to appear in R. LePoidevin, et al., eds., Routledge Companion to Metaphysics

The Passage of Time

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1. Dynamic and Static Views of Time

Time involves a kind of movement or activity. It does not stand still. It waits for no man. Sometimes it even flies. Poets liken time to a river, bringing fresh events and sweeping away old ones. Time is always passing.

The prosaic content of these sayings is that events change from future to present and from present to past. Your next birthday is in the future, but with the passage of time it draws nearer and nearer until it is present. 24 hours later it will be in the past, and then lapse forever deeper into history. And things get older: even if they don't wear out or lose their hair or change in any other way, their chronological age is always increasing. These changes are universal and inescapable: no event could ever fail to be first future, then present, then past, and no persisting thing can avoid growing older. We call this process time's passage.

Passage is unique to time. It marks an essential difference between time and space, which are in other ways similar. Space doesn't pass. Things can move in space, but they can also stay put: there is no universal process of spatial change analogous to chronological aging or events changing from present to past.

So it seems, anyway. But time's passage is something of a mystery. Many philosophers see it as an illusion. Things can change in size or shape or temperature, they say, but nothing changes in any purely temporal respect, by becoming older or further past. Change takes place within time, but time itself doesn't change. Time merely separates events temporally, as space separates them spatially. This is the static view of time. The dynamic view, by contrast, says that time really does pass: the world is caught up in a process of purely temporal change.

For the past hundred years or so, the debate between the static and dynamic views has been the central battleground in the philosophy of time. Most of this chapter is about what the two positions come to and where the disagreement lies. The last two sections are about who is right.

2. Passage and Tense

Time's passage follows from its division into past, present, and future. It seems, at least, that not all times are equal. One time--the present--is special. It may not differ in

its content from the past or the future: history may judge the present entirely unremarkable, in that the same sorts of things go on now as before and after. But even if that is so, the present time and current events differ from non-present ones in a purely temporal way: they are going on now.

If we think of the whole of time spread out from earlier to later, we naturally imagine a boundary separating those times and events that are over and done with from those that are still to come. That boundary marks the present. But it doesn't stay where it is. Once it was in the Cretaceous period; later it was at 1640; now it is in the 21st century. It moves constantly towards the future, and very future event will one day coincide with it. The movement of this boundary is the heart of time's passage. If the boundary exists, its location must change, and the status of events as past, present, and future must change with it. The dynamic view will be true.

Of course, time's passage cannot literally be a kind of movement. Movement is change of spatial position, and the present can 'move' only in time. It is at best a metaphorical sort of movement, akin to the rising of temperatures or prices. (Kinetic metaphors are common enough: think of 'The Government is moving to the right on crime.') The literal truth is simply that times and events change in their temporal direction and separation from the present.

So the division of times into past, present, and future leads to the dynamic view. We can see this in another way by reflecting on what philosophers call tense concepts (or 'A-concepts'): past, present, future, and their more determinate forms such as yesterday and next week. They are by nature evanescent, and apply to things only temporarily. What is future cannot forever remain so, but must become present and then past. What is past always remains past, but its degree of pastness changes, from being only yesterday to being a month ago, and so on. Age is also a tense concept: to say that someone is 100 years old is to say that she was born 100 years in the past. And age too is evanescent. I can't remain 100 years old forever: within a year, if I'm still alive, my age must advance to 101. These changes are time's passage.

3. The Tenseless Theory

At this point things get more difficult. I have made the dynamic view sound like an obvious truism. Surely some events and periods of time are present; and none of them can avoid changing by becoming past. That change makes the dynamic view true. But then how can anyone seriously deny the dynamic view? It looks as if friends of the static view must say either that nothing is present (or past or future), or that some things are present, but they never become past. Neither option looks tenable. If nothing were present, why would we use clocks? Isn't their purpose to tell us what time is present?

And no one can believe that your reading of this chapter will always be in the present. To reject the reality of time's passage, it seems, is to deny the reality of time altogether. Call this the basic challenge:

1. Some times are present.
2. Whatever is present will one day become past.
3. Thus, times change in respect of their presentness,

contrary to the static view. The static view looks incredible.

Friends of the static view have a subtle and ingenious reply to this objection. They say that if 1 is understood as the dynamists understand it--as implying that the the 21st century differs from other centuries in that it alone has the property of being present--then it is false. But there is another way of understanding 1, and 2 as well, according to which they are true, but do not imply 3, making them compatible with the static view. If the reality of time's passage sounds like a truism, that's because we have understood 1 and 2 as the dynamists do. But there is room for debate about whether this understanding is right.

Friends of the static view deny that the 21st century differs from other centuries in that it alone is present. Times and events do not have such properties as being present or being past. There are no such properties. Tense, like passage, is unreal. All times, as times, are equal. This is the tenseless theory (or 'B-theory') of time. It is a natural ally of the static view.

The tenseless theory may appear to contradict 1, but it needn't. Tense can have a legitimate place in the content of our thought and talk, even if it is not a feature of temporal reality. The tenseless theory does not make it wrong to say that the 21st century is present. We can still call it present insofar as it is our century. Other centuries are present for others: for Descartes, the 17th century is present and the 21st century is in the future; and his temporal perspective is just as valid as ours. From the perspective of each time, that time is present, and earlier times are past and later ones are future. But no time is just plain absolutely present. There is no uniquely correct way of dividing times into past, present, and future.

This makes the current century's 'nowness' analogous to the 'hereness' of the earth. The earth is here for us, but far away for the Martians; and again, our perspective is not privileged. Every place is 'here' at that place, but there is no absolute division of places into here and there. There is no such property as hereness, that some places have and others lack. All places, as places, are equal. Yet it is no mistake to say that the earth is here. The word 'here' (without a pointing gesture) simply refers to the speaker's

location. In the same way, on the tenseless theory, the word 'now' refers to the time when it is uttered, written down, or thought. So the fact that you are now reading this chapter is not the fact that your reading takes place at the one moment of time that is absolutely present, but simply that your reading takes place at the time when you say or think: I am now reading this chapter.

4. The Reducibility of Tense

These remarks suggest a way of eliminating tense from our thought and language. Your thought that you are now reading this chapter is true just in the case that it takes place during your reading. 'Takes place', though grammatically present tense, is logically tenseless here, for the statement tells us nothing about where your reading is located relative to the present. (It's like saying that the Taiping Rebellion takes place in the 19th century.) And during, like before and after, is not a tense concept: what happens during or before or after what never changes. So we can say what makes it true that you are now reading this chapter in tenseless terms. Likewise, if I had a bath two weeks ago, we can describe this fact without tense by saying that I have a bath two weeks before the time of my writing this.

The basic rules are something like this:

> To say, at a time t, that x is present (or past, or future) is to say something that is true if and only if x is located at (or before, or after) t;
>
> To say, at a time t, that x is now F (or was F, or will be F) is to say something that is true if and only if x is F at (or before, or after) t;

where the final verb in each case is untensed. If these rules are correct, then tense concepts and words are eliminable in the sense that we can say all there is to be said, or describe all the facts, without them. This doesn't mean that we ought to stop using words like 'now'. The word 'here' is also eliminable, in that we can describe all the facts without it--there are analogous elimination rules for statements such as 'it's wet here'--yet 'here' remains a useful word. Nor is the claim that our tenseless paraphrases have precisely the same meaning as the originals. It is merely that we can give the truth conditions for all statements in tenseless terms. Call this claim the reducibility of tense.

It is easy to see why the reducibility of tense goes together with the tenseless view. If the world is in itself tenseless, then we should expect tensed statements to be made true (or false) by tenseless facts, since those are all the facts there are; and it ought to be possible to describe these facts in tenseless language. Those tenseless descriptions will

then give the truth conditions for the tensed statements. Conversely, if we can give tenseless truth conditions for tensed statements, we should expect the reason to be that the world is in itself tenseless.

Now recall the basic challenge: obviously some times are present, and whatever is present will one day become past; and this becoming past looks like precisely the sort of purely temporal change that the static view denies. But if we restate these obvious facts in tenseless terms, they no longer appear to imply any sort of temporal change. Our tense-elimination rules suggest that if we utter 1 and 2 at t, their truth conditions are these:

1*. Some times are located at t.
2*. For anything located at t, some time later than t is after it.

And although 1 and 2 may seem to imply that times change in respect of their presentness, 1* and 2* do not. They don't describe any sort of change at all. So if tense is unreal and therefore eliminable, the premises of the basic challenge are perfectly compatible with the static view. We can use tensed language, and have tensed beliefs, without committing ourselves to the reality of time's passage. The static view does not deny the obvious.

5. The Tensed Theory and the Dynamic View

We began with time's passage, then moved to tense properties: presentness, chronological age, and so on. We can see now more clearly how these two themes intermingle. The static view rejects time's passage by denying that anything changes in its tense properties. In that case, we saw, there can be no tense properties in the world, for otherwise things would have to change in respect of them. So the static view entails the tenseless theory. This led in turn to the reducibility of tense, the claim that all statements have tenseless truth conditions.

The converse also holds: the tenseless theory entails the static view. If there are no tense properties in the world, there can be no purely temporal change. Suppose the Taiping Rebellion is past in 2020, present throughout 1852, and future in 1640, and that facts like these are all there is to say about its pastness, presentness, and futurity. (Likewise, my being 100 years old in 2008, 150 in 2058, and so on is all there is to say about my age; I have no age simpliciter.) Because events never change in respect of whether they are past, present, or future at a given time, there is no purely temporal change that they could undergo, and therefore no temporal passage. The only temporal property in respect of which something could change would be a tense property such as

being present--not present at some time, but present simpliciter. So the static view is true if, and only if, the tenseless theory is true.

Dynamists, by contrast, reject both the reducibility of tense and the tenseless theory. They deny that 'now' is analogous to 'here', and that tensed statements have tenseless truth conditions. They say that tense is woven into the fabric of temporal reality and not merely into the content of our thought and language: time is in itself divided into past, present, and future, and this division is in no way relative to times or observers. This is the tensed theory (or 'A-theory') of time. If time's passage is real, there must be such properties as absolute presentness in respect of which things change: the dynamic view entails the tensed theory. And here too the converse holds: if there is a real and absolute division of times into past, present, and future, its location must change, and there will be genuine passage. So the dynamic view is true if and only if the tensed theory is.

6. Dynamic and Static Omniscience

I have described two pairs of views: the dynamic view and tensed theory, on the one hand, and the static view and tenseless theory on the other. We can make this distinction more vivid by imagining an omniscient being. (To avoid certain complications, imagine her entirely detached from the world--not located anywhere in space or time, or at least not in our space or time.) She will know all the facts about the arrangement of objects and events throughout the whole of time: all about the roamings of the dinosaurs, the oil wars of our own age, the melting of the polar ice caps, and so on, and how these events relate to one another. Yet according to the tensed theory, she is not truly omniscient unless she also knows something else, namely which of these things are going on now, and which are past and which are yet to come. Otherwise her knowledge will be incomplete. And because what is present constantly changes--as the dynamic view has it--she cannot know this once and for all, but must constantly update her beliefs. She must know that you are now reading this sentence. But because that is true only for a moment, she must immediately reject it and start believing instead that you are now reading this sentence. And so it goes. If time's passage is real, omniscience would be a never-ending task.

On the tenseless theory, by contrast, our omniscient being needn't know any temporal facts beyond what happens at what date. She needn't know what events are present, any more than she must know what place is here. She needs no tensed beliefs because there are no tensed facts. And because the tenseless facts don't change--as the static view has it--she has no need to update her beliefs. She can know everything once and for all.

7. Why Does Time Seem to Pass?

I hope it is now clearer what the debate between the dynamic and static views is about. In the space remaining I will lay out a fragment of this debate. First a challenge for the static view.

The static view says that time does not really pass, and the tenseless theory says that there is no absolute difference between past, present, and future. Defenders of this position have some explaining to do, because this is not how things appear. They need to explain why time seems to pass. They also need to say why the present seems to differ, as such, from other times, and why the past seems to differ from the future. And they will want to say what, if not passage, could distinguish time from space. How would a static time be anything more than just another spatial dimension?

Defenders of the static view say that time seems to pass because we need to change our tensed statements and beliefs in order to avoid error (Mellor 1998: 66). Suppose I say, correctly, that today is Monday. It would be wrong for me to say that yesterday, or tomorrow. The need to change what we say about something to remain correct ordinarily implies that whatever we're talking about is changing. If I need to change what I say about the temperature, then the temperature must be changing. So the need to change what I say about what day is present suggests that days change in their temporal properties--from being tomorrow to being today to being yesterday--in which case time really does pass.

But we can explain the need to update our tensed statements without positing time's passage. According to the reducibility of tense, my statement that today is Monday is true if and only if I make it on Monday. That explains why it's wrong to say it on Tuesday. Not that my statement changes from true to false; rather, what I say on Monday is different from what I say on Tuesday, even though I express both in the same words. Compare: if we both say, 'I am Eric Olson', we say different things, one false and one true.

Why does the past seem to differ from the future? For instance, what explains why we plan for the future but not for the past, and remember the past but not the future?

According to the static view, the apparent fact that we plan only for the future is really the fact that we plan only for times after our planning. This is due to the temporal asymmetry of causation: causes always precede their effects. This means that the effects of our planning will always occur after we make those plans. Since there is no point in planning for something we cannot affect, we plan only for what comes later. (The related fact that the future is 'open' and the past 'fixed' is really the fact that, at any time, we can affect only what happens after that time.) Memory, too, is a causal process:

the memory of an event is an effect of it. So the apparent fact that we can remember only the past is really the fact that we can remember only things that occur before we remember them. This is all compatible with the static view, for what events occur before and after others never changes.

Why does the present seem different from other times? Why do we so naturally think of time as divided absolutely into past, present, and future? Well, the apparent fact that the present moment is special is really the fact that any time seems special at that time. This too is because of the temporal asymmetry of causation: the fact that at a given time we can affect only later events and remember only earlier ones, for instance. When you ponder the nature of the present, this temporal asymmetry gives the illusion that the time of your pondering is unique.

If there were a causal asymmetery in space, it would mislead us in the same way. If it were a law of nature that light never travelled southwards, everything to the south of you would appear bright during daylight hours, while to the north you would see only darkness. Your latitude would appear unique: it would seem to be the boundary between the illuminated part of the earth and the dark part. If you moved north, the darkness would seem to recede, so that more of the earth became bright. The boundary would appear to move, as if the dawn were following you. But this would all be an illusion. In reality there would be no boundary between the bright latitudes and the dark ones. They would all be equally bright. Nor would the overall pattern of illumination change as you moved. It is the same with the present.

If there is no such property as presentness, then clocks don't tell us what time has it. So what do they tell us? Looking at a clock tells you the time of your looking. Suppose you want to catch the noon train. Then each glance at the clock tells you how long that glance is before (or after) noon. So if the clock says 11:55 as you look at it, you can infer that your train leaves five minutes later, and act accordingly. That's what makes clocks useful.

What distinguishes time from space, if not time's passage? We have already noted that causes always precede their effects in time. Space has no such asymmetry: despite my imaginary story about light never moving southwards, causes can be equally above, below, north, south, east, or west of their effects. (Why time and space differ in this way is a good question, but they do.)

Another difference is that space, but not time, can have more than one dimension. Space has at least three dimensions; but there could not be a three-dimensional time.

We measure time and space differently--time with clocks, space with metresticks. And they come in different units: time in seconds, space in miles. This difference is no mere convention, like the fact that we measure roads in miles and racecourses in

furlongs. There is no non-arbitrary conversion from miles to seconds, as there is from miles to furlongs: we can't ask how how many seconds long the Great North Road would be if its length were in time rather than in space. Time and space are simply different quantities, like mass and temperature.

More generally, time and space play different roles in physics. Power, for instance, is work divided by time, not distance: a powerful engine is one that can do a lot of work in a short time. The second law of thermodynamics says that the overall entropy or disorder of a closed system is greater at later times than at earlier ones--that's what makes it so hard to get spilled wine back into the bottle. No law of nature says that entropy is greater in one place than another. Swap temporal variables for spatial ones in physics and in most cases you get nonsense.

None of these differences appeal to temporal passage.

8. How Fast Does Time Pass?

Finally, a problem for the dynamic view. It says that things change by becoming older or less future or more past. Now if a thing gets older or less future, it does so by a measurable amount: by a certain number of years or hours or seconds. And every such change takes a certain amount of time to occur. It follows that we can ask at what rate this change takes place. If a thing's temperature increases, it must increase at some rate: by a certain number of degrees per second. Just so, if my birth becomes more past, it must do so at some rate: by a certain number of seconds in a second. What is this rate?

Only one answer seems possible: time passes at one second per second--or some equivalent rate, such as sixty seconds per minute or twenty-four hours per day. I must get older by one second for every second I remain in existence. Time could not pass at two or at seventeen seconds per second.

This is odd. For one thing, the rate of any other change can increase or decrease: temperatures or prices, for instance, can rise faster or slower. But the rate at which time passes would be unalterable. For another, when something changes in any other measurable quantity, we can measure its rate of change; but we cannot measure the rate of time's passage. Clocks measure the amount of time separating two events, but they don't tell us at what rate that time elapses. For that we should need a chronological instrument analogous to a speedometer, and no such thing seems possible. In the passage of time a measurable quantity changes at an unmeasurable rate. If nothing else, time's passage would have to be radically different from any other sort of change.

But the real problem with time's passing at one second per second is that this is not a rate of change at all (van Inwagen 2002). One second per second is one second divided by one second. And when you divide one second by one second, you get one. Not one

of anything, just one. Dividing anything by itself, apart from zero, gives you one. Sixty seconds per minute and twenty-four hours per day are also one, because sixty seconds is equal to one minute and twenty-four hours is one day. And one is not a rate of change. A thing can change at a rate of one mile per hour or one degree per second, not at a rate of one. 'One' cannot answer a question of the form 'How fast...?', but only a question of the form, 'How many...?', or 'What number...?'. If we ask how many pigs are in the sty, 'one' is a possible answer. But if we ask at what rate a certain process of change goes on--how fast the temperature is rising, say--the answer cannot be 'one'. Just so, if we ask at what rate things grow older, 'one' is simply not an answer. So the dynamic view implies that time must pass at a rate that is not a rate, and that is impossible.

Dynamists need to argue that this reasoning is mistaken. They might say that one second per second really is a rate of change, even though it is equal to one (Prior 1968: 37). Or they may argue that time passes without passing at one second per second--perhaps at no rate at all (Markosian 1993). But neither response looks promising (Olson 2008).

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