FINAL DRAFT

A Passage Theory of Time

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Time passes. The fact that you read these words passes into the fact that you read these words instead, which passes into the fact that you now read these words, and so it goes. This paper explores a view of time that takes passage to be the most basic temporal notion, instead of the usual A-theoretic and B-theoretic notions.

When we describe the facts of one time as passing into the facts of a next time, we describe the world from an atemporal point of view. There are the facts that are constitutive of each moment of time and there is the passing of the one collection of facts into the other. But, when we adopt an atemporal view on which all times are on par, and yet admit a genuine passage of time, it seems that we adopt an incoherent view. Only the passage of a fact into a contrary fact can make for a genuine change of the objects involved in those facts. So if the facts of distinct times equally obtain, and those facts make for genuine change across time, then it seems that contrary facts equally obtain. Many conclude that passage and change are therefore incoherent notions that we should dispense with in favour of more kosher substitutes. This papers explores an alternative approach, namely one according to which passage involves indeed contrary facts and yet really obtains. We can make sense of this if the world is metaphysically fragmented. The proposed theory will build on the fragmentalist view that was introduced by Fine in his 'Tense and Reality' (2005). Unlike Fine's A-theoretic fragmentalism though, the proposed view will be a fragmentalist view based in a primitive notion of passage.

The essay consists of the following three sections. Section 1 argues that the standard A-theory, standard B-theory and Finean fragmentalism do not capture the passage of time. Section 2 spells out the version of fragmentalism that will be the basis of the proposed passage theory of time. Section 3 proposes the passage theory itself.

The main objective of this paper is simple: to describe a conception of time that is of intrinsic interest. I will be fairly quick when I discuss worries to the more standard theories in the understanding that these worries are not meant to refute these theories but only help introduce and shape another contender.

1 A Search for Passage

There is a widespread view that for time to pass is for certain tensed facts to obtain. Let an A-theory be any theory formulated in terms of tensed notions.[1] The tensed descriptions of the world are typically stated with the help of a past tense operator 'P' ('it was the case that…'), a future tense operator 'F' ('it will be the case that…'), and the principle that

[1] Though a tensed-based conception of time is often combined with a presentist view (according to which only current objects exist), it naturally features in other conceptions of time as well. Even on a growing block view, one will want to say that the block *will* include more; and even on a moving spotlight view, one will want to say that a different time *will* be qualitatively privileged (cf. Sider 2001: 22).

any unembedded sentence '*A*' is read as stating how things are *right now*.[2] So a sentence 'P(*A*)' says that it was the case that *A* or, equivalently, that it is now the case that it was the case that *A*. Using a tense-based language of this kind, one might think that time passes when certain things *were* the case and *will* be the case that aren't the case right now.[3]

But the tensed descriptions do not capture the passage of time at all. Given that any sentence *A* states what obtains right now, any fact whatsoever is a current fact; in particular, that something *will obtain* and that something *has obtained* are themselves current facts. At the heart of the A-theory lies the mentioned principle that any sentence states what currently obtains, that any sentence is merely descriptive of the current state of the world. This implies that any sentence only ever specifies the contents of a single momentary stage in time, namely the current one. To state that something obtains is just to describe more of the current stage in history, and not the passing from that stage of history to the next. Price made the objection vivid: '[W]hat did God need to create, in order to create the whole of reality, as our exclusive presentist describes it? Not a long series of worldstages, but just a single moment, complete with its internal representation of a past and future' (Price 2011: 279; cf. Fine 2005: §7).

The closest that a standard A-theory comes to capturing the passage of time is in the constant rewriting of its description of the world. It states that the world is (now) *this* way. And then we wait. And then it states that the world is (now) *this* way. But the crucial bit is in the waiting, this is where time passes, and the passing itself isn't captured in any of the descriptions that the theory offers us. To emulate passage is not to capture it (cf. Park 1971 and Savitt 2002), just as we do not capture the nature of redness by writing our theory in red ink. Nor do the tensed descriptions offer an animated picture of the world simply because they include bits that fix what is to come, and what came before. What an A-theory really offers us, across time, are the still snapshots of that which passes away *if and when time passes* and not a picture of that very passing itself. A passing picture isn't a picture of passage.

One might reply that the A-theory really proposes a reductive account of passage. The fact that new things will be the case, one might say, captures everything that is worth capturing about our ordinary concept of passage; the theory teaches us what passage must *at bottom* consist in. This reply does not help the dialectic forward, however. There is a difference between a satisfactory reductive account and an incomplete account of a target phenomenon. Whether the A-theory's reductive account of passage is satisfactory or simply misses the mark by failing to capture certain central aspects of passage depends on what passage consists in, and that is precisely at issue in the worry raised above. To the extent that the above worry sways us, we have reason to think that there is more to passage than is offered by the A-theory.

If the tensed descriptions of a standard A-theory do not capture the passage of time, what sort of view does? The culprit seems to be the principle that any statement is a statement about the way things are right now, which makes any fact a current fact. It is this principle that confines us to describing the world from the current perspective in time, rendering any statement a statement of just more momentary content. So perhaps we

[2] This basic framework is due to Prior (1967). The principle that *A* is equivalent to NOW(*A*) doesn't hold for sentences embedded under tense operators. Kamp (1971) showed that prefixing embedded sentences under a now operator can affect the truth-value of the sentences they are embedded in.

[3] Thus, for example, Prior: '"It was the case that *p*, but is not now the case that *p*" - this formula continues to express what is common to the flow of a literal river on the one hand (where it was the case that such-and-such drops were at a certain place, and this is the case no longer) and the flow of time on the other' Prior (1962/2003: 19).

should free ourselves from this reading of free-standing sentences and describe the world from an atemporal point of view instead.

Surprisingly, this might make one turn to B-theories in search for passage, since a B-theory assumes an atemporal perspective on reality and does not take reality to be confined to what is currently the case. But the B-theory assumes an atemporal perspective in a particular way, namely by thinking of time as a dimension similar to space. On a standard B-theory, there is assumed to be a series of times in our ontology, ordered by an earlier-than relation, at which objects are said to be 'located' and 'at which' objects are said to have their properties. There are different accounts of the way in which objects have their properties 'at times' (Lowe 1988: 73). One might think that a tree is straight 'at *t*' when (1) the tree has a temporal part that is straight and located at *t* (Lewis 1986: 202-204), or (2) the tree bears a straight-at relation to *t* (Mellor 1981: Ch.7), or (3) the tree instantiates in a *t*-relative way the straightness property (Johnston 1987: 128), or (4) the tree is involved in the type event [the tree is straight] which is tokened at *t* (Haslanger 2003: §9.3).[4] These views have in common that cross-temporal relations only hold between facts (or events) that are not incompatible, and between objects that are not involved in incompatible facts. Only compatible facts make up the various regions of the block universe.

It seems however that B-theories leave no room for a passage of time *precisely to the extent* that cross-temporal relations only hold between facts (or events) that are not incompatible and between objects that are not involved in incompatible facts.[5] Passage should make for change (McTaggart 1908: 459), and there is change only if a fact passes into a contrary fact. The following conditions all seem necessary conditions for change and yet are in direct conflict with the mentioned accounts of persistence (cf. Haslanger 2003):

> *Identity condition*: If an object persists through change, the object before the change is one and the same as the one existing after the change.
>
> *Proper subject condition*: The object undergoing the change is the very thing that is the different ways before and after the change.
>
> *Contrary ways condition*: The way an object is before the change conflicts with the way the object comes to be through the change.

These conditions are all underwritten by a simple picture of change: an object *a* changes across time if *a*'s being a certain way passes into *a's* no longer being that way. There is change when we pass from the presence of a fact to the absence of that fact, when we pass from it being the case that *A* to it no longer being the case that *A* (or vice versa, when we pass from not *A* to *A*). We cannot draw how things are across time in the way we can draw how objects are across space *because* things change across time, and change implies involvement in contrary facts.

Again, B-theorists may reply that they aim to offer a reductive account of change. A perdurantist, for example, might insist that an object's having different temporal parts with incompatible properties captures everything that is worth capturing about change,

[4] This is by no means an exhaustive list of options; see also e.g. Ehring (1997) and MacBride (2001). It also does not represent the only way of articulating perdurance and endurance views; see e.g. Hofweber and Velleman (2011).

[5] For a detailed 'no-change' objection to perdurantism, see Mellor (1998: 89). For a detailed 'no-change' objection to relationalism, see Rodriquez-Pereyra (2003: 191-192).

and that the theory teaches us what change must *at bottom* consist in. But again this reply does not help the dialectic forward. Whether the B-theoretic account of change is satisfactory or just incomplete depends on what change consists in. The no-change objections provide reasons to think that there is more to change than is offered by the B-theory.

The B-theory leaves no room for passage because it adopts an atemporal point of view *in the wrong way*, namely by spatializing the way objects are present in time. This suggests that we need to adopt an atemporal point of view whilst thinking of the contents of times in a way that is closer to the way they are thought of within the A-theory. We should not revise our conception of the objects that are involved in change, nor revise the intrinsic properties they have across time, nor revise the way objects have these properties – more generally, we should not attempt to render the facts across time compatible.

So we need a view that adopts an atemporal point of view and yet leaves the conflicting facts across time in place. Fine has introduced precisely such a view, which he called fragmentalism (see Fine 2005: §5).[6] To adopt this view, we step back from our temporally embedded perspective, and take the tensed contents of any time to be all equally part of reality. We admit the tensed facts of past times as they were back then (so we admit the fact that Aristotle is (now) sitting), and we also admit the tensed facts of future times as they will be in due time (so we admit the fact that a human is (now) walking on Mars). The tensed contents of all times are deemed equally real. This means that conflicting facts are part of reality. There is however a primitive notion of coherence that holds between some but not all facts, thus forming maximally 'coherent' collections of facts, the so-called fragments of reality. Any fragment is internally coherent as only non-conflicting facts 'cohere' and so the overall incoherent collection of facts is taken to consist of multiple internally coherent sub-collections of facts.

Does this tense-based fragmentalism succeed in capturing the passage of time? It seems not. At most, Fine's fragmentalism provides the facts of which we want to say that one passes into another. It still doesn't provide the passing itself. Fine himself is aware of this:

> [C]learly, something more than the equitable distribution of presentness is required to account for the passage of time. But at least, on the current view, there is no obvious impediment to accounting for the passage of time in terms of a successive now. We have assembled all of the relevant NOWs, so to speak, even if there remains some question as to why the relationship between them should be taken to constitute a genuine form of succession. Fine (2005: 288).

Fragmentalism is only a necessary part of a theory that captures the passage of time. It's not the full story. So, then, what is the full story?

Tallant, in a discussion of Fine's fragmentalism, sees various obstacles to the addition of a relation that could constitute passage. First, he notes:

> [S]uch a relation would have to be *in* neither of the fragments that it relates – it must bridge the gap between them. The first (obvious) problem is that it is entirely unclear what sort of relation is suited to relating distinct fragments of reality. Tallant (2013: 12-13).

[6] The A-theory's failure to capture the passage of time also motivates another non-standard A-theory, which Fine calls external relativism. I will not discuss this view here or compare it to the view that will be proposed in this paper. For a discussion of the relation between fragmentalism and relativism, and why fragmentalism is superior, see Fine (2005: §11).

Tallant is right: passage cannot be a further way things are 'at' a moment in time. The relevant relational fact could not simply be *just-more* momentary content again, after all, we are not interested in further additions to the momentary states of the world, we are interested in the passage of one momentary state into another. Tallant continues:

> The second problem is that, even if we can locate a relation to relate the distinct fragments, it remains unclear how this relation is to suffice for passage. [...] Only particular relations can generate temporal order. If that is right, and the relation between distinct fragments of reality is temporal, then presumably said relation will have to be the tenseless 'earlier than' and 'later than' relation, that is the fundament of the B-theory. Tallant (2013: 13).

I agree that we need a relation that doesn't just hold 'at' a time but is nevertheless a *temporal* relation. But Tallant is too quick in thinking that it can then only be the earlier-than relation that is added to the fragmentalist's view.

In fact, we can be sure that it is of no help to add the earlier-than relation, as the temporal order that this introduces is already captured by the tensed contents of the fragments as Fine is thinking of them. Let $frag_1$, $frag_2$,… refer to the fragments, understood as certain sets of tensed facts, and let [*A*] refer to *the fact that A*.[7] We can then define an earlier-than notion, symbolized with '≤', as follows (cf. Meyer 2013: 61):

$frag_1 \leq frag_2$ iff, if $[A] \in frag_1$, then $[PA] \in frag_2$[8]

Since the earlier-than relation can be defined in this way from the tensed contents of the fragments, it isn't temporal order that is lacking. We have no problem in ordering the fragments in such a way that they follow the trajectory of actual history, and yet the very passing of time seems absent. Mere temporal order doesn't make for passage.

This of course aggravates the question of what on earth the fragmentalist could add to the 'equitable distribution of presentness' in order to capture the passage of time. There are at least two possibilities. The first is that we find something – distinct from passage itself and distinct from the A-theoretic and B-theoretic notions – that constitutes the passing from one fragment into the next. I do not see what this further notion could be, however. A second possibility is that we started in the wrong place by assuming that we could explain the passage of time on the basis of other temporal notions. Perhaps there is something to passage that is basic, and cannot be captured in any other terms. The very fact that many of us can recognize that passage seems lacking from the standard A-theory, the standard B-theory and Fine's A-theoretic fragmentalism, suggests that at least many of us possess a concept of passage that is not exhausted by any of the theoretical primitives currently at play in these theories. If we indeed possess such a concept, we are

[7] Fine makes clear that this talk of facts as things, and of reality as a thing composed of facts, is mere loose talk, and not the idiom that reflects the fragmentalist's conception of the world (Fine 2005: 268). The difference between the strict and loose talk doesn't matter for the current point.

[8] We can also define the earlier-than relation using the future operator: $frag_1 \leq frag_2$ iff, if $[A] \in frag_2$, then $[FA] \in frag_1$. Of course, these two definitions only generate a satisfactory earlier-than relation if the tense-operators behave in the right way. Meyer (2013: §4.3) points out that a very weak tense logic suffices for this. Where H is the 'always has been the case' operator and G is the 'always going to be the case' operator, all we need are the axioms: $H(A \rightarrow B) \rightarrow (HA \rightarrow HB)$ and $G(A \rightarrow B) \rightarrow (GA \rightarrow HB)$, the tense-logical analogues of K's distribution axioms, and the two rules: if $\vdash A$ then $\vdash HA$, and if $\vdash A$ then $\vdash GA$, the tense analogues of necessitation.

free to employ it within in our theories of the world, and regiment it directly.[9] In that case we no longer search for a reductive explanation of what the passage of time consists in but instead investigate what the world has to be like if we assume that there is a real passage of time. Our starting point is now that the contents of one time pass into the contents of another time in the very sense in which this seems absent from the theories discussed above.

Let me summarize the dialectic. The A-theory seems not to capture the passage of time because it describes only momentary facts, suggesting that we need an atemporal view of the world. The B-theory seems not to capture passage because it does not allow conflicting facts across time, suggesting that we need an atemporal view that admits such conflicting facts. Fine's tense-based fragmentalism is precisely such a view, and yet it still fails to capture passage, suggesting that passage does not admit of a reductive explanation in terms of tense *even when* we adopt an atemporal perspective that admits the conflicting facts that appear to obtain across time. Taking these considerations together, it seems we must make room for conflicting facts in our conception of the world and relate those facts through a non-reductive notion of passage. I will proceed in two steps. First I will propose an understanding of fragmentalism (that differs from Fine's in certain ways) and discuss it in some detail; and then I will discuss how we can situate passage within the fragmentalist conception of the world.

2 Fragmentation across time

Fine's characterization of fragmentalism is firmly based in a certain conception of reality, according to which a primitive notion of reality should play a crucial role in metaphysics (see Fine 2001: §8-10; and 2005: §2). Instead of discussing Fine's (metametaphysical) framework, I will set out my preferred understanding of fragmentalism from scratch.[10] On this view, fragmentalism does not rely on a primitive notion of reality.

Consider a tree that starts out growing straight up but then gradually grows into a crooked and bent tree. If we consider this from an atemporal perspective and say that the tree is straight and bent, we quickly want to add that the tree is these ways *only at different times*. We add this temporal qualification because we take this to explain how the tree can be both straight and bent when considered from an atemporal perspective. But why does this temporal qualification explain this? The temporal qualification explains how incompatible facts can obtain because, I submit, the temporal separation implies a kind of metaphysical separation of the incompatible facts, a lack of co-reality. The fact that the tree is straight and the fact that the tree is bent do not obtain *together* in the sense that they do not constitute a unified chunk of world. The first fact only obtains insofar as the second fact doesn't and, vice versa, the second fact only obtains insofar as the first doesn't. Both facts obtain, they just obtain separately from each other. The point of talk of facts obtaining 'at different times' is not just to relate facts to some entities, times. The point of such talk is that, by relating incompatible to distinct times, we convey that the relevant facts do not co-obtain in a certain sense. We can abstract this failure of co-obtainment from the relativization that we use to convey it.

[9] The intelligibility of the concept of passage is the subject of much debate, most of which I cannot address here. Influential discussions of passage, or aspects of passage (such as its directionality), are found in Smart (1949), Williams (1951), Price (2011), Earman (1974), Maudlin (2007: Ch.4), Savitt (2002) and Norton (2010).

[10] I discuss Fine's conception of fragmentalism and compare it to the view of fragmentalism proposed below, in Lipman (2015).

Pursuing this line of thought further, we can make the involved understanding of co-obtainment explicit. It's normally assumed that for *A* and *B* to co-obtain is just for *A* and *B* each to obtain. Call this co-obtainment in the thin sense. Fragmentalism assumes that there is also a thick sense of co-obtainment according to which *A* and *B* can each obtain without co-obtaining. Given this distinction between a thin and thick sense of co-obtainment, it seems that we normally slide between them, reflecting an implicit assumption that the world is a metaphysically unified place. This slide goes as follows: we assume that if something is straight and bent, it must thereby be straight and bent *together*, and that, because something cannot be straight and bent *together*, it cannot be straight and bent, period. We cannot conceive of the co-obtainment in the thick sense of the tree's being straight and the tree's being bent, that is, we cannot conceive of a unified bit of world with a tree in it that is both straight and bent. But, from the fact that *this* is inconceivable, we draw a conclusion concerning co-obtainment in the thin sense: we conclude that it's impossible that the tree is straight and bent. We make an implicit assumption that, necessarily, any two facts that co-obtain in the thin sense, co-obtain in the thick sense. This is a substantive metaphysical assumption that is not at all obvious when we consider the way things are across time. It's implausible to think that Aristotle's sitting and my sitting form a unified bit of world within which we are both sitting just because the facts both obtain across time. Fragmentalism denies this unity assumption, and hence denies that there is a legitimate inference from the impossibility of being straight and bent *together* to the impossibility of being straight and bent.

The thin sense of co-obtainment is captured by ordinary conjunction. It's the case that $A \wedge B$ just when *A* and *B* are each the case. Ordinary conjunction is simply silent about whether *A* and *B* also form a single unified chunk of world. This can be distinguished from the thick notion of co-obtainment that I will express with a sentential connective '$\circ$', which *does* imply metaphysical unity: it is the case that $A \circ B$ just when there is a single unified bit of world which is such that *A* and *B*. I propose that we read '$A \circ B$' as '*A* insofar as *B*', so that for example 'the sun shines $\circ$ the tree is leafless' is read as 'the sun shines *insofar as* the tree is leafless'. This is to some extent a theoretical regimentation of the ordinary language phrase 'insofar as'.[11] Since we are introducing a new concept, our options are either to (ab)use a notion whose ordinary language sense comes close, or to introduce a new phrase, say 'shqand' and read '$A \circ B$' as '*A* shqand *B*'. I prefer the former option, using a well-known phrase that comes close, in a regimented way. For ease of expression, I will also sometimes talk *of* facts co-obtaining, in the understanding that this talk about reified facts can be translated into the official idiom: 'the fact that *A* and the fact that *B* co-obtain' can always be translated into '*A* insofar as *B*'. 'Co-obtainment' always refers to co-obtainment in the thick sense from now on.

Given the sharp distinction between two conjunctive notions '$\wedge$' and '$\circ$' we can now make a distinction between two kinds of conflicting facts:

> '*A*' and '*B*' state *contrary* facts iff they cannot both obtain, i.e. iff, necessarily, $\neg(A \wedge B)$.
>
> '*A*' and '*B*' state *incompatible* facts iff they cannot co-obtain, i.e. iff, necessarily, $\neg(A \circ B)$.

[11] In ordinary language, the phrase 'insofar as' has various readings. I'm using the phrase here to offer an informal reading of the introduced notion, and it's not assumed that any of the ordinary language meanings coincides neatly with the way it is used here; see also Lipman (forthcoming: §4).

Call sentences such that the one is the negation of the other ('*A*' and '¬*A*') *contradicting* sentences. It's natural to hold that contradicting sentences only express contrary facts, i.e. that, necessarily, ¬(*A*∧¬*A*). The conflict in what contradicting sentences state arises arguably from the meaning of negation and not from the particular predicates involved, and the kind of conflict that arises from negation is naturally taken to be contrarity. This stands in contrast to sentences such as 'the tree is bent' and 'the tree is straight', where any conflict we see between such sentences doesn't arise from their logical structure but from the meaning of the predicates involved. According to fragmentalism, there are pairs of facts which are incompatible but not contrary, for example, we might think that it's possible that the tree is straight *and* bent but impossible that the tree is straight *insofar as* it is bent.

If contradicting sentences always state contrary facts, there is a constraining connection between, on the hand, the logical structure we attribute to sentences and, on the other hand, the kind of conflict we think there is in what is stated by the relevant sentences. Take the pair of sentences 'Aristotle is alive' and 'Aristotle is dead'. Is it possible that Aristotle is alive and dead? Well, one might think that to be dead is just *not* to be alive, i.e. that 'Aristotle is dead' expresses *that Aristotle is not alive*.[12] If we believe that 'Aristotle is dead' expresses *that Aristotle is not alive*, we thereby believe that 'Aristotle is alive' and 'Aristotle is dead' express contrary facts, i.e. that it is impossible that Aristotle is alive and dead. Vice versa, if we believe that it is possible that Aristotle is alive and dead, this means that we cannot subsequently understand 'Aristotle is dead' as expressing that Aristotle is not alive. Our judgments concerning logical form and the involved kind of conflict constrain each other.[13]

What about compatible facts, do they necessarily co-obtain? I see no reason why they should. If two compatible facts seem to obtain at distinct moments in time only, such as Aristotle's sitting and my sitting, then they do not co-obtain, regardless of their compatibility. We can distinguish the possible case in which compatible facts co-obtain from the possible case in which they each obtain but fail to co-obtain. This renders the co-obtaining of compatible facts a contingent and substantive matter. A complete description of the world doesn't just need to capture everything that obtains, it needs to capture what co-obtains with what and what things obtain yet fail to co-obtain.

One may wonder how, exactly, fragmentalism is meant to be a coherent view. To have a better sense of this, and of the formal properties of co-obtainment more generally,

[12] One might think this, or one might not. Fragmentalists are not beholden to the grammatical structure of the language they use to describe the world. The fact that 'is dead' or 'is non-alive' are unary predicates in no way *determines* that it's possible that Aristotle is both alive and dead, or alive and non-alive. Whether predicates are unary, and how they are written more generally, doesn't determine anything. The point here is logical structure: a sentence with *surface structure* 'G*a*' might sometimes be understood as expressing *that* ¬*Fa*, and when that is the case, the fragmentalist is no longer free to hold that F*a* and G*a*, and vice versa, when she believes that F*a* and G*a*, she is no longer free to hold that the sentence 'G*a*' expresses *that* ¬*Fa*.

[13] To decide tricky cases, it can be a good heuristic to think in terms of the existence of properties (although this is not an official commitment of the framework – just a heuristic). Do 'Aristotle is alive' and 'Aristotle is dead' express contrary or merely incompatible facts? Here it might help to ask whether there are the properties of *being alive* and *being dead*, or merely the property of *being alive* that some things have and other things lack. In the case of 'the rose is red' and 'the rose is blue', for example, it seems intuitive that there are two properties, and that 'is red' is not adequately understood as 'is neither blue nor green nor orange …' but that there is a positively qualitative way that things are when they are red. When it sounds right to say that there are two distinct properties that the relevant sentences attribute to an object, this is some reason to think that they state merely incompatible facts.

we need to have a closer look at the inferential role of co-obtainment. It's helpful to resort to some simple model theory for this purpose.[14]

Let the set of sentences S consist of atomic sentences p, q, r,… and be such that, if A and B are sentences, so are $\neg A$, $A \wedge B$ and $A \circ B$ (nothing else is in S). A model M is a pair $<T, v>$ where T is a set of points and v is a function that assigns either 1 or 0 to each of the atomic sentences relative to each point $t \in T$.

The valuation v for the atomic sentences relative to points is extended to a valuation for all the sentences via the following recursive clauses (where t ranges over points in T):

- $v_t(A \circ B) = 1$ iff $v_t(A) = 1$ and $v_t(B) = 1$
- $v_t(A \wedge B) = 1$ iff $v_t(A) = 1$ and $v_t(B) = 1$
- $v_t(\neg A) = 1$ iff $v_t(A) \neq 1$

Note that conjunction and co-obtainment have the same clauses here. Truth in a model, written $M \Vdash A$ is defined via the following recursive clauses (where p is an arbitrary atomic sentence):

- $M \Vdash p$ iff $\exists t(v_t(p) = 1)$
- $M \Vdash A \circ B$ iff $\exists t(v_t(A \circ B) = 1)$
- $M \Vdash A \wedge B$ iff $M \Vdash A$ and $M \Vdash B$
- $M \Vdash \neg A$ iff $M \nVdash A$

Note that conjunction and co-obtainment have different clauses here. We define validity and logical truth in the standard way (where Σ is a set of sentences):

> An argument from Σ to A is *valid*, written $\Sigma \vDash A$, iff, for every model M, if $M \Vdash \Sigma$ then $M \Vdash A$.[15]

> A formula A is logically true, written $\vDash A$, iff, for every model M, $M \Vdash A$.

Note that the points in T are used to represent the fragmentation across facts and can for heuristic purposes be thought of as moments of time. One can also think of them more abstractly as representing unified bits of world.[16] That, within a model, $A \circ B$ is true if and only if there is a point at which A and B are true, reflects our metaphorical paraphrase of $A \circ B$ as saying that there is a single unified bit of world which is such that A and B. But, just as we should not confuse metaphorical paraphrases with the notion paraphrased (the view is not that we quantify over 'unified bits of worlds'), we should not confuse the structure of the models with the structure of what they are models of: the set-theoretic machinery is merely a heuristic tool to draw out whatever logical structure the co-obtainment notion needs to have in order for it to capture the metaphysical picture that

[14] The logic proposed is inspired by the 'discussive logic' of Jaśkowski (1948/1969) - with the important difference that Jaśkowski's discussive logic is paraconsistent, whereas the logic below isn't. For discussions of other closely related logics, see Rescher and Brandom (1980), Lewis (1982), Priest (2008) and, in particular, Restall (1997). For an accessible introduction to non-adjunctive logic, see Priest (2007: §4.2) and Varzi (1997). The logic presented here is discussed in a little more detail in Lipman (forthcoming).

[15] By $M \Vdash \Sigma$ we mean that $M \Vdash B$ for all $B \in \Sigma$.

[16] Alternatively, the points can be interpreted as the possible worlds known from standard modal logics, so that a single fragmented world (here represented by a single model) corresponds to a set of possible worlds in a frame of modal logic; see Restall (1997).

we are after. It's not part of our metaphysical view that sentences are true 'relative to' or 'at' points, and the points do not correspond to anything in the fragmentalist's ontology. Certain facts obtain *insofar as* other facts do, that is how the fragmentalist understands things.

The *v*-clauses say what is true and false at each of the points in the model theory. There are *v*-clauses for conjunction, negation and co-obtainment because the logic needs to handle the embedding of logically complex sentences within co-obtainment sentences. For example, $A\circ(B\circ C)$ is true in the model only if A and $B\circ C$ are true *at a point* and this requires that $B\circ C$ has a truth-value at a point. The same applies to $A\circ\neg B$ and $A\circ(B\wedge C)$.

We can now clarify the proposed version of fragmentalism. Note first of all that a sentence is true *at a point* if and only if its negation isn't true there. This means that we never have a point where both a sentence and its negation are true. That is:

$$\vDash \neg(A\circ \neg A)$$

It cannot be the case that something obtains *insofar as* it doesn't obtain.

Similarly, any sentence in our language is true in a model if and only if its negation isn't true in the model. This means that the law of non-contradiction holds:

$$\vDash \neg(A\wedge \neg A)$$

It cannot be the case that something both obtains and doesn't obtain. To illustrate the consequences of this, consider a model where we have t_1 at which p is true but q isn't, and t_2 at which q is true but p isn't. As there are points at which p and q are true, they are true in the model. This means that $\neg q$ isn't true in the model. But given that $\neg q$ is true *at* t_1, $p\circ \neg q$ is true in the model. So in this model, $\neg q$ is false, yet true *insofar as* p is true (i.e. $\neg q$ is false but $p\circ \neg q$ is true). The worldly fragmentation gives rise to negative sentences being true *insofar as* certain other things are true, even though they are false simpliciter.

This understanding of negative facts reflects a natural understanding of local absences versus global absences. Compare the way existence-at-a-location and existence simpliciter interact: an object exists when there is a location at which it exists but it doesn't fail to exist when there is a location at which it doesn't exist. An object doesn't exist only when there is *no* location at which it exists. Whereas local existence suffices for global existence, local non-existence doesn't suffice for global non-existence. There may be local non-existence without global non-existence. Similarly, in a fragmented world we can think of atomic sentences as stating the positive contents of the world. When an atomic fact obtains *insofar as* other facts obtain (or 'within a fragment'), this suffices for it to obtain simpliciter (or 'in the world as such'), but when the fact is absent *insofar as* other facts obtain (or absent 'in a fragment'), this does not suffice for the fact to be absent simpliciter (or absent 'from the world at large'). This is the view we arrive at when we think of negation as behaving classically, both within a fragment as well as in the world at large, and there is no reason why the fragmentalist should adopt a non-standard understanding of negation, and hence no reason why the fragmentalist requires a paraconsistent logic.

It can easily be seen from the semantics that co-obtainment is commutative and associative:

$$A\circ B \vDash B\circ A$$
$$A\circ(B\circ C) \vDash (A\circ B)\circ C$$

Co-obtainment is not an asymmetric affair in any way, and whenever *A* co-obtains with the co-obtainment of two other facts, this just means that all three facts co-obtain with each other.

Co-obtainment is however not idempotent:

$A \circ A \nvDash A$[17]
$A \nvDash A \circ A$[18]

It may be that *A* co-obtains with itself, and yet doesn't obtain. The reason for this is the earlier noted emergence of negative facts that do not obtain, yet *do* co-obtain with other facts. As a limit case of this, there are negative facts that co-obtain with themselves but which do not obtain as such. Vice versa, there are facts that obtain without co-obtaining with themselves. The failure of this arises from descriptions of multiple fragments. The conjunctive fact that the tree is bent *and* straight will fail to co-obtain with itself; there is no single unified bit of world that is characterized by the conjunction.

We may furthermore note the failure of adjunctive and simplifying rules for co-obtainment:

$A, B \nvDash A \circ B$[19]
$A \circ B \nvDash A$[20]

The fact that *A* obtains and *B* obtains doesn't mean that *A* obtains *insofar as B* obtains. This is the central feature of the co-obtainment notion we discussed above. Simplification fails, again, because a negative fact may obtain *insofar as* another fact obtains and yet fail to obtain.

Co-obtainment is also non-transitive:

$A \circ B, B \circ C \nvDash A \circ C$[21]

This failure of transitivity allows fragments to overlap, without the fragments collapsing into one. An object may be red *insofar as* it is straight, and it may be red *insofar as* it is bent, but in no way should this imply that the object is thereby straight *insofar as* it is bent.

This should suffice in building some formal grasp of the introduced sense of co-obtainment. The semantics teaches us how to use the notion of co-obtainment even if our understanding of it is admittedly still thin. Beyond the metaphorical paraphrases and the offered logical constraints on its use, our understanding of co-obtainment can only

[17] To see why we have $A \circ A \nvDash A$, consider a model where some atomic sentence p is false at one point t_1 but true at a different point t_2. In this model, $\neg p \circ \neg p$ is true given that there is a point where each is true (viz. t_1). And yet $\neg p$ is not true simpliciter, given that p is true at t_2.
[18] To see why we have $A \nvDash A \circ A$, consider a model in which we have t_1 at which p is true but q isn't and t_2 at which q is true but p isn't. Here $p \wedge q$ is true, but $(p \wedge q) \circ (p \wedge q)$ isn't true, as there is no single point at which $p \wedge q$ is true.
[19] For the failure of adjunction, consider a model where we have t_1 at which p is true and t_2 at which q is true. Here p is true and q is true (and hence $p \wedge q$ is true) because they are atomic sentences and there are points at which they are true. But $p \circ q$ isn't true, given that there is no point at which p and q are both true.
[20] For the failure of simplification, consider a model where we have t_1 at which p is true and t_2 at which q and $\neg p$ are true. Here $q \circ \neg p$ is true in the model, but $\neg p$ is not true in the model, given that p is true at t_1.
[21] Consider a model where we have a point t_1 at which p and q are true but r isn't, and a point t_2 at which q and r are true but p isn't. In such a model, $p \circ q$ and $q \circ r$ are true, but $p \circ r$ isn't.

become richer through its application in concrete cases. In the case at hand, that of fragmentation across time, the fragmentalist language affords us with an atemporal view of the world that doesn't force us to take the facts that constitute the world at various times all to co-obtain, or be compatible. We can describe the way that reality is at a single time as the co-obtainment of a large collection of facts, each one of which co-obtains with every other, and not all of which co-obtain with the facts that constitute the world at a different time. So the overall conception of the world, thus far, is reflected in a description of the following form:

> … ∧ (a brachiosaurus walks the earth ∘ Aristotle does not exist ∘ …) ∧ … ∧ (no brachiosaurus walks the earth ∘ Aristotle is alive ∘ …) ∧ … ∧ (no brachiosaur walks the earth ∘ Aristotle is dead ∘ Napoleon sits on his horse ∘ …) ∧ …[22]

The long co-obtainments that feature within these descriptions state what obtains 'at various times' as facts that mutually co-obtain.

The fragmentalist will believe that, for example, the changing tree is straight and bent. This only makes sense if we can resist thinking of the world as one continuous fabric of facts. Some of the facts in the overall collection are only real insofar as some of the other facts in the overall collection aren't real. Focus for a moment on the way things are around you while you are reading this. *Insofar as* things are those ways, Napoleon is entirely non-existent, as unreal as a unicorn. However, we are able to abstract from our current perspective in time. Now it remains the case that Napoleon is entirely non-existent *insofar as* things are the ways they are around you while you are reading this, but this does not mean that Napoleon cannot exist *insofar as* things are some other way.[23]

The current view of the world shouldn't be read as featuring tensed descriptions of facts. Contra Finean fragmentalism, the fragmentalist framework that will be the basis for the passage theory of time doesn't feature tense at all, not even the present tense. The descriptions should all be understood as tenseless descriptions. The reason for this is simple. If the claim that 'Aristotle is alive' were understood as saying *that Aristotle is now alive*, then, in treating all times on a par, the fragmentalist would be claiming that it is *now* the case that Aristotle is alive. But it's a straightforward historical fact that Aristotle isn't now alive.[24] In entertaining the fragmentalist view, I'm simply not concerned with the way things are now. The fragmentalist's predications must be tenseless predications if we are to adopt a truly neutral standpoint and treat the contents of all times on a par. We can think of 'Aristotle is alive' as expressing that Aristotle instantiates a certain property, not as expressing that he instantiates the property *now*, nor

[22] As co-obtainment has been symbolized using a binary connective, it should be clear that I have left out some unnecessary bracketing. It might well turn out that co-obtainment is more aptly conceived of as a multigrade or even infinitary connective.

[23] One might wonder here: what keeps us from adopting an even more expansive perspective that also purveys how the world is across modal space? I agree with Fine when he writes that 'there is not the same wide metaphysical gulf between the present and other times as there is between the actual world and other possible worlds. What goes on in the present and at other times is somehow part of the same all-encompassing reality in a way in which what goes on in the actual world and in other possible worlds is not' (Fine 2005: 285). The ways things are across time stand in various explanatory connections that one does not find across possible worlds. *How things could have been* doesn't explain how things are in the way in which *how things were* explains how things are now. Also, there is nothing like passage in the modal case; we are not taken through modal space in the way we are taken through time.

[24] Fine avoids denying the historical fact by resorting to a non-factive reality operator $\mathfrak{R}$: that it is the case that $\mathfrak{R}$(Aristotle is now alive) doesn't imply that Aristotle is now alive (see Fine 2005: 297-298). But the fact that $\mathfrak{R}$(Aristotle is now alive) worries me as much as the fact that Aristotle is now alive.

that he *always* or *eternally* instantiates the property, just that he has the property. We need to think of predications in a temporally naïve way. The predication of properties and relations to objects is stripped from any temporal meaning, not implying anything about *where in time* the object has the property.

3 Regimenting Passage

Nothing thus far represents the passing of time. Let us now appeal directly to the notion of passage that seems to be lacking in other theories. The result will of course not be a theory of passage; the result will be a theory of time based in passage.

We use many metaphors when we describe the passage of time: time is often compared to 'a river' that 'flows' and 'carries' us into the future. The resort to such metaphors is taken by many to show that passage is a confused or obscure notion (see e.g. Smart 1949; and Williams 1951). We will take passage to be a basic phenomenon, any description of which in different terms is bound to be metaphorical precisely because it is a basic and, indeed, elusive temporal phenomenon.[25] When we adopt a non-reductive theory of passage, we embrace these metaphors as providing much-needed elucidation. As time passes, there is indeed a sense in which we are driven 'forwards' and there is indeed a sense in which the reality of one stage 'flows' into the next stage.

Though the metaphors help convey aspects of the passage of time, they are also risky. When we describe the passage of time as a 'flow of time' or a 'moving now', this can suggest that passage itself changes or flows. But the passage of time has to be carefully distinguished from something that itself changes or moves. As Maudlin explains:

> Except in a metaphorical sense, time does not move or flow. Rivers flow and locomotives move. But rivers only flow and locomotives only move because time passes. The flow of the Mississippi and the motion of a train consist in more than just the collections of instantaneous states that have different relative positions of the waters of the Mississippi to the banks, or different relative positions of the train to the tracks it runs on. The Mississippi flows from north to south, and the locomotive goes from, say, New York to Chicago. The direction of the flow or motion is dependent on the direction of the passage of time. Given the essential role of the passage of time in understanding the notion of flow or motion or change, it is easy to see why one might be tempted to the metaphor that time itself flows. Maudlin (2007: 110).

Notions such as 'flow', 'change' and 'movement' are ultimately parasitic on the passage of time; the passage of time is a precondition for any change to occur and should not be confused with it. Indeed, I will assume that the passing of time is constitutive of stability and recurrence as much as it is constitutive of change across time.

When we embrace the notion of passage, we can try to understand it better through regimentation instead of through reduction. To express passage within our metaphysics, I will use a sentential passage-operator '↪' ('... passes into ...'). We add this notion to our metaphysical vocabulary and turn to models that precisify the added notion of passage. We can use a simple adaptation of the models we saw in the previous section. We add

[25] The non-analysability of our notion of passage was recognized by Broad: 'I do not suppose that so simple and fundamental a notion as that of absolute becoming can be analysed' (Broad 1938/1976: 281).

sentences of the form $A \hookrightarrow B$ to the language, and take a model M now to be a triple $\langle T, O, v \rangle$, where T is a set of points, v is a function that assigns 1 or 0 to the atomic sentences relative to each point in T, and O is a set of ordered pairs of points taken from T, representing an order relation on T that is irreflexive, antisymmetric, transitive and connected.

The valuation v for the atomic sentences relative to points in T is first extended to a valuation for all the sentences via the following recursive clauses (where t ranges over points in T):

- $v_t(A \hookrightarrow B) = 0$
- $v_t(A \circ B) = 1$ iff $v_t(A) = 1$ and $v_t(B) = 1$
- $v_t(A \wedge B) = 1$ iff $v_t(A) = 1$ and $v_t(B) = 1$
- $v_t(\neg A) = 1$ iff $v_t(A) \neq 1$

Note that any passage sentence is false at the points in T. This reflects the intuition that passage is not itself part of that which passes. We will discuss this below. The valuation v is further extended to an evaluation of the sentences relative to each ordered pair of points in the relation, i.e. relative to each $\langle t_1, t_2 \rangle \in O$:

- $v_{\langle t1,t2 \rangle}(p) = 0$
- $v_{\langle t1,t2 \rangle}(A \hookrightarrow B) = 1$ iff $v_{t1}(A) = 1$ and $v_{t2}(B) = 1$ and ($A = B$ or $A = \neg B$ or $\neg A = B$)
- $v_{\langle t1,t2 \rangle}(A \circ B) = 1$ iff $v_{\langle t1,t2 \rangle}(A) = 1$ and $v_{\langle t1,t2 \rangle}(B) = 1$
- $v_{\langle t1,t2 \rangle}(A \wedge B) = 1$ iff $v_{\langle t1,t2 \rangle}(A) = 1$ and $v_{\langle t1,t2 \rangle}(B) = 1$
- $v_{\langle t1,t2 \rangle}(\neg A) = 1$ iff $v_{\langle t1,t2 \rangle}(A) \neq 1$

Note that the only true passage sentences are those that feature either the same sentence on both sides, or a sentence and its negation. This captures the thought that a case of passage consists in a fact's recurrent obtaining, in its ceasing to obtain, or its coming to obtain. Note also that atomic sentences are false at the points in O; contrary to passage facts, they do not obtain *insofar as* matters pass. Again, we will discuss the motivation for these clauses below.

The clauses for the points in T and O together fix the truth of each sentence in a given model. This is defined via the following recursive clauses (where x ranges over $T \cup O$, that is, over *both* the points in T and the ordered pairs of points in O):

- $M \Vdash p$ iff $\exists x(v_x(p) = 1)$
- $M \Vdash A \hookrightarrow B$ iff $\exists x(v_x(A \hookrightarrow B) = 1)$
- $M \Vdash A \circ B$ iff $\exists x(v_x(A \circ B) = 1)$
- $M \Vdash A \wedge B$ iff $M \Vdash A$ and $M \Vdash B$
- $M \Vdash \neg A$ iff $M \nVdash A$

Validity and logical truth are defined as before.

To illustrate the model-theoretic machinery, consider the following time-series (with columns representing points in T, and the rows stating sentences that are true relative to those points according to function v):

t_1	t_2	t_3	t_4
A	$\neg A$	A	$\neg A$

B	B	$\neg B$	$\neg B$
$\neg C$	C	$\neg C$	C

A model like this determines the following sort of truths. There is the passage of the individual facts, for example, in the case of A we have: $A\hookrightarrow \neg A$ (t_1 to t_2), $\neg A\hookrightarrow A$ (t_2 to t_3), $A\hookrightarrow A$ (t_1 to t_3) and $\neg A\hookrightarrow \neg A$ (t_2 to t_4). These passage facts do not co-obtain, for example, we have it that $\neg((A\hookrightarrow \neg A)\circ(\neg A\hookrightarrow A))$. Other passage facts *do* co-obtain however, forming bundles of passings as it were. We have for example: $(A\hookrightarrow \neg A)\circ(B \hookrightarrow B)\circ(\neg C\hookrightarrow C)$, A's passing into $\neg A$ co-obtains with B's passing into B which both co-obtain with $\neg C$*'s* passing into C (t_1 to t_2). Co-obtaining with these is also the passage of logically complex facts, in particular we have: $(A\circ B\circ \neg C)\hookrightarrow \neg(A\circ B\circ \neg C)$: the fact that A, B, $\neg C$ all co-obtain passes into the fact that they no longer all co-obtain (t_1 to t_2). The passings of these large co-obtainment facts constitute the passings of large unified chunks of world (i.e. of moments of time).

In the remainder of this section, I will motivate the various clauses of the model-theoretic machinery and the formal properties that they fix.

One may first of all worry that the model theory seems B-theoretic. It clearly helps to think of the points in T as moments of time, and to think of the ordering relation O as an earlier than relation on times. In my view, this shows at best that the B-theoretic conception lends itself to an elucidation of the formal features of passage. In no way does this show that passage is really B-theoretic. The situation here is similar to that of standard tense logic, where the model theory also avails itself of points and an ordering relation that can be glossed as the earlier than relation (see e.g. Burgess 2002). How we like to think of the models doesn't determine how we think of the tense operators themselves, and the same applies here. Indeed, the model theory serves to regiment the formal properties of passage regardless of how we think of the points or the ordering relation, for example, we could just as well think of the points as numbers and the ordering relation as the larger than relation. As we will see, passage will also turn out to be formally different from the ordering relation that is used in the model theory (for example, whereas O is irreflexive and asymmetric, passage is neither irreflexive nor asymmetric).

Let us now have a closer look at some of the proposed features of the passage of time, and the rationale behind them. As noted, the only true passage sentences are those that feature either the same sentence on both sides, or a sentence and its negation. The fact that I sit doesn't pass into the fact that it rains, even if it rains at some later time. The fact that I sit either passes into the fact that I sit, or into the fact that I do *not* sit. This reflects the idea that, as Maudlin notes, 'the passage of time underwrites claims about one state "coming out of" or "being produced from" another' (Maudlin 2007: 110). The fact that it rains doesn't 'come out of' the fact that I sit, at least not in the sense of 'coming out of' that is sensibly said to be constitutive of time.

One might want to object that the clause is too restrictive in focusing on contrary facts, leaving out the passage from one fact into a fact that is merely incompatible with the first, such as from my sitting into my standing. Though this is a fair worry, introducing such passage-facts raises tricky model-theoretic questions, in particular, it requires that we somehow regiment the incompatibility between facts (in such a way that the models 'see' the incompatibility of the facts). Furthermore, our current language already allows us to capture the notion of qualitative change in terms of the loss of one property co-obtaining with the gain of a property incompatible with it:

> *Qualitative change*: *a* changes from being F to being G iff $(\mathrm{F}a\hookrightarrow \neg\mathrm{F}a)\circ(\neg\mathrm{G}a\hookrightarrow \mathrm{G}a)$ and, necessarily, $\neg(\mathrm{F}a\circ\mathrm{G}a)$.

Put informally, an object changes qualitatively when it loses a property *insofar as* it gains a property that is incompatible with it, for example, the tree changes from being straight to being bent if and only if (Straight(*tree*) ↪ ¬Straight(*tree*)) ∘ (¬Bent(*tree*) ↪ Bent(*tree*)).[26] If we introduce the direct passage from the tree's being straight and the tree's being bent, we introduce this passage as something *over and above* the fact that the loss of straightness co-obtains with the gain of bentness.

One might still worry that, if we should have either of these kinds of passage – between contrary facts and between incompatible facts – it is the passage from one fact to an incompatible fact because such passage is more fundamental and grounds the gain and loss of properties. For example, one might think that the tree's being straight passes into its not being straight *because* the tree's being straight passes into its being bent.[27] But I'm not convinced that the passage between incompatible facts is indeed the more fundamental kind of change, for the simple reason that it seems perfectly possible that there are cases of change where there is not obviously any change *to* the instantiation of a new property. For example, if we assume that to be dead is not to be alive, then it seems that Aristotle changes when there is passage from his being alive to his not being alive, even though there is only the loss of a property here, and not the change from one property to another. Thus, whereas change from one to another property can be understood in terms of the loss of one property and the gain of another, cases of a mere loss or a mere gain of properties cannot be understood in terms of change from one to an incompatible property. The proposed account can straightforwardly define these other kinds of change:

> *Ceasing to be a certain way*: *a* ceases to be F iff F*a*↪ ¬F*a*. For example: the tree ceases to be straight iff Straight(*a*)↪ ¬Straight(*a*).
>
> *Coming to be a certain way*: *a* becomes F iff ¬F*a*↪F*a*. For example: the tree becomes straight iff ¬Straight(*a*)↪Straight(*a*).

The current proposal is thus more general. There might of course be other good reasons to complicate the simple story offered here and the passage between incompatibles does seem plausible. But there is a danger that we would make things more complicated only to introduce facts that do not obviously add anything to what is already captured in the simpler picture given here.

The passage theory describes a world in which things genuinely change, or so I want to claim. The crucial difference with B-theoretic accounts is that the passage theory can appeal directly to a cross-temporal phenomenon, the passage of time, which involves genuinely conflicting matters. There is no need to admit that *a* is F and that *a* is not F in order to say that *a* changes from being F to not F because we can indeed identify the change with the passage from *a*'s being F to *a*'s not being F. The reason for this is that passage is not taken to be a factive notion:

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[26] This account of change results in an endurance account in the sense that one and the same object is involved in facts that obtain across time. Note that the offered account requires no revisions in our understanding of the objects that are involved in change, nor revisions in the intrinsic properties they have across time, nor revisions in the way objects have these properties. The offered account is thus conservative with regard to both our overall ontology and ideology (with the exception of introducing passage and co-obtainment of course). Moreover, we have made no reference to times at all within our official idiom, and we do not need to in order to avoid incoherence. The account is neutral on the question whether we should admit times to our ontology; if times serve a purpose other than relativizing incoherences away, we can add times to our ontology.

[27] Thanks to Dean Zimmerman for pressing this worry.

$A \hookrightarrow B \not\models A$
$A \hookrightarrow B \not\models B$

Say that a rose's being red passes into its not being red. If passage were factive, this would imply that the rose is red and not red, and that cannot be the case. Across time we can accept (1) that the rose is red and (2) that the rose is not red *insofar as* it is blue. Although it's not the case that the rose is not red (given that it *is* red), the passage from the rose's being red *to* its not being red *is* genuinely the case – and that is all we need for genuine change.

As mentioned, the model theory sharply distinguishes between truth at a point in *T* and truth at an ordered pair in *O*. At points in *T*, atomic sentences are true and passage sentences aren't, whereas at points in *O*, passage sentences are true and atomic sentences aren't. This reflects the intuition that momentary state are not constituted by their own transition, and that the passage of states are not themselves constituted by the momentary states that pass. The points in *T* represent the contents of times, or what happens 'in' time. The points in *O* represent passings as taking us from one time to another, and the very passing of momentary contents is not itself part of the momentary contents that pass. In more metaphysical terms: the passing of time itself is not 'in' time, but constitutes it.

Since the relation *O* is transitive, *O* includes pairs of points in *T* that are not adjacent in the temporal order. The contents of one time do not just pass into the contents of the next time (if there is one), they also pass into the contents of *any* time that comes after it. Is this right? Does the way things are now pass into the way things will be in some time from now? If time passes to a subsequent moment, and that second moment passes into a third moment, there is a sense in which the first moment *thereby* passes into the third moment – this just is what it is for the first moment to pass into that third moment, leaving little room to deny the overarching passage. We can think of the passage from the current facts to facts of later moments as being like a determinable, realized in the passing between the facts of intervening times. Just as we can recognize ways in which something is coloured (a red way, a blue way, etc.), we can recognize ways in which certain passage facts obtain. Say the following are successively true: *A*, ¬*A*, *A*. We might then say that it being the case that $A \hookrightarrow \neg A$ and $\neg A \hookrightarrow A$ is *how* it is the case that $A \hookrightarrow A$.[28] Note that it is only when there are no contrary facts in between, that passage from one time to another constitutes true stasis across time.

There is also a more theoretical pressure to think of passage as transitive. Time is plausibly thought to be continuous, that is, passage is naturally thought to be a passage through a continuous series and not naturally thought to consist of staccato jumps between discrete units of time. If we were to deny the overarching passage, and replace the order relation in the model theory with its transitive reduction (i.e. a non-transitive order relation), so that one moment only passes into the very next moment (cf. von Wright 1965), we would then be at a loss to account for the passage of time if time is continuous,

[28] Alternatively, we could invoke some suitable notion of metaphysical grounding or realization and say that $A \hookrightarrow A$ *because* or *in virtue of the fact that* $A \hookrightarrow \neg A$ and $\neg A \hookrightarrow A$. This may however raise issues depending on our commitments concerning grounding. That is, the approach may imply infinite chains of grounding facts in the case where time is continuous. It may also be problematic when we have a time series in which we successively have: A, A, A. Are we going to say that A↪A because A↪A (and A↪A)? This would be an objectionable case of self-grounding. Now this may in turn be avoided if we hold that the fundamental kind of passage is only ever that of maximal co-obtainment facts; but this may run contrary to the intuition that the passing of maximal facts is built up from the passing of facts that are 'part' of those co-obtainment facts.

i.e. such that between any two moments of time there is another, so that there is no 'next' time. Put differently: if time is continuous, which seems plausible, and if the way things are *now* pass into the way things are *now*, which is our starting assumption, then we thereby have good reasons to accept that there is overarching passage.

Next to its transitivity, it might be surprising that passage is not asymmetric:

$$A \hookrightarrow B \nvDash \neg(B \hookrightarrow A)$$

It is allowed that both $A \hookrightarrow B$ and $B \hookrightarrow A$. We should all agree that passage is an essentially directional affair, that passage is understood to take reality *from* somewhere *to* somewhere. But it is a mistake to think that the formal property of asymmetry (i.e. the property that $A \hookrightarrow B \vDash \neg(B \hookrightarrow A)$) is sufficient or even necessary to capture the temporal directionality. Asymmetry would tell us that when we pass from *A* to *B*, there is no passage from *B* back to *A*. But that is not directionality, that is non-recurrence across time, telling us that if *A* passes away, it cannot pass back into reality again.[29] Such a logical ban on non-recurrence seems implausible; it seems clear that certain facts can recur over time. If I sit, then stand up, and then sit down again, my sitting passes into my not sitting, and my not sitting passes into my sitting. Which is not to say that there may also be *specific kinds* of states that may not recur in this way, for example, the Second Law of Thermodynamics tells us that, when a closed system's state of entropy passes away, we never pass back to that very system having that very state of entropy again. There may thus be various asymmetries running along the passage of time. But that should not make us think of passage itself as being asymmetric.

Although passage is not asymmetric, it is also not symmetric:

$$A \hookrightarrow B \nvDash B \hookrightarrow A$$

But, again, even though passage is non-symmetric, this is not what provides or captures the directionality of passage; it only reflects the possibility that we pass one way and never back, as in the mentioned case of states of entropy. It is tempting to think that asymmetry and non-symmetry somehow capture the directionality of passage but they really only capture what points we are allowed to pass *through*.

So then how *do* we capture the directionality of passage? As far as I can see, the directionality of passage is a primitive aspect of the notion of passage, something we only really express by saying that we *pass* from one to another thing, that passage drives us forwards. I do not see how this aspect of passage can be captured by anything other than the notion of passage itself. Much has been written about the direction of time. There are various types of physical asymmetries running along the direction of time, such as the increase of entropy, the expansion of the universe, and the causation of events. Many have explored reductive views of the direction of time (see Mellor 1998: Ch.12; Zeh 2007 and the papers in Savitt 1995), an example of which is the view that the direction of time runs from a first state to a second state when the entropy of the second state is larger than that of the first. The proposed view of the direction of time clearly stands in contrast to such reductive views. The directionality of time does not emerge from anything that is the case at the various times, but is part and parcel of passage itself. Not only is it hard to see how any directional passage can truly be seen to emerge from the proposed reductive

[29] It is thus also a mistake to think that, simply because the earlier than relation is asymmetric, it thereby captures something of the directional aspect of passage. That the earlier than relation is asymmetric merely means that there is a certain order to the contents of time.

bases, the non-reductive view has other advantages. The reductive views make it hard to see what the content is of various important physical laws. As Maudlin (2007: 129) points out, if the direction of time is reduced to the increase in entropy for example, this seems to suck the content out of the Second Law of Thermodynamics, which surely doesn't just state that entropy increase as entropy increases. The non-reductive view of the passage of time enables a straightforward reading of physical laws that concern asymmetries over time. On the one hand there is the increase in entropy (or any other physical asymmetry) and on the other hand there is the passage of time. So the relevant physical law relates one thing to another and is therefore substantive.

To sum up: passage is either that of one fact into itself or that of one fact into a contrary fact, it is non-factive, transitive and neither asymmetric nor symmetric. Of course, this merely regiments the formal features of passage and much more needs to be done to show that this regimentation fits the metaphysical work that the notion of passage is meant to do for us, if we accept it as basic. One next step is to explore what the truth conditions are of tensed sentences and sentences that involve dates, in light of the proposed metaphysical view of the world. Another step is to consider the relation of the view to the special theory of relativity. We have assumed a single foliation of facts constituting one definite order in which things come to pass, and we know that things cannot be that simple.[30] Also, given the various choice points we encountered, we can explore variants of the view proposed here. Some of the choices made above are not set in stone.[31]

Concluding remarks

One may have noticed how we retraced some of the steps of McTaggart's argument for the unreality of time. McTaggart's argument targets both the A-theoretic and B-theoretic conceptions of time. The A-theoretic determinations of events give rise to an inconsistency when we take an atemporal standpoint (cf. Dummett 1960: 503) and collect together the ways events are *throughout* time: the same event is then past, present and future. The A-theorist can reply to this that the mistake is to resort to an atemporal perspective: if one assumes an atemporal perspective one will indeed attribute incompatible determinations to the same event (which cannot subsequently be explained away), but this just shows that we should never assume an atemporal perspective in the first place and say that an event is past *and* present *and* future, any event is only past, *or* present, *or* future (Prior 1967: 5-6). The objection raised in §1 plugs this hole in McTaggart's argument: if we merely describe the way things are now, so that any given event is either only past, or only present, or only future, then our description turns into a snapshot of a single moment, within which no passage or change is to be found. Passage occurs *from* one moment *to* the next; we must stand back from a single moment of time and assume an atemporal perspective if we are to make room for a real passage of time.

Against the B-theoretic conception of time McTaggart famously insisted on the essential connection between passage and change, arguing that B-theoretic conceptions do not allow for genuine change (McTaggart 1908: 459). I agree. It is a necessary condition for passage that at least some of the passage of time constitutes genuine change.

[30] See, e.g., Gödel (1949/1990). Fine argues that fragmentalism is superior to the A-theory precisely because it is compatible with the special relativity theory; see Fine (2005: §10).

[31] Just as there are many systems of tense logic, so we can naturally expect various systems of passage logic. We could for example explore different logics by changing the order relation *O* in the model theory. This is how we also explore various systems of tense logic; see e.g. Burgess (2002).

If an alleged notion of passage did not make for any change, it would not be passage. But to make for change, there must be passage between contrary facts – and this the B-theory allows no room for.

McTaggart's assumptions about the passage of time have all been taken on board as necessary conditions that a primitive notion of passage must meet in order to qualify as genuine passage. The crucial question is whether we can conceive of the world in such a way that passage – thus understood – can obtain. Fragmentalism delivers such a world and so, pending other ways of making sense of a world harbouring incompatible facts, it seems that fragmentation across time is thereby a necessary condition for genuine passage. We arrive at a metaphysical view that is not logically incoherent and yet offers everything that McTaggart demanded of a temporal world.[32]

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