Philoponus on the Nature of Time*

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John Philoponus produced an influential argument that time must have had a beginning. While that argument has been widely discussed, particularly in its Kantian form, little attention has been paid to his view of the nature of time, which is contained in his exposition of Aristotle. Yet the argument seems to rest on his view of the nature of time. I produce a sketch of his dynamic and relationist account of time and explain how it can overcome various problems raised by Aristotle. I also explain how, with a little help from Damascius, he could have overcome a problem raised for dynamic theories of time by McTaggart and Smart. I argue that it might well be possible to modernise his view in the light of modern science.

Introduction

The Byzantine philosopher John Philoponus (c. 490–570 CE) is now known only to specialists. Nevertheless, as Richard Sorabji and others have shown, he is an important figure in the history of science and metaphysics (Davidson, 1987; Sorabji, 1983; Sorabji, 2010). Philoponus’ critique of Aristotelian science had a considerable influence on the development of scientific thought. He also produced a very influential argument that, contrary to Aristotle, time must have had a beginning. I have discussed the historical significance and merits of that argument elsewhere (Couvalis, 2011, 2013a, 2013b). I argued that a crucial part of that argument is the underlying assumption that time is dynamic, so that new units are continuously added on to it. However, I did not explain the details of Philoponus’ dynamic account of time or discuss its plausibility.

The only place in which Philoponus gives us a detailed account of the nature of time is in his commentary on Aristotle’s Physics 4.10–14. Richard Sorabji has argued that that account of time is mostly pedestrian (Philoponus, 2011, vii–ix). It is true that it is a detailed exposition of Aristotle as Philoponus understands him. However, spelling out how Philoponus thinks Aristotle can solve two important philosophical

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puzzles in an intuitively satisfying manner will allow us to see its strengths. I am not
going to discuss whether he is correct in his interpretation of Aristotle, which is a
matter for scholars rather than philosophers.

Philoponus does not explicitly present a solution to a further important puzzle for
dynamic accounts of time, which is the problem that dynamic accounts seem to be
committed to a regress of times. However, Philoponus’ contemporary, the Athenian
philosopher Simplicius (c. 490–560 CE), approvingly presents Damascius’ solution to
the problem. Damascius (c. 458–after 538 CE) was the last head of the Neoplatonist
Academy in Athens. His ingenious discussion of time deserves to be better known and
to be brought into the philosophical mainstream. I will argue that by using Damascius,
and some hints in Philoponus, we can see how Philoponus could solve that puzzle.

All of this will help to show that a key premise in Philoponus’ argument that time
must have had a beginning is defensible.

The nature of time

Two puzzles about time

Philoponus begins by discussing various puzzles about time. I will focus on three as
the others seem to be variants of them. Let me start with two of them. One puzzle is
that time consists of two parts. The future part does not yet exist and the past part
has ceased to exist. A totality that is made up of parts that do not exist cannot exist.
Hence time does not exist. A second puzzle is that the now, which seems to be time
or the only part of time which exists, cannot be a part of time or time. Parts can be
used to measure the whole. However, the now is unextended. Further, everything
divisible consists of divisibles, but the now is not divisible (Philoponus, 1887:702–703;
2011:4–5). Before I go on, note that these two puzzles arise because the now is treated
as closely analogous to a spatial point. It is treated as if it were an instant of no size.

What is time?

To solve the puzzles, Philoponus presents two accounts of the nature of time that he
treats as compatible. One is that time is generated by the flow of the now (Philopo-
nus, 1887:727; 2011:31), and another is that the being of time consists in becoming
(Philoponus, 1887:735; 2011:40).

Let us turn first to the flow of the now. Philoponus compares time to a line. Follow-
ing Aristotle, he argues that a line cannot be generated by points. Between any two
points that are not identical, there must always be more points. Different points cannot
be in contact with one another for, being of zero size, they have no sides. Points in
contact with one another must be the same point. Hence, a line cannot be generated
by points, however many points we put in. A line is generated by the flow of a single
point. It seems he means this only to be a metaphor for understanding time, for as we
will see later, he does not think of this now as being a zero sized instant which moves.
In any case, the Aristotelian thesis is that lines consist of smaller lines (intervals), not
of points. The points can only exist as limits of intervals. Philoponus is operating with what these days is called a “gunk” conception of space and spatial lines according to which they do not consist of points, though we can designate points on them.

Up to the late nineteenth century, “gunk” conceptions of space and time were widely accepted. However, they have been mostly rejected since the rise of set theory and transfinite mathematics. In set theory, lines are treated as consisting of an infinite number of points, and time is treated as consisting of an infinite number of instants. Set theorists argue that they have dealt with the problems Aristotle raises. For instance, a set theorist might deal with the second puzzle by affirming that instants have no size but exist, and that an infinite number of them constitute time.¹ This, however, is intuitively bizarre even though we can make it consistent by invoking set theory. As Galen Strawson has said concerning the related issue of spatial points “If one is being metaphysically straight, the intuition that nothing (concrete, spatio-temporal) can exist at a mathematical point because there just isn’t any room, is rock solid” (Strawson, 2006:16). As a result of criticisms like that of Strawson, “gunk” conceptions have recently enjoyed a resurgence. If we want to avoid undermining rock solid intuitions, we might, as Philoponus does, deal with the puzzles in a more intuitively satisfying way than those afflicted by set theory. We will not appeal to zero sized instants. I will assume here that “gunk” conceptions of both space and time can be defended.²

To explain his view of time Philoponus also uses the analogy of a moving object that may be called a different thing when it is in a different place, but is one thing in being. He says that

[T]he now, too, is the productive cause of time, since its flowing generates time. So if as the point stands to the magnitude and the moving body to the movement, so the now stands to time; and if the point being one and the same generates magnitude (for it is not by the juxtaposition of a plurality of points that the line is generated, but by the flowing of one point), and likewise the moving body, being one, generates the movement: it surely follows that the now too, being one, generates time. For time is not generated by many nows lying side by side (since it is not constituted from nows), but by the flowing of one. For it is by the same nows being taken as prior and posterior that time has being. So: just as the moving object is the same by being which <it is>; (ie it is a stone or a man or a star or something else), but through being taken in another and another it is different (since, as I said, for Socrates to be at home is one thing, and <for him to be> in the market-place another): so the now is identical in substrate and in essence ... yet precisely through being prior and posterior it is different in description. (Philoponus, 1887:727–728; 2011:31)

There are at least two ways to interpret Philoponus’ remarks. One is that the moving now generates time so that bits are added to time. The river of time grows further and further into the past. On this conception the past exists, its just not the current

¹ The classic defence of this approach is Grunbaum, 1967:40–63. For a brief discussion of key criticisms, see Dainton, 2010:301–312.
² For a brief discussion of Gunk and its rivals, see Dainton, 2010:309ff.
bit of time. A second way to interpret it is that only the moving now exists. On this conception, the river metaphor is misleading. Nothing Philoponus says in his commentary suggests that he thinks that the past continues to exist. However, in the classic statement of his argument against an infinite past time in *Against Proclus*, he talks as if that argument is sound whether the past continues to exist or not (Philoponus, 1899:10; 2004:24). He seems to not want to commit himself as to whether the past exists or not. I will assume that he is non-committal on the issue.

To understand Philoponus’ view further, we need to understand both how he thinks time is analogous to a line and a moving body, and how he thinks it is disanalogous. Philoponus accepts the Aristotelian thesis that change is necessary to time. Without change, there would be no time. However, time is not to be identified with any particular change, and things at rest can also be in time.

Philoponus thinks the correct way to measure time is to take something as a standard that has a uniform rate of change and measure the rate of other changes in relation to it. Presumably this is intended to coordinate all change in the universe. He thinks the only things that change at a uniform rate are to be found in the heavens. Like all his contemporaries, he assumes the truth of the Ptolemaic theory of the universe according to which the moon, sun, planets and stars revolve around the earth. Further, the earth is at the centre of the universe. He argues that the most useful measure is the movement of the sphere of the fixed stars around the earth for it rotates uniformly once a day. We create units of measurement to measure time by dividing the movement of the fixed stars into prior and posterior parts (processes of alteration are too irregular to measure time) (Philoponus, 1887:718, 777; 2011:20, 86). This allows us to explain how time is not movement but is necessarily connected to movement. Philoponus says “All time that is together, taken anywhere <in the world>, is one and the same. For it measures the prior and posterior of every movement (not of growth as such or alteration as such, however); but the prior and posterior of movements that occur together are the same, so time too is the same. However, it is not correct to go on and say this of movement too, for movements that are together are not the same; rather, some differ not only in number but also in form, and others, although the same in form e.g. a plurality of locomotions, are still not the same in number. Yet time everywhere is one and the same in number. So from this consideration too it is clear that time is not movement but number of movement” (Philoponus, 1887:725; 2011:28).

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3 The view that time requires change has been challenged by Sidney Shoemaker (Shoemaker, 1969). I have no space to discuss the merits of his argument here.

4 There is, of course, a problem in working out what is a uniform rate of change. It might seem as if there is a vicious circularity lurking here. However, Hasok Chang has shown in considerable detail how inadequate temperature scales and other knowledge (which was in turn partly based on inadequate temperature scales) were used to establish an adequate temperature scale. He points out that only a coherence theory of justification can explain what happens in such cases, and that some circularity is inevitably involved (Chang, 2004). Nordmann makes a similar point in discussing the difficulties involved in arriving at an adequate measure of time (Nordmann, 1998).
Pretty clearly Philoponus takes simultaneity as a brute fact in his account. Simultaneity is, of course, a problem for many theories of time; and it was only after Einstein that it became clear that producing a workable account of simultaneity leads to startling results. So Philoponus cannot be blamed for failing to see the problems raised by simultaneity. A modern defender of Philoponus would have to add an account of simultaneity from a current dynamic theory. I cannot do it here.

Since he takes it that time is necessarily connected to regular change, Philoponus thinks that time is not closely analogous to movement or to lines. The now is both the cause of the division of time and its continuity. However, the now is only the cause of the division of time in thought and not in actuality, “[F]or if it is not possible for the first movement, that of which time is primarily the measure, to come to a halt or be interrupted by rest, it is clear that it is not possible for time, either, to be cut in actuality...” (Philoponus, 1887:733; 2011:37).

The view is spelt out further in a discussion of how time is numbered and in which becoming is discussed: “...the point, since it has position and stays put and subsists in an object that has position can be taken twice [i.e. as the end of one part of an object and as the beginning of another], for it will not escape our taking; but the now cannot be taken twice, both as beginning and as end. For because time, in which it subsists, has its being in becoming and in flowing, the same now cannot be taken twice, both as a beginning and as an end...” (Philoponus, 1887:735; 2011:40. See also 2011:70–71. My explanation is in square brackets).

Philoponus seems to have in mind that we can divide space by points because it is static, but we cannot divide time because it is essentially dynamic. A point is literally a division of space in which space is really the parts on either side of the division. The point is, as it were, an edge of a segment of space. However, a point-like now (an instant) cannot really be a division of time in which time is really on either side of the division.

Philoponus’ remarks are a little obscure. Nevertheless, I think we can spell out what he means by focussing on how we would measure time by using a heavenly sphere. To measure time, we would represent a uniformly moving heavenly sphere as static and divide it into equal size segments by introducing point-like cuts. We treat one of those cuts as being the present — a moving now that is successively at prior and posterior places in relation to the horizon. The distance between the present (posterior) cut and a past (prior) cut, which is now in the position where the present cut was, indicates the time elapsed. This would allow us to measure time by using spatial distance. However, time is actually produced by a kind of now which is not point-like. We can grasp this as we can grasp that the cuts are constantly moving. We would always see them as slightly blurry (or flowing) because they are constantly moving.

The solution to the two puzzles
While Philoponus does not explicitly answer Aristotle’s puzzles about time, it is now easy to see what his answer would be. The first puzzle is solved because the now of
becoming is not really a dividing point or line between past and future. It flows so is not really point-like. To represent it as a dividing point, we must represent time as if it were space-like. We can do this in thought, but it does not correctly represent the reality of time. Time can be generated through the now of becoming because this now is not point like. The second puzzle is solved by realising that something that measures a part of time can measure time just as something that covers a part of space can measure space. It can do this because the continuously changing movement we use to measure time is not a static thing. Note what is crucial here. Time must be treated as analogous to space in some respects but not in others. To entirely spatialise time is to misrepresent its nature and to create an incoherent picture of time.

**A third puzzle and its solution**

Philoponus explains a third puzzle about time in some detail. He does not explicitly propose a solution to it (Philoponus, 1887:707–708; 2011:8–10). Nevertheless, I will argue his account of time would allow him to solve it with some help from Damascius.

Let me begin with Damascius’ crisp statement of the same puzzle and the central problem it raises for dynamic theories of time: “if the now passes away, it either passes away in itself or in another now, since what passes away passes away in time, just as what comes to be comes to be in time”. Damascius comments that “[I]t is clear that this account presupposes a time of time…” (Simplicius, 1882:799; 1992:123).

Unlike Damascius, Philoponus seems unaware that underlying the puzzle is the harder puzzle that a dynamic theory of time seems to presuppose a second order time. Philoponus treats the puzzle as if it arises merely from treating the now as point-like. As he rightly says, points cannot succeed points; so if the now is point-like it cannot perish in the next point. As I have shown above, Philoponus can deal with puzzles that arise from conceiving of time as composed of instants by arguing that in a dynamic time, the now of becoming is not point-like.

The problem of a flowing time apparently requiring another time is similar to problems raised by various recent philosophers. According to them, postulating a flowing time leads one into absurdity because we need an infinite regress of flowing times for a flowing time to flow, but this is absurd. McTaggart started the modern debate, though Smart puts the central problem more concisely (McTaggart, 1908). Smart argues that it is absurd to think of our consciousness advancing into the future as

> [O]ur consciousness does not literally advance into the future, because if it did we could intelligibly ask ‘how fast does it advance?’ We should need to postulate a hyper-time with reference to which our advance could be measured (seconds per hyper-seconds), but there seems to be no need to postulate an entity like a hyper-time. (There is still something odd about movement in time even if it is said, as it might be, that the hyper-time has an order but no metric. This would rule out talk of ‘seconds per hyper-seconds’, but it would not affect the fact that change in time would still be a change in hyper-time. Moreover, anyone who thought that time-flow was necessary for time would presumably want to say that hyper-time flow was necessary for
hyper-time. He would therefore be driven to postulate a hyper-hyper-time, and so on without end.) (Smart, 1963:136)

Damascius’ solution of the puzzle relies on drawing an analogy between the spatial and the temporal case. He comments:

[I]n general, if we try to find measures of measures we shall go on without limit, taking as the measure of the yard-measure another yard-measure ... If those ideas are absurd, where each thing is able to share its own special nature with others that require it, but does not need to share in the very thing which it itself is, that too is an absurdity ... So it is not necessary that time should pass away in time, nor the now in the now. For in the flow of time the occurrence of the now is being seen against the background of some conceived rest. But how, if time has its being in becoming, being itself in process, will it avoid needing a time to measure and order the parts of time, so that they do not pile up on each other? Surely time is in process in this way, as accompanying process as the measure of process. For even the yard-stick is distinct from what it measures, remaining in its true nature as a measure and not needing anything to measure it. (Simplicius, 1882:800; 1992a:123–124)

The underlying argument is that if you thought that a flowing time needs another time to exist (etc.) you should think that a space needs another space to exist in order to have a particular magnitude (etc.), but that is absurd. However, the point is put in terms of measurement. To measure a flowing part of time, say the time taken by a dance, all you need is a uniformly flowing thing, say the movement of the sphere of the fixed stars. You do not need to measure the movement of the sphere of the fixed stars by yet another flowing thing. It is identical in magnitude to itself. If you thought you did need another flowing thing, you should think that something that is used to measure a portion of space needs another thing to measure it, and so on to infinity. To think that an adequate measure always needs something quite different to measure it is absurd. Rate of flow is not importantly different from spatial magnitude.

Why does Damascius think we are tempted to fall for a fallacy in the temporal case, but not in the spatial one? The answer seems to be contained in the brief remark “[F]or in the flow of time the occurrence of the now is being seen against the background of some conceived rest”. I think this remark is badly translated by Urmson. I would translate it as: “[F]or the reality (hypostasis) of the now is perceived (theoreitai) in the flow of time in relation to (kata ton opianoun) an underlying rest in thought (hyponoomenin stasis)” (Simphilicus, 1882:800). Hyponoomenin is a puzzling word. It is not in the standard dictionary LSJ and a search on TLG seems to show it to be the only passage in which it occurs in the entire Greek corpus. However, in an earlier passage Simplicius quotes from Damascius, Damascius uses the related word epinoian to mean “in thought” [but not in reality] (Simphilicus, 1882:798; 1992a:120). What I think Damascius has in mind in the passage above is that we measure time by the flow of something against a background of rest and this leads us to think that we can only

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5 Sorabji translates this line as “For the reality (hypostasis) of now is seen in the flow (rhusis) of time against some presupposed rest whatever it may be” (Sorabji, 1983:60–61).
make sense of the flow of time against some hidden background of rest. However, the measure of time is not time.\(^6\)

To understand this point think of how Philoponus says we measure time. We divide the movement of the sphere of the fixed stars around the earth into parts. How do we do this? In Philoponus’ and Damascius’ time, we would do it by checking when particular stars or parts of constellations are at points on the immobile horizon. Like Philoponus, Damascius seems to assume that the only rational accurate measure of time will involve uniform celestial movement against a fixed background. Damascius’ underlying point seems to be that we use a metaphor of flow that makes us think of something like a river that flows past a static riverbank because of the way we measure time. If we follow through the metaphor literally, there would have to be a second order time (to measure the rate of flow of time in relation to the riverbank). But that is only a metaphor. Becoming is only like the flow of a river to some degree.

A useful analogy here might be that light is a wave. For many years, scientists like Maxwell thought that if light is a wave that transmits heat etc., it must be like water and sound waves and propagate in a particulate mechanical medium, the ether. Maxwell regarded this as obvious (Maxwell, 1864:528). But it is not a necessary truth about light waves that they require a particulate mechanical medium. A famous experiment by Michelson and Morley showed that light is a wave that can propagate in a vacuum. It does not require a particulate mechanical medium. The “wave” metaphor for light is only partially accurate.

It is common for modern advocates of static theories of time to argue that we misperceive things and that in fact things are really space-time worms in a static space-time, though perception of time involves representing it as flowing (e.g. Smart, 1963:131–151). Damascius’ view is the opposite. It is making time necessarily involve something static that involves an illusion produced by human perception. We wrongly slip static elements into the understanding of time because of how we measure time.

**Time is not a separate dimension**

Let me add something here. Despite the talk of a flowing now and of becoming, buried in Damascius’ response to the third puzzle is the assumption that there is not a time dimension flowing at its own rate. In principle, you could pick anything that has a uniform rate of change and use it to measure the rate of other changes, and you would have time relative to that. It happens that only spheres in the heavens have a

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\(^6\) As Damascius is a neo-platonist, he is also committed to the claim that a “static” form of time exists in the world of the eternal forms. However, this is not what he is referring to in this argument by speaking of an “underlying rest in thought”. If it were, it would be difficult to make sense of the emphasis on this world measurement in his reply. Further, the central subject of the passage Simplicius quotes is clearly the kinds of things that have their being in becoming, like time (Simplicius, 1992a:120–121). In any case, I am here interested not in Damascius’ overall view, but in what someone with a dynamic view of time could use from Damascius.
uniform rate of change and that the movement of the sphere of fixed stars is the most convenient standard to use. The relations between the changes in movement between the sphere of the fixed stars and the changes in other processes are real, and the nows we mark out in thought can be coordinated with nows in other events. However, to think that time as such is really a thing that flows is to make a mistake. We cannot make sense of the claim that a separate dimension of time flows at a particular rate. Things “become” or change at different rates. Kittens become adult cats faster than babies become adult humans. One heavenly sphere revolves at a different rate from another.

If we follow through Damascius’ argument, perhaps we should be saying that neither the standard dynamic nor static accounts of time are correct, because both assume that time is a dimension with an intrinsic metric. For Damascius, there is only an objective order in time, not an intrinsic metric.7

The dynamic account of time underlying Damascius’ account does not give us an arrow like now of becoming, except in relation to a particular process. If we are to understand Philoponus’ claim that time began in the light of Damascius’ argument, we must understand it to mean that there is a beginning of all changes or processes, whose distance from some other point-like now is to be measured by something that began to move at a uniform rate.

**An objective order in time does not require a hyper-time**

What about Smart’s claim that even an objective order in time requires a hyper-time? Damascius might deny it by using a variant of his spatial analogy argument. There is spatial order, yet no one thinks that hyper-spaces are necessary for spatial order to exist. Perhaps temporal order is, as Aristotle thought, just a brute inexplicable fact about the universe.8

A modern defender of Damascius might respond to Smart by saying that that Special Relativity shows that there is no objective time order of causally unconnectable events. This means that there is no need to conceive of time as a measurement independent dimension. To explain the point briefly: according to the standard interpretation of SR, space-time is absolute, but the time order of causally unconnectable events is not. For these events, time order depends on the frame from which it is

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7 Bradford Skow has recently carefully distinguished the claim that time has an extrinsic metric from the claim that the metric of time is merely conventional (Skow, 2010). As Philoponus and Damascius think that divisions in various processes can be correctly coordinated with divisions in particular uniform processes, their view is not to be confused with conventionalism. Rather, it is a form of relationism about time. (For a brief explanation of the distinction between relationism and substantivalism, see Dainton, 2010:164–181.) Nevertheless, Philoponus thinks the choice of one uniform process rather than another as the key extrinsic metric is a matter of convenience, though it is not arbitrary. He says that we always choose a faster process to measure a slower one, just as we choose a cubit to measure ten cubits (Philoponus, 2011:11).

8 For a brief discussion of Aristotle on simultaneity and order, see Coope, 2004:4, 113–114.
measured. Two events can be simultaneous in one frame, and one can be before the other in another frame. We could go further. For instance, on one interpretation of SR, space-time and the space-time order of causally unconnectable events, are merely mathematical artifacts. On this account, for causally unconnectable events, there is only order relative to a frame (Smith and Oaklander, 1995:165–184).  

How Philoponus could adapt Damascius

I will now turn to showing that Philoponus' account of time would allow him to produce Damascius' response to the third puzzle. Philoponus defends the view that “time is number not as measuring, but as measured”. In his discussion, he distinguishes two senses in which things can have a number. In the first sense, a group of things can have a number independently of any convention. For instance, ten horses have a number because they are ten separate things of the kind “horse” in some place. In the second sense, a continuum can have a number because it has the potential to be divided by us into parts. He comments, “So in those cases, continuous is predicated by nature, but number by convention, and on the basis of our conception”. Philoponus explains how time can both measure movement and be itself measured by movement “if one of two pieces of wood lying side by side with each other gets measured, one would say that the measured one also measures the one lying alongside; for whatever the size of the one, that is the size of the other. In this way, then, we say that time too measures movement, because they are together with, and stretch alongside, each other. So, necessarily, whatever the size of the one, that is the size of the other” (Philoponus, 1887:724; 2011:27).

In a later discussion, Philoponus qualifies his remark. He points out that a bushel of grain is measured by a standard of measurement provided by a bushel of grain, but it can be a different bushel that has made it a standard. However, he says that “... with time one cannot say this. For it is not the case that first the movement has been measured by the time and then it reciprocally measures the time. Instead they are reciprocally apprehended together like relatives. So just as together and by the same token the father owes being father to the son, and the son being son to the father, and similarly with right and left, just so are time and movement determined by each other ... Thus it is both the case that movement owes its being this-much to time (since time is the number of it), and the case that the time's being this-much comes from no

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9 It is possible to go even further while remaining consistent with SR. Hans Reichenbach and Adolf Grunbaum have argued with some plausibility that, within limits, we decide by convention which causally unconnectable events are simultaneous. On their account, even relative to frames, there is no fact of the matter about the simultaneity of causally unconnectable events (Reichenbach 1958:123–135, Grunbaum, 1964:3–65). Reichenbach and Grunbaum's view has been challenged but the debate continues (Janis, 2014). For a detailed and well worked out argument that the existence of space-time is the best explanation of the truth of the equations of Special and General Relativity, see Nerlich, 2013. If Nerlich is right, Philoponus' view of time is on the wrong track, though it may well have been plausible before the discovery of Relativity. The debate on Nerlich's arguments has only just begun.
other source but movement. For if <movement> were not, time too would not be, just as, if time (by which I mean number of movement) were not; movement too would not be; for movement is something numerable” (Philoponus, 1887:742; 2011:48).

We can see from these remarks that Philoponus thinks that there is a central difference between time and space. As is well known, he produced a highly influential critique of Aristotle’s strange relationist account of space and argued that space is three-dimensional extension; something essentially independent of the bodies it contains (Philoponus, 1887:567–585, 675–695; 1991:28–73). Indeed, Sedley asserts that Philoponus’ arguments against Aristotle on space and the void “are outstanding contributions in their own right, and major landmarks in the history of science” (Sedley, 2010:182). This explains why he thinks another bushel can be used to measure a bushel. The volume of a bushel is independent of any measure we use. It exists in its own right. By contrast, the size of the time gap between two events is not measurement independent. Its size is dependent on the uniform process that is used to measure it. Of course, we have to pick a uniform process, and uniform processes can be coordinated with one another; but there is no fact of the matter about the size of the time gap between two events independently of the relation between it and the uniform process we use to measure time.

There has been a debate as to whether Aristotle’s account of time suffers from a vicious circularity. After all, if motion is change of place over time, it looks like time cannot also be defined in terms of motion without risk of vicious circularity. Tony Roark has recently argued that to understand how Aristotle avoids circularity in his account of time, we need to understand that Aristotle defines change/motion (kinesis) as fulfilment of a potentiality. As there is no reference to time in that definition, Aristotle can avoid circularity (Roark, 2011). Philoponus seems to want to challenge the claim that there is a vicious circularity in interdefinability. Philoponus’ allusion to right and left and father and son are intended to show that motion and time are interdefinable, but that this does not lead to any vicious circularity. Given Philoponus’ view of space, the right and left analogy is perhaps not the most perspicacious. However, his point is simply that right and left are clearly defined by relation to each other, as well as by reference to a thing and a facing direction. Consider my head facing towards my nose. One of my arms is now my left and the other my right. By contrast, consider the position of my head facing towards my hair. What was previously my left arm is now my right arm. The father and son example is clearer if we leave aside the male chauvinist assumption that daughters are not children. I cannot pursue the issue in detail here, but Philoponus’ line of argument is worth pursuing.

It may seem odd to us that while Philoponus is willing to challenge the prevailing Aristotelian account of space, he is happy to accept an Aristotelian account of time.

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10 In a passage which is otherwise similar to Philoponus’ discussion of the bushel, Simplicius does not distinguish spatial from temporal measurement, perhaps because he is a relationist about both space and time (Simplicius, 1882:733; 1992b:143).
in which time is identified with a feature of uniform movement. The reason is that whereas we have got used to thinking of time as a space-like dimension that exists independently of motion, he does not think of time as being that sort of thing at all. Does this mean that Philoponus’ account may well have been plausible at the time but has been shown to be fundamentally mistaken? Is Philoponus’ view of philosophical interest only in showing us how we can be deeply misled in our thinking about time by focussing too much on how we measure time? As I have suggested at various places in this paper, we should not think of Philoponus’ account as one that cannot be reconciled with modern science. Rather, we should take it seriously as an account that might be integrated into modern science if we question our customary habits of thought.

**Conclusion**

We can see that Philoponus has important insights into how to escape problems with dynamic “gunk” theories of time. Whether Philoponus’ dynamic “gunk” theory is ultimately defensible will depend on developments in physics and mathematics. I hope I have provided enough arguments to show that that theory should be taken seriously. In this way, I have shown that one of the background premises in Philoponus’ argument for a beginning of time is not incoherent or absurd.

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