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RATES OF PASSAGE

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That time flows or passes seems to be among the most obvious and inescapable of truths, yet there is an entire camp of philosophers who deny it—upholders of what is variously called the static theory of time, the eternalist theory, the four-dimensional theory, or the B theory.[1] There is an initially compelling argument for their position, expressible in a pair of rhetorical questions: If time passes, must there not be a *rate* at which it passes? Yet what could that rate possibly be? The very idea of such a rate seems nonsensical or absurd. To make sense of it, we would evidently need to posit a hyper-time in which ordinary time passes, but the notion of hyper-time, besides being mystifying by itself, seems to be but the second step in a preposterous infinite series of time dimensions, hyper-hyper-time and so on up.[2] My aim in this paper is to defend the man in the street's dynamic conception of time by answering this simple yet forceful argument. The sections are as follows:

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[1] For a run-down of various related "isms" and the various names in play for them, see Sider 2001 or the introduction to Gale 1967. I have taken the term 'dynamic theory' from Gale.

[2] Proponents of the argument include Smart 1949 and Williams 1951. An excellent presentation and critique of the argument (about which I have a good deal to say below) is Markosian 1993. Markosian notes that there are two other principal arguments against the passage of time: McTaggart's famous argument of 1908 and the argument based on Einstein's theory of relativity. I have had my say about these other two arguments in Van Cleve 1996 and 2011 n.d.

1. Markosian and Prior on the passage of time

What does it mean to say that time passes? In this section, I outline a lavish answer given by Ned Markosian and the more austere answer given by Arthur Prior.

Markosian tells us that what he means by the passage of time may be summed up in three tenets: the tensed view of propositions, the A-property thesis, and the pure passage of time thesis (1993).

Tenet 1, the tensed view of propositions, says that propositions do not have their truth values *simpliciter* or eternally, but have different truth values at different times. The proposition *I am sitting* is true now, but was false a minute ago as I rose to answer the phone. This contrasts with the view of Russell and others, according to whom *I am sitting* is an incomplete proposition, requiring supplementation by a date and becoming true or false eternally once a date is supplied. Proponents of the tensed view say instead that tensed propositions are complete as they stand and may change in truth value with the passage of time.

Tenet 2, the A-property thesis, says that there really are the properties McTaggart called the A characteristics—monadic properties of being past (to some degree or other), present, and future (to some degree or other) (1927, chapter 33). Furthermore, such properties are not analyzable in terms of the relations McTaggart called the B relations, such as earlier than and later than. ‘My operation is past’ is not to be analyzed (for example, á la Smart 1949) as ‘My operation lies earlier on the time line than my utterance of these words’.

Tenet 3, the pure passage of time thesis, says that the various A characteristics are successively exemplified by events and times. The dropping of the ball in Times Square at the stroke of midnight on January 1, 2020, is now future, will become less and less future until it becomes fleetingly present, and will then become ever more past. The same things will be true of the year 2020 itself and all the days, hours, and minutes it contains: thus it is quite literally true that time passes.

Markosian observes that no analogs of his three tenets are true of space. He also argues that the first of the three tenets, the tensed view of propositions, entails each of the other two.

In my view, the second and third of Markosian's tenets are *not* implied by the first and are actually optional for a believer in dynamic time. To explain why, I turn now to the views of Arthur Prior, my master in most matters in the philosophy of time. Prior would be on anyone's list of champions of dynamic time, but he would also repudiate the second and third of Markosian's three tenets.

Prior does accept Markosian's tenet 1, the tensed view of propositions. Indeed, he is the pioneering figure in tense logic. But he does not accept Markosian's tenet 2 or the claim that tenet 1 implies tenet 2. In Prior's system, tenses are *substitutes* for the A properties, not equivalents of them.

In Prior's logic of tenses, tenses are represented by sentential operators (or adverbs, as he sometimes classifies them), placed in front of sentences just as modal operators are. Instead of inflecting the verb, as in 'John walked to the store', we may say 'it was the case that John walks to the store'.[3] 'Pp' is read as 'it was the case that p' and 'Fp' is read as 'it will be the case that p'. There is no need for a present tense operator, as the present

[3] I have learned of one natural language—was it Hebrew?—that actually handles tense this way.

tense is the default tense. (For these and other aspects of Prior's tense logic, see his 1967.)

Tense operators can be specific or metrical as well as generic or qualitative. We can say not merely that it was the case that p, but that it was the case three days ago that p, conveying the extra information in a subscript: P_3p. We may also introduce 'Hp' ('it always Has been the case that p') as an abbreviation of '~P~p' and 'Gp'('it is always Going to be the case that p') as an abbreviation of '~F~p'.

Placing an operator in front of a sentence is significantly different from attaching a predicate to a subject, but many philosophers are insensitive to the difference. For example, many philosophers use 'it is true that p' and 'that p is true' interchangeably. That is harmless if done solely for stylistic convenience, but not if done in the belief that the two locutions are on a par ontologically and ideologically. As for the ontological difference, the second carries ontic commitment to propositions or truth bearers that the first does not. As Prior likes to say, the commitments of 'it is true that p' are simply those of 'p'—as it might be, grass, if the instance of 'it is true that p' is 'it is true that grass is green'. (See 1962, p. 15). As for the ideological difference, with truth and falsity as predicates, you can formulate the liar paradox; with truth and falsity merely as operators, you cannot.

The three (generic) tenses and the three (generic) A predicates are often spoken of as though they were interchangeable, perhaps because both may be expressed by the terms 'past', 'present', and 'future'. They are not equivalent, however, or even of the same syntactic category, as the general distinction between operators and predicates carries over to tense operators and A predicates.[4] Tenses are a way of doing without the A predicates, not just another name for them.[5]

The widespread indifference to the distinction I have just been drawing—between tenses and the A predicates—is reflected in the fact that philosophers who take tense seriously are often called "A theorists." If you insist on using the term this way, you should recognize that Prior is an A theorist who does not believe in A properties.

If Prior does not believe there are A properties, then of course he does not believe that A properties are exemplified by events and times, as claimed in Markosian's tenet 3. But even if he did believe there are A properties, he would not believe they are successively exemplified by events and times. This is so for three reasons.

First, because there are no such entities as *times*. A time, presumably, is a sliver of Time—a piece of that vast all-pervasive substance housing or carrying all events and things. Newton believed there was such a thing, but Leibniz believed that "time" was nothing over and above the things said to be "in" it. Prior is a Leibnizian rather than a Newtonian about time. The distinction between static and dynamic time is orthogonal to the distinction between substantival and relationist time, so the dynamic view should not be formulated in such a way that it has the substantival view built in.

Second, because there are no such entities as *events*. Prior is a no-event ontologist. When we say 'the marriage of Tom and Sally occurred two days ago', that is really just an inflated way of saying that Tom and Sally married each other two days ago. In the

[4] I must complain, therefore, about Hinchliff's using 'tenses' as another name for the A properties in his otherwise excellent 2000.

[5] To the detriment of his philosophy of time, McTaggart had the opposite view. It is an essential premise in his argument against the reality of time that tensed discourse is reducible to A-predicate discourse. For example, "When we say that X will be Y, we are asserting X to be [tenselessly] Y at a moment of future time" (1927, p. 21).

latter way of putting it, the subjects of the sentence (and therefore the only entities to which the sentence is ontologically committed) are Tom and Sally. "What looks like talk about events is really at bottom talk about things." (1962, p. 16).[6]

This second point answers an objection some readers may have had to the first—that times need not be thought of as primitive entities or pieces of Time, but may be construed as classes or conjunctions of simultaneous events. In Prior's complete scheme of things, time reduces to events and events themselves reduce to things.

Third, because even if there were such things as times and events, none of them would exemplify the A-properties of *pastness* and *futurity*. That is because Prior is a *presentist*. Nothing exists but what exists at present, and nothing can have a property if it is not there to have it. We should not speak, therefore, of the 2020 New Year's Eve dropping of the ball as becoming less and less future, or of the 2010 World Series as becoming progressively more past. Those events are not around to have those properties. At most one A property is ever exemplified: presentness.

None of this is to say, of course, that the 2010 World Series is a false story or a fabrication of memory. It *did* happen; which is to say that it was the case that a series of games took place settling who could raise the championship banner. The perspicuous way of saying this uses tense operators.

I think it will be worthwhile to expand on two of the points just made about operators and ontology. First, regarding operators and events, consider the following pairs of sentences:

[6] Of course, there are many challenges that need to be confronted here, such as Davidson's argument that we need events to reconstruct inferences involving adverbial modification. For discussion, see Horgan 1978.

1a. If you arrived by noon, you took the train.
1b. Your having arrived by noon implies your having taken the train.

2a. Jack fell down before Jack broke his crown.
2b. Jack's fall preceded the breaking of his crown.

3a. It was the case XX years ago that I am born.
3b. My birth lies XX years in the past.

The first sentence in each pair is constructed using an operator or connective and makes no reference to events or fact-like entities. The second sentence in each pair does make apparent reference to events or fact-like entities and says things about them using predicates or relational expressions. In Prior's view, the second sentence in each pair is merely a stilted paraphrase of the first. We do not need to countenance events or facts in our ontology; we may recast sentences about events (Sir Anthony's retirement occurred a year ago) as sentences about things (It was the case a year ago that Sir Anthony retired).[7]

Second, regarding operators and time, note that tense operators let us express truths about the topological structure of time without committing ourselves to Time as an entity. For example, the way to say, Prior style, that time is dense, is this: $Fp \rightarrow FFp$ (if it will be the case that p, then it will be the case that it will be the case that p). To see how this precludes discrete time, indulge for a moment in the fiction of moments and imagine that Now is the present time and Next is the immediately succeeding time, and that it will be true Next that p but never again thereafter. We have Fp but not FFp, there being no moment sandwiched between Now and Next at which it could be true that Fp. Other topological properties expressible using tense operators are the forwards infinity of time ($\sim F \sim p \rightarrow Fp$), the unchangeability of the past ($Pp \rightarrow GPp$), and the circularity time ($(p \vee Pp) \rightarrow Fp$, for any *p* however detailed and comprehensive) (1967, chapter 4). In Prior's

[7] See my 1996 for further defense of 2a against the Davidsonian claim that to say what we want to say, we really need 2b.

view, such formulae are not true or false in virtue of their being an entity, Time, with a certain structure; they are ground-level truths. This aspect of Prior's philosophy (which we might call his "tense-logicism") comes out clearly in the following passages:

> If taken literally, statements like 'Time will have an end', 'Time is circular', 'Time is continuous', etc., suggest that there is some monstrous object called Time, the parts of which are arranged in such-and-such ways (a common idea is that of a string on which events are strung like beads); and such statements cease to carry such suggestions when they are interpreted as short-hand for statements which do not even appear to mention any such entity, but simply talk about what will have been the case, etc. (1967, p. 75).

> Instants as literal objects, or as cross-sections of a literal object, go along with the picture of 'time' as a literal object, a sort of snake which either eats its tail or doesn't, either has ends or doesn't, either is made of separate segments or isn't; and this picture I think we must drop. (1967, p. 189)[8]

In sum, Prior would accept none of Markosian's talk of events or times passing from future to present to fast as an explication of what it means to say time passes. What, then, *does* he understand by time's passage, and what would he say to questions about its rate?

He begins his article "Changes in Events and Changes in Things" by asking at what rate his birth is becoming more past, and suggests that the answer is simple: "a year per year, an hour per hour, a second per second." (1962, p. 7). He goes on to say a bit by way of defending such strange-sounding rates:

> I've no doubt the ordinary measure of acceleration, so many feet per second per second, sounded queer when it was first used. . . . [I]f we have learned to talk of an acceleration of a foot per second per second without imagining that the second 'second' must somehow be a different kind of 'second' from the first one . . . can we not accustom ourselves equally to a change of 'a second per second' without any such imagining? (1962, p. 9).

[8] Here an analogy with modal logic and the framework of possible worlds may be helpful. A philosopher of Prior's bent would say that a principle such as $\Box p \rightarrow \Box\Box p$ is fundamental, its truth in no way grounded in there being such things as possible worlds and a transitive relation of accessibility among them. It stands on its own, however helpful talk of worlds and relations among them may be as a model or heuristic.

One can get the impression, however, that the ‘one second per second’ answer may not have been his last word, and may instead have been intended facetiously as a dismissal of the question.[9] Before the article is done, Prior develops the ideas about grammar and ontology I have introduced above. He says that problems about time and change arise because many expressions that look like nouns should be replaced by verbs (as when we replace ‘Tom and Sally’s marriage occurred’ with ‘Tom married Sally’) and many expressions that look like verbs should be replaced by adverbs or sentence operators (as when we replace ‘I was eating my breakfast’ by ‘it was the case that I am eating my breakfast’). He also tells us that the idea that time passes is merely a metaphor, to be cashed out in the following way using tense operators:

> For some p, it was the case that p, but it is not now the case that p (Pp & ~p). (1962, p.14)

In other words, a change has occurred. An instance of the formula using metric operators, Prior tells us, is

> It was the case 5 months ago that (it was the case only 47 years ago that I am being born), and it is not now the case that (it was the case only 47 years ago that I am being born). ($P_{5/12}$(P_{47}(I am being born)) & ~(P_{47}(I am being born))).

That is, Prior is no longer only 47 years old, as he was 5 months ago. That is the cash value of the metaphor that his birth is receding into the past. He ends the article by saying that the ‘Pp & ~p’ formula expresses all that is common to the literal flow of a river and the flow of time. He may be read as intimating that questions about the rate of time’s flow no longer arise.

To summarize, the three components of time’s passage set forth by Markosian need not come together in a package deal. Finding tense operators to be indispensable is not

[9] Mark Hinchliff has suggested this interpretation of Prior to me.

the same thing as predicating McTaggart's A properties of anything, and you can believe that time passes in the sense given by Prior's schema Pp & ~p without believing that events or times successively exemplify the various A properties. Nonetheless, in the next several sections, I am going to continue working within Markosian's framework. That will enable us better to appreciate Markosian's own solution to the rate-of-passage arguments, some elements of which may carry over when we shift back to the more austere framework of Prior.

2. Markosian's reply to the rate-of-passage arguments

Markosian formulates two rate-of-passage arguments that he finds in the enemies of passage. In the first, the problem with passage is an infinite regress:

1. If time flows or passes, then there is some second time-dimension with respect to which the passage of normal time is to be measured.

2. If there is some second time-dimension with respect to which the passage of normal time is to be measured, then the second time-dimension must flow or pass.

3. If the second time-dimension flows or passes, then there must be some third time-dimension with respect to which the passage of the second time-dimension is to be measured, and, hence, some fourth time-dimension with respect to which the passage of the third time-dimension is to be measured, and so on ad infinitum.

4. It's not the case that there is some third time-dimension with respect to which the passage of the second time-dimension is to be measured, and, hence, some fourth time-dimension with respect to which the passage of the third time-dimension is to be measured, and so on ad infinitum.

5. It's not the case that time flows or passes.

In the second, the problem with passage is outright nonsense:

1. If it makes sense to say that time passes, then it makes sense to ask 'How fast does time pass?'

2. If it makes sense to ask 'How fast does time pass?', then it's possible for there to be a coherent answer to this question.

3. It's not possible for there to be a coherent answer to this question.

4. It doesn't make sense to say that time passes.

I shall focus on the infinite regress argument in my discussion of Markosian's defense, leaving to footnotes the applications of his points to the nonsense argument.

As a preliminary, Markosian makes some observations about the concept of a rate and about what we are doing when we assign a rate. On his view, when we give the rate of any process or change, such as the rate at which Abebe Bikila ran the 1964 Olympic Marathon, we are always comparing it with the rate of some process—perhaps in the first instance with the passage of hands around a clock, but in aspiration with something else, for which we hope our clock is an accurate stand-in: the pure passage of time itself. We say that Bikila has run the course at 12 miles per hour, meaning in the first instance that Bikila has covered 12 miles per each circuit of the clock's hands, but purporting to mean ultimately that he has covered that many miles in each hour of pure time.

Markosian's reply to the rate-of-passage arguments proceeds by specifying three cases, which evidently exhaust the alternatives, and showing that in each case, it is open to us to deny one premise or another in the rate-of-passage arguments. The cases are as follows:

Case 1: a rate of change may be measured by comparing it with *any* other rate, not necessarily that of the passage of time itself.

Case 2: a rate of change may be measured *only* by comparing it with the rate of passage of time itself. This case subdivides to give us the remaining two cases:

Case 2a: the rate of pure passage may be measured by comparison with itself. Compare: the standard meter stick is a meter long.

Case 2b: it makes no sense to assign a rate to the pure passage of time. Compare: "There is *one* thing of which one can say neither that it is one metre long, nor that it is not one metre long, and that is the standard metre in Paris." (Wittgenstein 1958, section 50; see Pollock 2004 for discussion.)

In case 1, having said that Bikila is running at the rate of 12 miles per hour, we may turn around and say that time itself is passing at the rate of one hour per every 12 miles run by Bikila. This is authorized because our case assumption says that a rate (in this case, that of the passage of time) may be measured by comparing it with the rate of *any* other change, including a mundane process. In this case, we may deny premise 1 of the infinite regress argument—the flow of time is measured not by reference to hyper-time, but by reference to a mundane process.[10]

In case 2a, we may say that time is passing at the rate of one hour per hour, just as Prior had suggested. There is nothing illegitimate about this, because our case assumption says that self-comparison is permitted when we are measuring the passage of time itself. We may once again deny premise 1 in the regress argument, saying that the flow of time is measured not by reference to a second time series but to the original time series.[11]

In case 2b, we must deny that it makes sense to ask how fast time passes or assign it any rate. Under this option, we may once more deny premise 1 in the infinite regress argument, this time on the ground that if the passage of time may not sensibly be said to

[10]In the second rate of passage argument, we deny premise 3. "One hour per 12 miles run by Bikila" is our coherent answer to the rate question.

[11] In the second rate-of-passage argument, we again deny premise 3, "an hour per hour" being our coherent answer to the rate question.

have a rate at all, then there need not be any hyper-time by reference to which its rate is determined.[12]

The beauty of Markosian's argument is that we need not take a stand on which of the three alternative handlings of the rate of time's passage is correct. If his three cases are as exhaustive as they appear to be, then one of his options must be correct, even if we are not sure which one it is and even if each of them seems suspicious in some way

Even so, insofar as each of the options yielded by his cases *does* seem suspicious in some way, doubts may linger. Let us consider the prima facie worries about each.

An hour per12 miles run by Bikila. Some may question whether that is really a rate. Must a rate not be given in units of time rather than distance? In reply, it may be said that just as light-years are units of distance that sound like units of time, so Bikila-miles are units of time that sound like units of distance. Or, it may be said that even if Bikila miles are units of distance, a rate need not be the ratio of some parameter to a unit of time. One may quite intelligibly speak of the rate at which temperature decreases per each mile of elevation gain on the mountain.[13]

Others may ask whether one who takes the pure passage of time seriously should take seriously the possibility of measuring it by reference to Bikila's running. Suppose Bikila speeds up, now covering 15 miles in each hour. That means time is passing at the rate of only 4/5 of an hour per 12 miles run by Bikila. So has time slowed down? That does not sound like anything a believer in pure passage should want to say.

[12] In the second rate-of-passage argument, we deny premise 1, which says time passes only if it makes sense to talk of a rate at which it passes.

[13] For another example, I once read that Manny Ramirez reached 400 home runs faster than any other hitter. I presume this means that his ratio of 400 home runs to the number of at-bats required to achieve it was higher than that of any other player, regardless of how much time it took to reach that number of at-bats.

An hour per hour. Van Inwagen has complained that an hour per hour cannot be the rate of anything because the units in numerator and denominator cancel out, leaving only a unitless (or "dimensionless") number behind (2009, p. 75). I believe this worry has been adequately addressed by Skow ("One Second per Second," forthcoming).[14]

A further worry remains, however. Isn't an hour per hour a *tautological* rate? However fast the hours were going by, wouldn't they still be going by at the rate of an hour per hour? So how can that rate tell us anything?

No sense to a rate of passage of time. Well, why not? If anything passes or changes in any way whatever, must there not be sense in inquiring about its rate?

In view of these doubts, let us look farther afield, seeing if we can find some further alternative overlooked by Markosian or, failing that, some further reassurance concerning one of his three.

3. Rates of passage and infinite regress arguments

In this section, I wish to see what light we can get on the infinite regress argument against passage by considering two other famous infinite regress arguments, the regress argument standardly used to support foundationalism in epistemology and the Third Man Argument against Plato's theory of Forms.

I begin by carving up the premises in Markosian's presentation of the infinite regress argument a little differently, the better to compare it with the others. Here is my reformulation:

1. Time passes.

[14] Skow notes (among several other things in defense of 'one second per second' as a legitimate rate) that the rate of change in the period of a pendulum is naturally given in seconds per second.

2. If time passes, there is a further series by which its rate of passage is measured or determined.

3. A series can be used to measure or determine the passage of time only if it undergoes passage itself.

4. There can be no symmetrical or mutual determination of rates.

5. Therefore, there is an infinite regress of temporal series.

When the argument is put this way, there are five or more possible responses to it. One may accept the conclusion, as was actually done by J.W. Dunne.[15] One may reject premise 1, as is done by Smart, Williams, and other proponents of the rate-of-passage argument, that being their point in giving it. One may reject premise 2 and allow a rate of passage to be measured by itself, as with Prior's "an hour per hour." One may reject premise 3, though I cannot think of anyone who has explicitly done this. Finally, one may reject premise 4 in either of two ways. Markosian rejects it with his "one hour per every 12 miles run by Bikila." Schlesinger rejects it in a way not previously mentioned, proposing that hours_1 pass at the rate of one per hour_2, while hours_2 pass at the rate of one per hour_1. Thus Markosian allows a purely temporal rate and a mundane rate to be reciprocally determined, while Schlesinger allows two purely temporal rates to be reciprocally determined. Either way, the regress to ever higher time dimensions gets cut off.

Now let us look at two other infinite regress arguments with very much the same form. The first is the classical "infinite regress of reasons" argument:

1. There are justified beliefs.

2. If a belief is justified, some other belief serves as a reason for it.

[15] As far as I know, Dunne's motivations for accepting such a regress were independent of the argument 1-5.

3. A belief serves as a reason only if it is itself justified.
4. There cannot be a circle in justification.
5. Therefore, there is an infinite regress of justified beliefs.

As in the first argument, we have a "starter" premise, a "relation to a further item" premise, an "item of the same sort" premise, and an anti-circularity premise, all of them together yielding an infinite regress as conclusion. As before, there are five possible generic responses, all of which have had their takers. One may accept the infinite regress, as advocated in contemporary epistemology by Peter Klein (1999). One may reject the first premise, embracing a radical skepticism that denies there are any justified beliefs at all. One may reject the second premise, which is the favored strategy of foundationalists. One may reject the third premise, as suggested by various remarks of Reichenbach, Wittgenstein, and Rorty, whom I like to call "positists," as they hold that our system of knowledge is based at the bottom on mere posits.[16] Finally, one may reject the fourth premise, which is implicitly done by those who espouse coherence theories of justification, in which each of two or more beliefs may be enlisted in the justification of the others.[17] Such are the main alternatives in the traditional dialectic of foundationalism and its competitors.

The other infinite regress argument I wish to consider is the Third Man Argument, which Plato put in the mouth of Parmenides as an argument against his own theory of Forms:

[16] Chisholm (2000) attributes to Reichenbach, perhaps not altogether fairly, the view that knowledge rests at bottom on "blind posits," which are not justified. Wittgenstein in *On Certainty* (1969) apparently thinks that the stopping points in the dialectic of justification are themselves neither justified nor unjustified; they are simply the places "where my spade is turned."

[17] BonJour (1985) distinguishes between "linear" coherence theories, which allow for circular justification, and "holistic" coherence theories, which allegedly eschew simple circles, but let everything be justified in part by its relation to other elements of the system. However, in holistic theories, there are still bound to be simple circles of *partial* justification.

1. This piece of chalk is white.
2. An object is white only in virtue of bearing R to an entity distinct from itself—the (or *a*) Form of Whiteness.
3. Whiteness is itself white (Self-Predication).
4. Anti-symmetry: if x is white in virtue of its relation to y, then y cannot be white in virtue of its relation to x.
5. Therefore, there is an infinite hierarchy of Forms.[18]

The premises are parallel to those of the preceding two arguments,[19] but this time we do not find as many of the possible responses to the argument actually taken. I know of no one who accepts 5 or denies 1 or 4. Some Platonists deny 3. Whiteness is something whose presence in something makes it white, they say, but it is not itself white; nor is Heaviness heavy, Forms not being the sort of thing that could press down on a scales. Other Platonists deny 2. Whiteness is white, they say, but in virtue of exemplifying *itself* rather than any further entity. Self-Predication is explained by Self-Exemplification.

Have we now canvassed all the options available in response to our three regresses? We have not. There is one additional response to which I now wish to call attention, the omission of which may already have been apparent to some readers.

In the regress of reasons argument, I said that premise 2 is rejected by foundationalists. I now wish to distinguish two forms this denial could take. First, one could object to the idea that justification always arises by way of a relation to a *further*

[18] See Vlastos 1954 for a classic reconstruction of the argument, somewhat different from what I present here. Vlastos wrestles with the problem of how to find Platonic premises that do not beget contradiction before the infinite regress even gets going. Without the parenthetical retreat from the definite article in my own premise 2, it would contradict premise 3.

[19] Actually, there is one lack of parallelism between the Third Man Argument as I formulate it and the first rate-of-passage argument. Premise 4 in the Third Man Argument could be held true simply by definition of the 'in virtue of' relation, which is essentially asymmetrical as well as transitive. Had I formulated premise 4 in the rate-of-passage argument in terms of 'in virtue of', it would have been incontestable. I did not so formulate it because I wanted to keep the 'one hour per 12 miles run by Bikila' option in play.

belief, saying instead that some beliefs are literally *self*-justifying; they are reasons for themselves. The perennial language of foundationalist epistemology does indeed suggest such a thing—there is talk of the self-justifying, of the self-evident, and of that which can only be justified by reiterating it. But the language of self-justification is puzzling if taken literally, calling to mind other reflexive feats such as Baron von Münchhausen's pulling himself out of the swamp by his own hair. Moreover, if taken literally, talk of self-justification conflicts with another premise the foundationalist accepts on the way to his or her foundations, namely, premise 4. A literally self-justifying belief would form the smallest of all circles, a single node with an arc looping back on its starting point, and circles are precisely what is prohibited by premise 4. So let us move on to the second way of denying premise 2, which in my opinion yields a much more plausible version of foundationalism: there are some beliefs that are justified apart from their relation to any reasons. They are justified not because they serve as their *own* reasons, but because they are justified *without* reasons.[20] Since justification is a supervenient property, there would have to be something in virtue of which foundational beliefs are justified (their infallibility, their reliability, etc.), but that *in virtue of which* a belief is justified need not be a *reason* for it.[21]

There are two parallel ways of denying the second premise in the Third Man Argument. The Platonist way of denying premise 2 is to go in for Self-Exemplification: Whiteness is white because it exemplifies itself. But as in the justification regress, this

[20] This possibility is not on the radar screen of those who can hear the word 'justified' only as the past participle of the verb 'justify' and not simply as a designation of a certain positive epistemic status.
[21] For more on this point, see the distinction between reasons and justifiers in Van Cleve 1985. In light of this distinction, perhaps some of those I called positists earlier are more charitably construed as foundationalists of a sort—"formal foundationalists" in the sense of Sosa 1980. A bottom-level belief is not *un*justified, but is justified in virtue of a property not on the traditional foundationalist's list, such as being something your peers let you get away with asserting.

option runs afoul of premise 4, an instance of which is 'if Whiteness is white in virtue of its relation to Whiteness, then Whiteness is *not* white in virtue of its relation to Whiteness'. By the law $(p \rightarrow \sim p) \rightarrow \sim p$, that rules out Self-Exemplification as the ground of Self-Predication. The other way of denying premise 2 is to object not to the idea that being white consists in a relation to a *further* entity, but to the idea that it consists in a *relation* at all. A thing can be white without standing in any relation to a Form or, for that matter, to any outside entity whatever, such as a paradigm white object. This is the ostrich nominalist's way of avoiding an infinite hierarchy of Forms, and it is the way I myself favor (see Van Cleve 1994).

In summary, we can respond to the "relation to a further item" premise either by denying the "further" part or by denying the "relation" part.

With our vision of logical space thus expanded, let us return to the rate of passage argument.[22] The first time around, we considered only one way of denying premise 2: the passage of time might be measured not by comparing it with a further series, but by comparing it with itself. That is the idea embodied in the suggestion that the hours pass at the rate of one per hour. But there should also be a way of denying premise 2 parallel to the second way of denying it in the other arguments. What would it be in the present case? Perhaps something like this: the passage of time does not have a rate that is given by self-comparison, but a rate that is not given by any comparison at all.

Talk of such rates is at odds with Markosian's way of thinking about rates, which makes them always matters of comparison:

[22] My purpose in bringing in the other infinite regress arguments has not been to *justify* the option I am about to explore, but to *discover* it. I am not saying that because denying the second premise in the second way is the best course in some cases, it is also the best course in the rate-of-passage case.

> [O]ur investigation reveals that while Bikila's position on the course changes by one mile, the position of the hands on the clock changes by the amount that marks off five minutes. . . . [W]e are in effect comparing the rates of these two changes to one another. . . .[Since the clock is only a stand-in for the sun], what we have really done in carrying out our procedure is to compare the rate of Bikila's change of position to the rate of the sun's change of position . . . . [Since the sun is only a stand-in for the pure passage of time], it at least appears that what we are after in trying to determine the rates of various physical processes, such as Bikila's running of the marathon, are the rates at which those processes occur in comparison to the rate of the pure passage of time. (pp. 840-43)

Markosian goes on to suggest that *all* talk of rates is talk of how a given rate compares to some rate—either the rate of some mundane change or the rate of the passage of time itself. If so, the rate of passage of time itself (if it makes sense to talk of such a thing at all) would have to be given by comparison with either a mundane rate, or a further temporal rate, or itself.[23]

Can we now descry a further option? "A rate not given by any comparison" is my name for it, but that is admittedly a dark phrase. Let us see if we can throw any light on it by pursuing a spatial analogy.

4. Absolute lengths and absolute rates

Here is a memorable passage from C.I. Lewis:

> The size of Caesar's toga is relative to the yardstick. But if we say, "The number of square yards in the toga is determined by the yardstick," the statement is over-simple. Given the toga, its size in yards is determined by the yardstick; given the yardstick, the

[23] Notice that I have just mentioned an alternative that Markosian seems to let drop out of consideration—comparing the rate of the passage of time with some further temporal rate. This alternative is not excluded by his three case assumptions. Case assumption 2 should presumably be read as 'for any rate r, r is measurable only by comparison with the rate of the passage of time'. If so, then to secure exhaustiveness, case assumption 1 must be stated as 'some rate r is measurable by comparison with something other than the rate of passage of time'. For all that has been said, it could be the rate of passage of hyper-time rather than the rate of some mundane process.

Notice also that when case assumption 1 is stated as I have suggested, it does not explicitly authorize the measuring of the rate of passage of time by comparison with something other than itself, such as the rate of a mundane process. It only says that *some* rates are measurable by comparison with something other than the rate of passage of time. The use of the indefinite article in formulating case assumption 1 may obscure this point.

Notice finally that insofar as all three of Markosian's case assumptions make the measurement of a rate a matter of comparison with some rate, they ignore the possibility I am just now beginning to explore in the text.

> number of yards in the toga is determined by the toga itself. If the toga had not a determinate sizableness independent of the yardstick, or if the yardstick had no size independent of the toga, then there would be no such fact as the number of yards in the toga; the relation would be utterly indeterminate. This independent character of the toga, or of the yardstick, is what we should be likely to call its "absolute" size. . . .
>
> *Some* size must be an absolute so-bigness . . . or there is no size at all. (1929, pp. 168-69)

We could express Lewis's point in contemporary terms by saying that the relation between two things of being the same in size (or standing in any other size ratio) is an *internal* or *supervenient* relation, supervening on intrinsic characteristics of its relata. In consequence of this, there must be such a property as intrinsic or absolute size, for that is what determines relative or comparative size. Being the same in size should be classified together with being the same in color (which most people would regard as an internal relation) rather than with being distant from (which most people would regard as an external relation).

On the other side of this issue are Poincaré and the positivists, for whom size is inherently or constitutively a relational matter. To call a toga so long can only mean that it bears such-and-such a ratio to some object chosen as a standard. This view has two corollaries: (a) an object all alone in the universe would have no size whatever, and (b) the supposition that everything in the universe has doubled in size overnight is either necessarily false or nonsensical.[24] If all size ratios remain the same, nothing has changed in size.

My intuitions are with Lewis. Suppose an object that was formerly half as long as another is now equal in length to it. Doesn't that require that one of the objects has

[24] It is sometimes said that a universal doubling would be undetectable, but that ignores what Galileo knew: that a twofold increase in length would mean an eightfold increase in volume, making organisms incapable of supporting their own weight.

grown or the other shrunk—or both, in some combination?[25] If so, one has done something that it might have done in the absence of the other—increase or diminish in intrinsic or absolute size. As we might put it, absolute size is size not given by any comparison.

Now let's consider the same issue, but regarding rates rather than sizes. If one process takes place at a rate twice as fast as another, mustn't each have an absolute so-fastness? Suppose one runner begins a race by circling the track twice for every time another circles it once, but by the end of the race the second runner is matching the first lap for lap. Surely one runner has sped up, or the other slowed down, or some of each, absolutely speaking. The case for absolute length seems to carry over to absolute rates.

The wish to secure absolute rates is apparently what motivated Newton's belief in substantival time. In a famous scholium, he says

> Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external. . . . It may be, that there is no such thing as an equable motion, whereby time may be accurately measured. All motions may be accelerated and retarded, but the flowing of absolute time is not liable to any change. (1993, pp. 37 and 39).

Newton was convinced that there must be a fact of the matter which of two things has changed its rate when the two have changed their rate relative to each other, and he took it to be an intelligible supposition that all mundane rates have doubled in magnitude overnight. He also believed that only time as a special entity with privileged properties could ground such facts and possibilities (similarly for absolute length and substantival space). It is arguable, however, that he did not really need the second belief to undergird the first. To do their jobs, time itself would have to have an absolute rate, and chunks of

[25] I also count as a combined case their both having grown (or both having shrunk), but by unequal amounts.

substantival space would have to have absolute sizes. But once it is admitted that absolute sizes and absolute rates can be possessed by *something*, why not let physical objects and processes possess them directly, without inheriting them from container spaces and times? Had Newton been pressed on this point, perhaps he would have been happy to be an absolutist without being a substantivalist.

Let us return to the issue at hand. I said my intuitions are with Lewis rather than the positivists, but for present purposes I need not take sides. I can defend the doctrine of passage by means of a constructive dilemma.

If comparative rates *do* supervene on absolute rates, then there are such things as absolute rates. A process has a certain rate independent of how it compares with other rates. That sounds like a vindication of the "rate not given by any comparison" idea broached above as an overlooked response to the infinite regress argument. Appealing to this idea, we may say that the hours are passing at a certain rate while declining to specify any process by reference to which this rate can be compared or measured—neither itself nor any other process, temporal or mundane.

If comparative rates do *not* supervene on absolute rates, then any fact about how fast something is happening is simply a fact about how fast it is happening in comparison with something else. Under this supposition, it seems to me that Markosian's Bikila option gains enhanced respectability. If saying that A is going twice as fast as B gives information about A's rate (and information of the only sort that *could* be given about it), it also gives equally good information about B's rate—that it is half of A's.

The "no supervenience" alternative may also enable us to mitigate an objection to the Bikila option I left unanswered above—that it would not tell us whether we are dealing with a speed-up by Bikila or a slow-down of time. On the no-supervenience view, there is simply no distinction to be made here. The ratio of hours to Bikila miles has changed, and there is no fact of the matter about which quantity in the ratio has changed.

It must be confessed, however, that there may be something incongruous about defending the Bikila option by reference to the no-supervenience view. Insofar as the opposing supervenience view is a critical prop for belief in pure passage, the defense may destroy the raison d'etre for the theory defended.

The upshot of our constructive dilemma is that the pure passage of time has *either* a rate not given by any comparison *or* a rate given by comparison with mundane processes, such as Bikila's running. But insofar as the defense of the latter option undermines the basis of the pure passage view, the former option now comes to the fore.

5. An hour per hour all over again

We need now to think harder about whether the idea that the rate of pure passage is an absolute or noncomparative rate really constitutes a new option. We were trying to get away from the standard options, such as an hour per hour. But what, it may be asked, are the units for the supposed absolute rate of passage? The question is inescapable. To say that time passes at a rate not given by any comparison is still to say that it passes at a rate, and a rate is a ratio. A ratio may be written as a fraction. What in the present case are the numerator and the denominator, and what are the units in each?

We do not avoid the question of units by saying that just as an absolute length is a length not consisting in a ratio to the length of anything else, so an absolute rate is a rate not consisting in a ratio to the rate of anything else. That is true; but a rate is *already* a ratio, so an absolute rate, though not consisting in a ratio or comparison to any ratio, is still a ratio.[26]

Let's go at that last point from a slightly different angle. Markosian holds that the measurement or determination of a rate always consists in comparing it with a rate (whether itself or another), and that, I believe, is a mistake. There must be non-comparative rates, or rates not given by any comparison *with rates*. But that does not mean there are rates that are not comparisons, period. Any rate is a ratio, and any ratio is a comparison of sorts. When we say that the ratio of women to men at a certain college is 54 to 46, we are comparing these numbers. So when we insist (contrary to Markosian) that there must be rates "not given by any comparison," i.e., not given by any comparison with rates, we are not saying that there are rates that are not ratios.

What, then, is the ratio that constitutes the rate of the pure passage of time—what are its numerator and denominator, and what are the units? As the process consists of the hours going by, the numerator must be the number of hours elapsed. The denominator must presumably involve units of some kind of time or temporal surrogate—and here the old alternatives present themselves for review again. Are they Bikila miles, $hours_1$, $hours_2$, or . . .?

It behooves us at this point to reconsider the reasons for being suspicious of the hour-per-hour rate. The worry I left standing above is this: *however fast time were passing, it would still be passing at the rate of an hour per hour.* So how can that be an informative rate—how can it serve as an answer our question?

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[26] Does it consist in a ratio to itself? No; it *bears* a ratio to itself, namely, unity, but it does not *consist* in its so bearing.

David Sosa has suggested to me that the italicized claim is false, as may perhaps be seen by comparing it with *however long the standard meter stick were, it would still be a meter long*.[27] In a similar vein, Mark Johnston has suggested to me that although the first of the following two statements is true, the second is false:

1. Had time gone faster, 'time passes at one hour per hour' would still have been true.
2. Had time gone faster, time would still have passed at one hour per hour.

In the background of both suggestions is Kripke's contention that *the standard meter stick is one meter long*, though knowable a priori, is contingent. Could *time passes at one hour per hour* be one more example of the contingent a priori?[28]

Let us review how *the standard meter stick is a meter long* is supposed to come out contingent. Consider first the following definition, in which 'S' names the stick we have chosen as our standard:

D1. x is one meter long =df x is as long as stick S.

There is no contingency forthcoming here, since it is necessary that S is as long as S. But now consider

D2. The length L of stick S is such that to have L is to be one meter long.

This is what I take to be involved in what Kripke calls "fixing the reference" (as opposed to "giving the meaning") of the predicate 'is one meter long'. Under D2, it is not

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[27] Geach (1956) does not share the intuition that the italicized claim is false; he thinks it is what distinguishes the standard from the things measured by it.

[28] I have always been suspicious of Kripke's examples of contingent a priori propositions, since it seems to me that he does not get *the same thing* to be both contingent and a priori. I find my suspicions confirmed by the reconstruction of Kripke's ideas in Chalmers 1996, pp. 56-69. However, none of that matters here. If *time passes at one hour per hour* can be shown to be contingent, my worry about the hour-per-hour rate is dissipated. Whether it's the same thing or some closely related thing that is a priori, the disputed impression of noncontingency would be accounted for.

necessary that S is one meter long. S might not have had length L, and it could grow to have a length longer than L tomorrow.

Now let's apply the foregoing considerations to the standard clock instead of the standard meter stick. I will pretend that our standard clock is a clock with hands rather than an atomic clock using caesium-33 atoms. A D2-like way to fix the reference of 'one hour' would be

> The time it now takes hand h to make one revolution is such that to take that much time is to take an hour.

Under this definition, the following statement is false:

> Had the standard clock run faster, the standard hand would still have completed one revolution per hour.

We can thus make perfectly good sense of the thought that the standard hour hand might have taken more or less than an hour to make one revolution.[29]

Finally, let's apply the same considerations to the pure passage of time—the lapsing of the hours as opposed to the revolutions of clock hands. Could *that* conceivably take place at a rate other than an hour per hour? An hour goes by. How long does it take? An hour. Suppose the next one goes by more quickly, taking less than an hour. *What is it* that goes by more quickly? I don't see how we can identify it except as 'a stretch of time equal in length to the previous hour'—and that cannot go by in less than an hour.

We run into similar difficulties in trying to understand how Johnston's second conditional could be false. Can we really envision a situation in which the antecedent

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[29] The distinctions needed for grasping this point are already present in Augustine's *Confessions* (Hackett, p. 21): "I wish to know whether a day is that movement itself [of the sun in its completed circle from east to west] or simply the time the movement takes . . . . If the movement of the sun through one complete circuit were the day, then it would be a day even if the sun sped through its course in a space of time equal to an hour. If the time the sun now takes to complete its circuit is the day, then it would not be a day if between one sunrise and the next there were only the space of an hour: the sun would have to go round twenty-four times to make one day."

would be true and the consequent false? The antecedent is ‘had time gone faster’ or, as it might just as well be, ‘if time were to *start* going faster’. Here is a try: one hour goes by, then another goes by more quickly; that is, in a length of time less than that taken by the first hour. Then what is it that has gone by more quickly? What can we say except a period of time equal in length to the first time? It is beginning to look as though we can’t suppose the antecedent to be true.

Can we suppose the consequent false? That is no easier. The consequent is ‘time would still have passed at one hour per hour’ or (after the speed-up in time) ‘time would still be passing at one hour per hour’. In the case of the standard meter stick, we could consider the length L had by stick S and say S might not have had it. In the case at hand, we could consider the length of the interval had by a given hour and say that the hours going by now are doing so in a length of time less than that. But how are we to demarcate these things that are going by? What can they be but chunks of time equal in length to the original hour?

So I do not see how Johnston’s conditional can fail to be true. Does that vindicate my worry about the hour-per-hour rate—that it does not track the rate of passage because it is a rate that would obtain no matter what?

No—there is a saving grace. If the antecedent of Johnston’s conditional cannot be true, I cannot raise the complaint that time could speed up without the hour-per-hour rate changing, since time could not speed up at all. Time of itself flows equably, as Newton said—strange though it be that there should be such a thing.

An hour per hour is back in contention. But is it possible to avoid the question to which it is an answer?

6. Prior's schema and the puzzle of passage

As promised, I now address our problem in the more austere framework of Prior. In Prior's view, time is not some smoothly streaming substance, and 'time passes' is not really a subject-predicate sentence. Talk of time's passing is a metaphor, the literal content of which can be expressed by saying that instances of the schema (Pp & ~p) are true. I wish to consider two questions. First, is Prior's schema for capturing passage really adequate? Second, if it is, do puzzles about the rate of passage no longer arise?

An adequate schema? Is Prior's formula ∃p(Pp & ~p) really adequate for expressing the passage of time? Not without modification, as I shall argue by confronting it with a scenario for whose possibility Prior himself argues for elsewhere: dead time without ending time (1968).

The question Prior considers in the 1968 article is whether an end to change would necessarily imply an end to time, and his answer is no. To understand his thesis, we need to understand two terms. First, by "dead time" Prior means time during which there will never again be any changes, or "time throughout which whatever is true at any moment is true at any moment future to that one" (p. 156). Using a more familiar term introduced by Shoemaker (1969), we may say that dead time would be an everlasting global *freeze*. (I discuss the relation of Prior's views to Shoemaker's in the Appendix.) Second, by an "end of time," Prior means something quite radical: a time at which no proposition whatever in the future tense would be true. His postulate for ending time is ~Fp v F~Fp. Since axiom schemata are meant to hold for any *p*, this says that we either have now reached (first disjunct) or will one day reach (second disjunct) a point at which *nothing will thereafter be true*—not even the truths of logic and mathematics![30]

What would a world look like in which time dies but does not end? We can portray such a world by using *a* through *e* as variables for world-state propositions—roughly, maximally consistent propositions that describe everything that happens at a given instant, except that instead of being true *at* instants, world-state propositions *are* instants.[31] A world in which time goes dead without ending might be portrayed thus (the string of symbols is meant to be a picture, since it would be ill-formed as a formula):

abcccc…

After b comes the first moment of dead time—dead because nothing changes thereafter, all the same things being true in every succeeding instant. Yet time has not ended, since during the c-stretch, whenever it is true that c, it is also true that Fc.[32]

Prior notes that we could rule out the scenario portrayed above if we had the axiom ~Uaa—no instant or world-state succeeds itself. But he thinks employing that axiom would be begging the question against dead but unending time.

Here is another objection some might be tempted to raise against the abccc… scenario. During the first moment of dead time (assuming for the sake of this argument

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[30] If we were at the end of time, would that mean not even Pp will be true in the future, for some p that has already happened? Evidently, the answer is yes. Does that mean in turn that we are giving up the axiom of the unalterability of the past? As Prior formulates the axiom, the answer is no. He expresses the unalterability of the past by Pp -> GPp, i.e., Pp -> ~F~Pp, and that is still true. However, if we characterized unalterability more strongly as Pp -> (n)F_nPp, it would not be true. For something p that has already happened, we cannot say at the end of time that it will always be true that p has happened, but only that it will never be false that p has happened.

[31] Prior lays down three conditions *a* must satisfy to be a world-state proposition: ◊a, □(a→p) v □(a→~p), and ∃aa (p. 141). Defining world-state propositions in this manner and letting them do the work of instants makes them similar to the "ersatz times" of some contemporary philosophers, except that Prior's *a*s, *b*s, and *c*s are formulas rather than terms. So he cannot really identify instants with world-state propositions, but he can paraphrase talk of instants by using world-state propositions.

[32] Prior does not discuss the questions whether there could be a freeze followed by a thaw (abcccde) or beginningless and endless dead time (. . . aaaa . . .), but as far as I can see, they should be as possible as the scenario he does defend.

that time is discrete),[33] we have P_1b—it was the case one unit of time ago that b. During the next moment of dead time, we have P_2b—it was the case two units of time ago that b. But that means we do not really have all the same propositions true as part of the endlessly repeated *c* and so do not really have dead time after all.

Prior's reply to this objection is that it presupposes that time has an intrinsic metric—an assumption he ascribes to Locke, but seems to regard as problematic himself, though he takes no official stand on it (pp. 152, 154-55, 157). If time has an intrinsic metric, then even in dead time, there could be longer and shorter intervals. The equality or not of two intervals would be an intrinsic and perhaps fundamental fact about them. By contrast, if time has no intrinsic metric, the length of an interval must be measured by something extrinsic to the interval itself, presumably some periodic physical process such as the rotation of the earth.[34] In the absence of mundane changes, then, there could be no such thing as one interval being longer or shorter than another. "McTaggart changes," such as the transition from P_1b to P_2b, could not occur in the absence of ordinary changes, that is, changes in the truth values of propositions not containing tense operators.

I do not know why Prior did not consider saying something like this: the c stretch has now been underway for just as long as some event in the pre-c era. That would be measuring an interval of dead time by reference to a mundane event lying outside the

[33] Prior notes that the argument requires either that time be discrete or that there be a first moment of dead time but no last moment of live time (p. 156). If there is a first moment of dead time in either of these ways, it seems to me that an objection like the one we are considering can be made without recourse to metric tense operators: it is true *after* but not *in* the first moment of dead time that Pc.

[34] LePoidevin distinguishes *objectivism* about the temporal metric, according to which two successive intervals of time are equal in length or not apart from their relation to any conventionally chosen standard, from *conventionalism*, according to which equality or the lack of it can only consist in a relation to a conventionally established standard, the standard being accurate by fiat (2003, pp. 6-7). His definitions apparently elide an intermediate possibility discussed by Skow (2010)—that the temporal metric is extrinsic to temporal intervals, making reference to some physical process, but a process not selected by convention. In any case, the view that time has an intrinsic metric would come under LePoidevin's objectivist heading.

interval. Of course, someone with verificationist scruples would question whether there can be a fact of the matter whether two nonsimultaneous events, or an event and a dead duration not simultaneous with it, are the same in length.[35] But Prior is no verificationist.[36]

In light of the foregoing discussion, I am tempted to think that we can diagram Prior's views as in the following triangle: [draw in arrows from bottom to top but not v.v. and both ways between passage and change]

TIME

PASSAGE CHANGE

'Change' is meant in the first instance to cover the disjunction of ordinary change and McTaggart change. But for anyone who takes tense seriously as Prior does, ordinary change would imply McTaggart change, and for anyone who thinks there is no intrinsic temporal metric, McTaggart change would require ordinary change. Thus the disjuncts would be equivalent.

Let us now return to the question that launched this excursus—whether Prior's formula $\exists p(Pp \,\&\, {\sim}p)$—something was once the case that is no longer the case—is adequate to unpack the metaphor of passage. If he is right about dead time, the answer is no. During the "first" instant of dead time and all subsequent instants—which are really the same endlessly repeated instant c—it is true that Pa & ~a. (Note that we are not using metric tense operators—Pa & ~a just means that it was once the case that a and is no

[35] It would not help to bring in a clock one cycle of which coincides with the first event and another cycle of which coincides with the second event—unless one knew that the two clock cycles were equal. It is here that the verificationist would likely go conventionalist, making them equal by fiat.
[36] He is prepared to reject standard versions of the special theory of relativity because of their verificationist underpinnings. See 1970 and 2003, pp. 245-48.

longer the case that a.) Yet it is not true during the c part of the scenario that time is passing or that anything is changing. The formula is not adequate in this extreme case. It is true during the dead era that there have *been* changes, that time *has* passed, but not that it is passing any longer.

How could we say in tense-logical terms that time is *always* passing—that it is now, always has been, and always will be the case that things are changing? We could start by saying this: $(m)\exists p(p \,\&\, \exists n(n < m \,\&\, {\sim}P_n p))$.[37] That says that for any period of time, something is the case now that was not the case some shorter-than-that period ago. That gets us a change within any arbitrarily small portion of the past with respect to the present moment. We must then say that what holds of the present in this regard holds at all times, that is, it always has been and always will be the case:

$$H(m)\exists p(p \,\&\, \exists n(n < m \,\&\, {\sim}P_n p)) \,\&\, (m)\exists p(p \,\&\, \exists n(n < m \,\&\, {\sim}P_n p)) \\ \&\, G(m)\exists p(p \,\&\, \exists n(n < m \,\&\, {\sim}P_n p)).$$ [38]

Fortunately, however, we can operate with simpler formulae in considering what becomes of the puzzle of passage in the tense-logical framework.

No more puzzle? One can read Prior 1962 as intimating that once we cash in talk of time's passing for tense-logical formulae, questions about how fast time passes no longer arise.[39] But the intimated claim is not correct; nor, I think, does Prior really make it. We can raise a version of our question all over again using metric tense operators: how long

[37] How can we quantify into subscript position like this, some readers may wonder, if there are no such entities as intervals of time? For Prior's answer, see 1967, p. 96, and 1971, chapter 3 ("Platonism and Quantification").

[38] A simpler version of the kernel of the three conjuncts would be $\exists p(p \,\&\, {\sim}Pp)$. That says (of any moment at which it is true) that something is true then that was never true previously, and if affirmed of all moments, it would deliver the desired Heraclitean doctrine. However, it would also rule out Nietzschean eternal return.

[39] "Discard 'X's birth is now ten years past ' for ' It is now ten years since X was born ', and how the pseudo-problems flee away!" is a characteristic Priorian pronouncement (1958, p. 245). However, what Prior is referring to as a pseudo-problem here is not the puzzle of passage, but the puzzle of how no longer existing things can have properties.

does it take for it to stop being the case that $P_n p$ and start being the case that $P_m p$? For instance, how long is the interval between its being true that $P_1 p$ and its being true that $P_2 p$, or between its being true that $P_2 p$ and its being true that $P_3 p$? I picture Prior's subscripts as turning over like the tiles in an old-fashioned odometer:

$$P_1p, P_2p, P_3p, P_4p, P_5p, \ldots$$

At what rate do they turn?

As soon as we have asked this question, the answer seems obvious: it takes 1 unit of time for $P_1 p$ to give way to $P_2 p$; more generally, it takes m – n units for $P_n p$ to give way to $P_m p$ and m + n units for $F_m p$ to give way to $P_n p$.[40] We seem to be back in the vicinity of a year per year, a day per day, an hour per hour, and a second per second.

That is exactly Prior's own view in "Time after Time" (1958). There he initially states the puzzle of passage as follows: the date of Johnny's birth is constantly receding further into the past; how fast is it receding? But that way of putting it makes assumptions Prior repudiates. It reifies dates and births, and it assumes that there is a region called "the past" in which they are housed, or if you like, that pastness is a property possessed (in varying degrees) by existing things. The Prioristically correct way of putting the matter is this:

> To begin with it is the case that no more than ten years have passed since X was born, and then this is not the case; to begin with it is not the case that eleven years have passed since X was born, and then this is the case. What was the case ceases to be the case, and what was not the case comes to be the case; if this is not change, what is? (1958, p. 244)

Our puzzle may now be restated as follows:

> But at what rate does this change, if it is one, occur? How fast does one get older? Surely the answer to this question is obvious. I am now exactly a year older than I was

[40] The PC (Prioristically correct) way of putting '$P_1 p$ gives way to $P_2 p$', given that '$P_1 p$' and '$P_2 p$' are formulas rather than terms, would be this: it stops being the case that $P_1 p$ and starts being the case that $P_2 p$.

> a year ago; it has taken me exactly a year to become a year older; and quite generally, the rate of this change is one time-unit per time-unit. Nor does any mysterious 'super-time' enter into this calculation. It has taken exactly one year of ordinary time for my age to increase by exactly one year of ordinary time, and that is all there is to it. (1958, p. 244)

If it takes a year for me to age by a year, then I am aging at the rate of one year per year.[41]

When Prior's "Changes in Events" (1962) is read alongside his "Time after Time" (1958), then, it becomes clear that "an hour per hour" is not a facetious brush-off of the "how fast?" question, but an answer advanced in all seriousness.[42] The role of tense-logical formulations is not to avoid questions about rates of passage, but to show that in the phrase 'an hour per hour' we need not be using 'hour' in two senses. If a year ago Prior was 47 (i.e., P_1P_{47}(Prior is born)) and two years ago he was 46 (i.e., P_2P_{46}(Prior is born), then it took him a year to get a year older. We do not need different senses of 'year' in the operators to make sense of this any more than we need different senses of necessity to make sense of $\Box\Box p$.

In a section entitled "Questions with Easy Answers," Skow criticizes the last passage quoted from Prior on the ground that the question to which it gives an answer is "metaphysically uninteresting" in the sense that "it makes sense and has a coherent answer even if the B-theory is correct" ("On the Meaning," p. 9). He quotes Smart approvingly:

> It is true, as Prior points out, that after one second I have got older by a second. But equally one could say that a ruler gets larger in a left to right direction (say) by one

[41] Actually, in the first instance I can say only that I am aging at the *average* rate of a year per year, which leaves it open that I could have aged more quickly from 47 to 47.5 than from 47.5 to 48. But asking the question again for these subintervals would yield equal rates for each: half a year per half a year.

[42] In the preface to *Papers on Time and Tense* (2003), Prior tells us that the 1962 article is a further development of ideas first proposed in the 1958 article.

> centimeter per centimeter. There is no notion of 'flow' or 'passage' here. (Skow, "On the Meaning," p. 9).

Pace Smart, however, it is not true that the question 'How fast am I getting older?' is on all fours with the question 'At what rate is the ruler getting longer?' The question 'How old am I?' has an answer now, and it will have a different answer tomorrow. The question 'How long is the ruler?' normally has the same answer tomorrow as today. "But the question 'How long is the ruler *here*?' does have different answers in different places," someone may say in reply. "Here (at the 5-inch mark) it is 5 inches long; here (at the 6-inch mark) it is 6 inches long." No: the segment terminating at the 5-inch mark is 5 inches long, and the segment terminating at the 6-inch mark is 6 inches long. By contrast, I do not have a segment terminating at the 50-year mark, because enduring things do not have temporal segments. That is part of the package that generally goes along with taking tense seriously.

In any case, why must we suppose with Skow that if Prior's question has an easy answer, it must not be the right question to be addressing about the rate of passage? Is it not possible that contrary to the opponents of passage, the only questions that genuinely arise about it have easy answers rather than absurd or nonsensical ones?[43]

7. Summary and conclusion

I never wanted to write an essay reaching the conclusion that time passes at the rate of one hour per hour, but that is how things have turned out. I hope my sallies in search of an answer have proved more instructive than the answer itself.

[43] The only question about rates of passage that Skow himself finds metaphysically interesting is one he formulates within the moving spotlight theory: how fast does the NOW (the spotlight of the present) move into the future? That he finds only this question to be of metaphysical interest is, in my opinion, unfortunate, since the moving spotlight theory is the one theory that McTaggart refutes. For details, see my 1996 and 2009.

I began by setting out two accounts of what it means to say that time passes—a lavish account involving the literal passage of days and hours (along with their contents) through the A properties of futurity, presentness, and pastness, and a more austere account that takes tense seriously, but eschews the existence of events and times and anything not present. Addressing the "how fast?" question within the lavish framework, I considered three answers canvassed by Markosian: "an hour per hour," "an hour per 12 miles run by Bikila," and "don't ask, because it makes no sense to say that time passes at any rate." Noting prima facie worries for each of these answers, I sought another answer, guided by the menu of responses to other classic infinite regress arguments. What suggested itself was this: time passes at a rate, but a rate not given by any comparison. That answer, though correct, does not relieve us from having to specify a rate with units. So I returned to the hour-per-hour answer, finding it not discredited by the initial objection that time would pass at *that* rate even if it sped up or slowed down. I then turned to the rate-of-passage question within the austere tense-logical framework of Prior. I found that a version of the rate question remains: at what rate does it stop being the case that p and start being the case that P_1p, then later start being the case that P_2p, and so on? There seems to be just one answer, and that the obvious one: it takes an hour for it to stop being the case that I am eating my breakfast and start being the case that it was true an hour ago that I was then eating my breakfast. In either framework, the hour-per-hour answer is available, and there is no need in giving it to embark on an ever-ascending ladder of time dimensions.

APPENDIX: SHOEMAKER WORLDS

In a widely read article (1969), Sydney Shoemaker argues that there could be time without change—or at any rate, that it would be possible for there to be *evidence* for thinking there had been an interval with no change.[44] His argument is relevant to three topics broached above: the possibility of dead or frozen time, the possibility of universal doubling, and intrinsic metrics. After noting the points of contact, I expose a difficulty for Shoemaker's argument and propose a way around it.

Shoemaker's argument is a simple and elegant thought experiment. Suppose the universe is divided into three sectors, A, B, and C. Every third year, there is a year-long "local freeze" in sector A—a cessation of all changes whatever within A—which is observed by the inhabitants of B and C. So far there is nothing to contravene the principle "no time without change," since there are changes in B and C during the freeze in A. Every fourth year, there is similarly a year-long freeze in B (as observed from A and C), and every fifth year, there is a year-long freeze in C (as observed from A and B). Pooling their information in no-freeze years, observers in the three sectors come to know what the reader knows, and by inductive extrapolation from this data, they conclude that a total freeze (a freeze throughout the universe) occurs every 60th year.

Shoemaker and Prior are in agreement, then, that there could be time without change. What Prior calls "dead time" is simply a total freeze that never ends.[45]

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[44] Shoemaker makes only the more modest claim—that there could be evidence for believing in time without change, not that time without change is logically possible. He means thereby to undercut verificationist arguments against time without change. However, in Bayesian and some other confirmation theories, there can be no evidence that confirms a necessary falsehood. From the standpoint of these theories, Shoemaker is displaying false modesty.

[45] A potential difference turns out not to be one in the end. Shoemaker says he is interested in the possibility of time without ordinary change, regardless of whether time requires "McTaggart change," such as an object's having been in existence longer. Prior initially allows that McTaggart change would spoil

The possibility of time without change is sometimes thought to make trouble for a relationist account of time, but this verdict is not upheld in Prior's philosophy. Dead time is time without change, but it does not involve substantival time. The moments of dead time are nothing distinct from world-states.

If Shoemaker's argument shows that there could be (or that there could be evidence for) a universal freeze, would a similar argument show that there could be a universal doubling of all rates? The idea would be that in every third year, observers in B and C notice that all processes in A have doubled in speed, resuming their normal rates at year's end. The rest of the argument proceeds as before, except that "local doubling" is substituted for "local freeze" throughout, yielding the conclusion that a universal doubling occurs every 60th year. Closer scrutiny reveals, however, that this version of the argument does not work. A positivist who believed that doubling is inherently a comparative concept would say that the doubling in A can only mean that processes there are now happening twice as fast as before in relation to processes in B and C (and similarly for local doubling in B and C). The claim of universal doubling would then amount to the absurd supposition that processes in each sector are happening twice as fast as processes in the other sectors. There is no parallel problem for the original argument, since when observers in B detect a freeze in A, they need only note (for example) that

the hypothesis of dead time (on the assumption of an intrinsic metric). But to sustain the possibility of dead time, he is also willing to redefine dead time as "time throughout which there is no change in the truth-value of those propositions which have no past or future-tense operators in them" (1968, p. 158). He thus fully agrees with Shoemaker that there could be periods of time without ordinary change.

nothing in A is moving relative to anything else in A, not that nothing in A is moving relative to anything in their own sector.[46]

Shoemaker considers (as an objection to his scenario) the claim that there could be no acceptable cause for things starting up again after a total freeze. Any cause of the eventual thaw would have to violate the following "Principle P:"

> If an event is caused, then any temporal interval immediately preceding it, no matter how short, contains a sufficient cause of its occurrence.

Principle P is meant to rule out what is sometimes disparaged as "action at a temporal distance."

In reply, Shoemaker distinguishes two ways in which principle P could be violated (or two different varieties of "action at a temporal distance.") In the first way, an event has a *noncontiguous* cause—a cause that operates across a temporal gap with no intervening causal chain. This is what we would have if the start-up were caused by events a year earlier, before the total freeze began. In the second way, an event has a *minimum-duration* cause—a cause that consists in some condition's holding for a certain minimum period of time. We would have an instance of causation of this type if it were a causal law that anything that is red for an hour explodes (with no sufficient causes for the explosion occurring during any shorter interval before the explosion). We would also have an instance of causation of this type if it were a causal law that a year-long freeze is always followed by a thaw. Shoemaker suggests that although the first type of action at a temporal distance (involving noncontiguous causation) should be shunned, the second type could be accepted under some circumstances.

[46] Actually, this does seem to open up a lacuna in Shoemaker's argument. Simultaneous local freezes in A, B, and C would not yield a total freeze if the sectors were receding from each other, which seems permitted by the definition of a local freeze.

What is of interest for our purposes is that minimum-duration causes operating during a total freeze would require that time have an intrinsic metric. Since no clocks or other physical processes are running during the freeze, what makes the freeze a year long would have to be something built into time itself (in a sense not necessarily implying substantival time).[47]

I turn now to a glitch in Shoemaker's argument that so far as I know has not been pointed out before. Here is how the universe is supposed to look from a God's-eye perspective—to keep things on the page, I drop down to a two-sector universe, and I use 1s for changeful years and 0s for freezes:

A	1	1	0	1	1	0	1	1	0	1	1	0
B	1	1	1	0	1	1	1	0	1	1	1	0

From the data presented up until the final column, the inhabitants of the universe are supposed to infer that there is a total freeze every 12th year. But how are they supposed to acquire the data? During freeze years, the inhabitants of A see nothing.[48] They aren't presented with the display the reader sees in row B, but rather with a display that looks like this (in which every entry in B that is below a 0 has been deleted):

B	1	1	0	1	1	0	1	1	1	1	0	1

For the same reason, what the inhabitants of B see of sector A looks like this:

A	1	1	0	1	0	1	0	1	1	1	1	0

[47] Or could the frozen interval be measured by reference to processes in the preceding nonfrozen interval?

[48] Shoemaker says they are unconscious. The alternative, I suppose, is that they have a variegated but frozen visual field showing things as they were just before the freeze, but the field would presumably have to be sustained by some brain activity, of which there is none.

Comparing notes, they would find no obvious pattern from which to extrapolate. If they inferred a total freeze in year 3 they would be mistaken, since the third year seen from A was actually not a freeze year for B. Perhaps some genius among them would eventually hit upon "A freezes every third year and B every fourth" as the explanation of their data, but whether that would actually be the best explanation is debatable.[49]

So much for Shoemaker's original epistemological argument. I now wish to propose a metaphysical fix, using a recombination principle for possibility such as been advocated by David Lewis. Lewis puts part of the principle this way, calling it a "patchwork principle" for possibility:

> If it is possible that X happen intrinsically in a spatiotemporal region, and if it is likewise possible that Y happen in a region, then also it is possible that both X and Y happen in two distinct but adjacent regions. (1983, p. 77)

The other half of the full recombination principle would be a reverse patchwork principle, saying that if an X + Y universe is possible, so is a universe containing X without Y or Y without X. Gendler and Hawthorne (2006) aptly call the conjunction of the halves a "cut-and-paste principle" for possibility.

The application of this principle is obvious. Suppose there is a universe consisting of a sector A as described by Shoemaker (a local freeze every third year) and a sector B with no freezes. We need only detach A from B, and the result will be a possible universe containing a total freeze. Or we could let B be a sector containing just one

[49] The following reply to this objection occurs to me. In the first days following a freeze, inhabitants of A would see that there appears to have been a "jump" in B, and that many things are suddenly just as one should expect them to be one year later (a year's growth in trees and so forth). If they had in other years witnessed a freeze in B, perhaps it would occur to them that the jump is explained by their own arrested consciousness. I leave it to the reader to reflect on whether this could support an overall inference to the hypothesis "two on, one off for us, three on, one off for them."

freeze, a year after one of A's, and then cut and realign the sectors so that the two local freezes are simultaneous.

It may be objected that "containing a year-long local freeze" is not an intrinsic property of A—it depends on their being clocks running or other changes happening in B. Therefore, we cannot detach A from B while leaving the freeze as it was. My rejoinder is as follows. The objector may be within his rights in insisting that the detached A universe could not be said to contain a freeze that was a year long—there can be no fact of the matter how long the freeze lasted. However, if there was a freeze lasting for any duration greater than zero, Shoemaker wins. The objector must evidently say that the world-state into which A was frozen in the original universe disappears upon the removal of B, and that, I submit, is implausible.

Acknowledgements to be added.

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