessel*

In the *Categories* (chap. 6) time is described as a totality. "Time, past, present, and future, forms a continuous whole." Ross (1923:90) states that "Present, past, and future are in time as being parts of it; events are in it as being measurable by it. They are contained by time, therefore, just as things in place are [contained] by their place".

The following analogical argument may be used to justify the view that time is a vessel or container:

- 1) Motion, space and time are interdependent entities — this interdependence means that they share the same properties. Aristotle implies this when he argues that they are all continuums and they are all finite.
- 2) In *Physics* Aristotle concludes that "For this reason, too, place is thought to be a kind of surface, and as it were a vessel, i.e. a container of the thing". (*Physics* book 4, chap. 4 last sentence)

Thus, place, or space, is defined to be a vessel for objects.

Thus 3. Since time shares the properties of space, Time too is a vessel.

This view of time as a vessel for events appears in a modern guise as a canvas upon which events get painted. It is the time of high-school physics and history, a line we use to order the events of the world. In Aristotle the nature of things and the agency of living things cause change. Thus, in this view, time is purely passive.

2.2. *Causal time*

To quote Bodnar (2009:9) "Aristotle postulates that the processes of the universe depend on an eternal motion (or on several eternal motions), the eternal revolution of the heavenly spheres, which in turn is dependent on one or several unmoved movers" (*Physics* 8.6, 258b26–259a9). The eternal, perfect, circular motion of the outermost heavenly sphere causes the inner spheres to revolve and this motion in turn is communicated to the rotating Sun and from there to cause changes on the Earth. An alternative description of this might be to say that the motion of the heavenly spheres is the source of energy for all other motion.

In *On generation and Corruption* Aristotle argues:

Further (b) since time is continuous, movement must be continuous, inasmuch as there can be no time without movement. Time, therefore, is a 'number' of some continuous movement—a 'number', therefore, of the circular movement, as was established in the discussions at the beginning. (*On generation and Corruption* book 2 chap. 10)

This identifies time with the motion of the heavenly spheres. Since this motion plays a causal role for Aristotle we may infer that time too acts in a causal way.

Time is like a big clock in the sky which, when it ticks causes all other processes to progress. This view of time as God's clock occurs in Cartesian philosophy. Much more recently some commentators on General Relativity give space-time a causal role. Thus Aristotle's ideas find a correlate in modern thought.

2.3. Local fragmentary time

In the *Physics*, time is identified with particular periods of time and particular instances of change (motion). Mendell (2008:20) notes that "Aristotle's treatment of time (*Physics* iv.10–14) includes some observations about number which come closest to being an account of number. ... time is number in the ... sense of so-much change as measured by a unit of change". In the *Categories* time is identified intrinsically as a quantity — something we can predicate of an event.

Instances of discrete quantities are number and speech; of continuous, lines, surfaces, solids, and, besides these, time and place. ...

Strictly speaking, only the things which I have mentioned belong to the category of quantity: everything else that is called quantitative is a quantity in a secondary sense. It is because we have in mind some one of these quantities, properly so called, that we apply quantitative terms to other things. We speak of what is white as large, because the surface over which the white extends is large; we speak of an action or a process as lengthy, because the time covered is long; these things cannot in their own right claim the quantitative epithet. For instance, should any one explain how long an action was, his statement would be made in terms of the time taken, to the effect that it lasted a year, or something of that sort. In the same way, he would explain the size of a white object in terms of surface, for he would state the area which it covered. Thus the things already mentioned, and these alone, are in their intrinsic nature quantities; nothing else can claim the name in its own right, but, if at all, only in a secondary sense. (*Categories*, chap. 6)

If we take this literally then time is entirely local and it is just a measurement we make of change. As a measurement it has no causal role to play. Its existence is a bit like that of a mathematical object. This does not mean that it does not exist as it may just exist in a special sense.

Consider a visual metaphor. Imagine a whiteboard, its surface is a continuous plastic thing. We could place marks or events on it. In contrast let us replace the surface with a mosaic of tiles. Each tile exists as a local entity but we can still step back and see a totality even though the only things existing are the individual tiles.

In modern physics, particularly in General Relativity, time is identified only locally, that is in local frames of reference. This local time is determined by the velocity of an object and the presence of mass. Whilst this is noticeably different from Aristotle, it does share the patchwork nature of time.

2.4. Time as a moving now

In commenting on the phrase “by holding it together” (*Physics* Book 4, chap. 11) Bostock (1996:264) tells us that “the Greek word for ‘continuous’ literally means ‘held together.’ [Thus] Aristotle may be thinking of a line as generated by a moving point, and held together in this way, as a movement is generated by a moving body, and time is generated by a ‘moving now’”. Inwood (1991:174) rejects the doctrine of the moving point, but he recognises that Hussey, Bostock and Owen interpret *Physics* (219b9) as saying that a line is swept out by a moving point; a line can be seen as the product of a flow of a point; or “If we draw a line AB, we do so by moving the tip of our charcoal from a to b”. In the case of time the now plays a role similar to this point: as it moves along it traces out time, thus, we can say that its motion is time.

The moving now is a single point. It is the only aspect of time that exists. To put it more precisely: only things that are synchronous with the now exist. The now changes some things that are potential to actual, and some actualities become potential. For example, when we paint a black wall white, before we begin, at time 1 the wall was actually black and potentially white; then, at time 2 when we have finished painting, the wall is actually white and potentially black (since it is possible it might change colour again). However there are other things, the essential properties, which persist throughout multiple moving nows. Establishing the causal role of the now is problematic. Does it cause changes, as I have just suggested, or do the changes push the now along in the same way in which my hand traces out the line I am drawing? For Aristotle causal power is in things so I am tempted to think that the now is pushed along by the powers in the world.

The doctrine of the moving now appears in modern philosophical theories of space-time as the doctrine of Presentism (Markosian 2008, Pt 6). Whilst matters have progressed since Aristotle, the Aristotelian metaphor of time being like a point tracing out a line is clearly a fore-runner.

3. These four views of time are incompatible with each other

Aristotle can't have held all of these views, since they are incompatible with each other. In the first three views time is a continuum, it consists of an extended period. A continuum, for Aristotle, has one key property: it does not contain points. Thus, the theory of the moving now which is a point, is in conflict with these.

The idea of causal time, as a kind of clock in the sky whose ticks cause time to flow everywhere else assigns a causal role to time. In the other theories time has no causal

role. It is a static substratum; it is just a measurement or it may be pushed along by the objects in the world. Again we have incompatibility.

Finally at issue in these theories is whether time is a global or a local phenomenon. The particular identification of time with particular changes makes it local, but the other theories make time a global entity.

4. Possible resolutions

How much can these views be reconciled? We will see that there are a number of ways to resolve the inconsistencies but that each way has its cost. One quick solution is Bostock's.

4.1. Bostock's Deflationary approach

According to Bostock, we only have fragments of Aristotle's writings. The writings are of lectures he gave his students. Some parts of the *Physics* are from early in his career, and some later. Bostock tells us that the usual view is that Aristotle did not compile these works himself but that Aristotle gave verbal lectures which were later compiled by his students who edited the work. He further notes that even the order of the writing is not certain (Bostock, 1996:vii). He goes on to say that "one should bear in mind that it is quite possible that [the *Physics*] contains some passages that Aristotle rejected from earlier versions... [and that]... one cannot be sure how much... would have survived in its present form if Aristotle had ever written up a 'final version' of his thoughts on time" (Bostock, 1996:xliv).

A related issue is the problem of translation. Kretzmann observes that:

Greek uses one word — '*nun*' — adverbially in the sense of 'now' and substantively in the sense of 'instant' or, more particularly, 'the present instant', 'the now'. ... it is frequently important and difficult to decide on the correct interpretation, which is rarely made perfectly unambiguous by the context. (Kretzmann, 1976:113 fn. 9)

Furthermore, it may also be ambiguous as to whether "the now" is an ontological instant or the "perceived now" or a "measured now" which, because it involves the process of perception, would be of finite duration. We can find another example, in comparing the translations by J.I. Beare of Aristotle's *On Sense and the Sensible* and J.A. Smith's translation of *On the Soul*. Beare uses the term "coinstantaneous" to refer to perceptual occurrences whilst Smith uses the term "contemporaneous". One term presupposes instants the other simply means "during the same period of time". Given that a major issue in reading Aristotle involves whether he claims instants of time exist, this difference between translations is a major problem. The fragmentary nature of the texts will also mean that we are missing important contextual information which would allow us to disambiguate these cases.

In other words it might be said that Aristotle did not hold *all* of these theories to be true. Either he just changed his mind, or his students got it wrong, or our attempts at translation are erroneous.

Whilst this approach solves the problem, I find it unsatisfactory as we are left wondering what Aristotle's preferred view of time might be like. Furthermore, many of the views are repeated or at least briefly encapsulated across many other works, not just the *Physics*, suggesting a belief in all of these theories. In book 1 chapter 12 of *On the Heavens*, Aristotle repeats his argument that time is infinite. The infinite, eternal nature of time is also found in *On Generation and Corruption*, book 2 chapter 10, where the eternal nature of change is argued for. In chapter 6 of the *Categories* (5a25–37) he gives time as an instance of a continuous quantity and also says that the parts of time do not have abiding existence and position but "It would be better to say that such parts had a relative order, in virtue of one being prior to another". This recalls the account of the moving now. In the *Metaphysics*, book V chapter 13, time, space and motion are all given as examples of a *quantum* which is continuous and infinitely divisible. Later in the *Metaphysics*, in book 12 chapter 6, he says time cannot come into being or cease to be and that time is continuous.

A final objection is that when philosophers change their minds they tend to signal that; but in contrast, in his other works Aristotle claims that his theory of the nature of time has been completely discussed (in the *Physics*).

4.2. Hacking's Irrealism

Hacking proposes a cognitive interpretation of the *Categories*. Aristotle is not describing an ontology of external things, but how our mind organises itself. This is a similar idea to Kant's "Critique of Pure Reason": Aristotle is describing how the abstract reasoning of our mind operates. This would apply to the view that time is just a container, for example. Kant argues that this container view of time and space is imposed by the mind on the world as a way to organise the chaos of the world.

We can equate Aristotle's view of time as a particular local continuum with the cognitive task of measuring the finite duration of some specific event.

Next, consider that a particular goal of our reasoning is to provide causal stories about the world which gives us the power to predict and control events. Thus, the account of the causal clock time can be seen as just a causal story we tell ourselves and has no ontological import. This explains the first 3 accounts of time we find in Aristotle. We could extend Hacking's method and suggest that the moving now is an account of our phenomenal experience of time. It is just what we observe or experience time to be, and hence need not entail an ontology of time. In this picture the ontology of time is eliminated: we just have phenomenal experience which can be inconsistent.

While this cognitive account has merits as an analysis of Aristotle, Aristotle's goal in his study of Nature is clearly to discover the underlying nature, elements and principles of time. Thus, I don't think he would accept this kind of irrealism.

4.3. The role of context

The questions you ask and the viewpoint you adopt can effect the knowledge you have about a topic. In his book *On the Heavens*, Aristotle is asking what the whole universe

is like. He starts out by asking what it is made of and accepts the view that it consists of Earth, Water, Air and Fire. He suggests that matter consists of molecules made up of pairs of these elements. If the universe were infinitely old then the molecules and elements would all have moved to their proper place and the world would be like a layer-cake and structured entities like man would not exist. To avoid this outcome Aristotle further claims that the elements in the molecules change from one element to another in a continual cyclic pattern. For example, matter made up of earth–water, which has the properties of a moist solid, changes (or dries out) to become made up of earth–air which is a dry solid. This example shows how Aristotle’s knowledge is a complete consistent whole with the properties of matter being consistent with the infinite nature of time.

We tend to think that the elements are ordered according to weight. However, if we consider the problem of whether objects float or sink it might be better to think of the ordering as based on something like density. Earth, being heaviest moves downward to its natural place at the centre of the Universe and fire, being lightest, moves upwards. However, there is another consequence of this variation of density: there is also a difference in the amount of friction or drag present. It is very hard to wade through mud. It is easier, although still difficult, to wade through water; and it is relatively easy to walk through air. As Ross notes, Aristotle introduces an extra element for the outermost fixed stars, they are not fire, as some suggest, but Aether (Ross, p. 96). The key property of this Aether is that it is frictionless. This means that the motion of these stars is eternal and time is infinite. Aristotle has almost given us Newton’s *First Law of Motion*. Aristotle is saying that “a frictionless body will continue in motion”.

Thus, my concern that time is described as both finite and infinite is resolved. The motion and time of the frictionless Aether is infinite, but the motion and time taken by other matter is finite. The context of “what is moving” results in different properties. The results about the nature of time from *On the Heavens* is summarised in book 8 of the *Physics*.

On the Heavens is asking global questions about what the universe, as a whole, is like. This effects the type of answers you get. Whilst a local motion is bounded in time and space it is a different question of whether the whole universe is bounded or unbounded (infinite in extension). To answer this type of question one has to adopt what we might call a Gods-eye-view or the view from nowhere. From this viewpoint time is looked at as a complete totality, a block universe laid out in front of us. The local division of time into past, present and future is ignored by the perspective adopted. This resolves my worry that time is both local and global in Aristotle’s account. It is not time that is changing but the viewpoint we adopt that changes properties that are “relative to the viewpoint”. From this viewpoint which is outside of time and space it also seems more reasonable to talk of time as a vessel or canvas or substratum in which events occur.

I also raised the issue of the causal role of time in causing events to progress. This is not Aristotle’s notion of causation which is immediate, local, and goal directed. From

the global perspective I don't think this question about causation would make sense. However, we are given a chain of interacting events. When the matter gets denser as we move from the outermost stars towards the centre, motion (or perhaps in this case we should consider it energy) is transferred from the fixed stars to the inner stars and planets and finally to the fire of the sun. The fiery energy from the sun then causes life and motion on the earth. This looks like it gives a causal role to time, however from the local perspective of sitting in my room time is just a background vessel not really playing such a causal role. Thus the contradiction in considering time as both causal and acausal is also resolved.

Of the various differences and contradictions I highlighted in Aristotle's accounts of time, I believe this resolves most of them. The one remaining contradiction is between seeing time as an infinitely divisible continuum containing no points, and the idea that the present or "now" is a point that is a key part of time.

4.4. The issue of the continuum and points — Extra machinery

Aristotle's description of the present as dividing the past, which is no longer, and the future which is yet to be, makes it look like a point. Aristotle's refutation of Zeno's paradox of Achilles and the Tortoise points out that Zeno assumes that Achilles must visit, or touch, every atomic point in turn. This assumption is rejected by Aristotle who claims that there are no actual atomic points in a continuum. Time is a continuum, but the now is a part of time. This means that time both does and does not contain points. Can we resolve this contradiction? In modern mathematics we could make the present an infinitesimal: it is then infinitely divisible, smaller than anything real, and behaves like it is of zero size. As this invokes a completed infinity to get to something smaller than any real, it is not an option open to Aristotle. Aristotle may have two different strategies for resolving the contradiction.

First, Aristotle distinguishes two different senses of the term "to be" or "to exist". He postulates *potential existence* and also *actual existence*. Actual existence seems to mean existing at the present moment, while potential existence is not existing at the present but something that will exist at a future present moment. To say that the present exists at the present moment seems acceptable. This would make the present an actual real thing. Motion and the continuum of time that contains the motion are extended things. Since a continuum is to be treated as indivisible then it does not exist, as a completed thing, at the present moment. (Recall that for Aristotle instantaneous motion does not occur.) Hence time, as a continuum, has potential and not actual existence. Ross (p. 171) tells us that the actual is the individual and particular, whilst the potential are universals. This too would make the present an actual existent and the more general time of the continuum a potential existent. In modal logics of potentiality, you isolate the potential propositions from the actual, and this prevents them leading to logical inconsistency and triviality.

A second attempt to resolve this inconsistency can be found in Aristotle's definition of the present. In the *Physics* (220a4) Aristotle defines the present as the unit

of time and says that it is used to count time. At first thought it seems that thought that Aristotle might be discussing the important distinction between how we measure things (or count things) which involves matching potential divisions and how things actually are as a single undivided thing. However, if you read this section literally it resolves the issue of the point-like nature of the present moment. In the *Metaphysics* Aristotle takes some time defining the terms he is going to use in his philosophy. A point is defined as something of zero size which has a specific position. This is a standard sort of definition you get from Euclidean geometry which identifies points on lines. However, a unit is defined as something different, it does not have a specific location. A further distinction between points and units can be found in *On Indivisible Lines* (972b25), where a point is identified as the limit from one side only at the end of a line. A point is an end. This is differentiated from a join which is the point-like object inside a line which can be physically divided into 2 endpoints and is a limit from 2 directions. The now which divides the past from the future is a *join* rather than a point. Whilst this book is attributed to Aristotle's successors, it may reflect Aristotle's views. Furthermore, Bostock notes that the now may be interpreted as a *universal* (Bostock, 1996:xlvi & 265 note to 220a22). Recall that a point however, is a *particular* with a specific location. Thus, we have three arguments that the now is not a point. By making this definitional move Aristotle has denied that the present moment is a point and hence that it is inconsistent with his idea of time as a continuum.

Identifying the present moment as a unit may also leave open the issue of whether the moment has a size. In Aristotle's theory of counting the unit plays a special role. Given a bowl of figs we first start by selecting a fig to be our unit of counting. Then we count by picking up a second item that matches our unit, and by repeating this process of matching the unit to successive items we discover how many figs are in the bowl. In this case of counting the unit is a thing of finite size that we use as a kind of yard-stick. It is treated as an indivisible thing, without parts, but almost paradoxically it has its own size. In the case of the present moment this seems to leave open the issue of whether it is of zero size or not.

These two strategies for treating the present moment do resolve the inconsistency between the account of time as an actually indivisible but potentially infinitely divisible continuum, and the account of time as consisting of a point-like present moment. However, these strategies lead to additional problems of their own. The distinction between actual and potential existence is sometimes unclear, and, in this case, the concept of a unit and how it exists is problematical. Introducing these extra components of the nature of reality to resolve inconsistencies in the theory is a rational strategy but it may be open to a charge of being *ad hoc*. This charge may be refuted by the fact that the potential/actual distinction occurs throughout Aristotle's writings. For example, Aristotle believes that you can't get something from nothing and that qualitative change involves changing from potential existence to actual existence.

Conclusion

Aristotle presents us with four different accounts of time. In his account of what the universe is made of he adopts a similar strategy. He considers all the alternative theories, rejects those that are inconsistent, and hence comes to a single conclusion (i.e. in *On the Heavens*). In the *Physics* we don't get this logical signposting. Perhaps his editors (or transcribers) thought the rejection of a particular theory too obvious to mention, or perhaps, as Bostock suggests these key fragments of the text are missing. This remains a possible solution to the contradictions. Hacking proposes an irrealist interpretation of Aristotle which sees Aristotle as describing our mental organisation. This would allow the presence of contradictions as a consequence of our mental capacities to model things. Whilst many irrealist continental and post-modern philosophers build on the work of the Greek skeptics and Plato and Aristotle to justify their philosophies, I find Aristotle's use of natural biological examples to position him firmly in the realist camp. Thus, although I recognise the merits of Hacking's approach, in the case of Aristotle and time I believe Aristotle is giving a realist account. In section 4.3 I proposed that the context of the questions being asked and the local or global viewpoint adopted resolved most of the inconsistencies I had earlier highlighted. In section 4.4 I concluded that the extra machinery of actual and potential existence as well as identifying the now as a unit rather than a point, resolves the inconsistency between describing time as a continuum and the now as a point. Thus, I conclude that we can resolve the apparent inconsistencies in Aristotle's accounts of time.

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