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The Metaphysics of Time
Investigations in Tense-logic and a B-series Semantics

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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Introduction

The view that time flows from the future to the present and then recedes into the past is both natural and deeply problematic. So called 'A-theories' about time claim that this is the fundamental nature of temporality. This is not the view which will be defended in this paper. Rather I shall argue for what is known as a 'B-theory' analysis of time and language, one in which the relations of 'earlier than' and 'later than' are necessary and sufficient for any analysis of time. The structure of this paper is tripartite. The first part will address the philosophical and metaphysical tenets of both the A and B-theories of time. In this section, McTaggart's 1908 argument for the unreality of time will be presented along with some objections to it. I will show that some seemingly convincing arguments against 'McTaggart's paradox' are unsuccessful and his paradox does indeed call the A-series into question. This section will lay the groundwork for further discussions relating to other disciplines which are concerned with this debate by describing the issues and points of tension.

In the following section, I look at arguments from the work of Arthur Prior advancing an A-series view of time through the development of formal tense-logic. In this section I shall present some of the main elements of tense-logic. I will investigate what is known as 'The four grades of tense-logical involvement' and show that the progression of tense-logical involvement aimed at proving that all B-series concepts can be reduced to A-series concepts is flawed on both logical and philosophical grounds. I will argue that the hybridization of tense-logic required by Prior's project leads to some problem, although perhaps not insurmountable ones. In addition, I will argue that although Prior's conception of the role and nature of logic is incorrect his reduction can be conducted in accordance with a more sound mathematical basis. Once Prior's logical reduction is interpreted through a model-theoretic viewpoint we are able to offer even more evidence against the A-series.

In the last section, I present a version of the B-theory which was put forward by Mellor in *Real Time II*, namely that A-series statements and propositions are made true by B-series truthmakers, or the so-called tenseless token-reflexive account of time. This section aims to resolve some of the metaphysical problems of time by specifying a B-series semantics for temporal discourse. I will argue that this is the only way to make sense of tenses and get around McTaggart's paradox. This section follows on from the last by specifying the only possible interpretation of Prior's tense-logic and U-calculi, one which takes the B-series as fundamental for time.

The reason for the segmented approach of this paper is that I believe that the battle for an accurate and adequate theory of time cannot be isolated to the metaphysical domain. In fact, I argue that where the metaphysics is misleading and ambiguous, both the study of formal language and semantics can not only assist but illuminate the issues in favour of a specific theory. In addition, philosophical issues pertaining to the beginning of time, its density or discreteness will not be dealt with in the present work (although any assumptions anent these things will be made clear). The aim of this paper is to argue for the correct view of time and discuss this issue within the realms of metaphysics, logic and semantics. It is with the metaphysics of time that I shall begin.

SECTION 1: THE METAPHYSICS OF TIME

1.1. A-times and the A-series

The A-series is the series of times which run from the distant future to present to past and further past. The positions of time associated with this series often constitute the idea referred to as 'temporal becoming'. We refer to an event as being in the past such as 'the death of Socrates' or as in the future as in 'tomorrow's weather'. That the event of my typing is happening now assigns it a position in the present, but tomorrow it will be a past event. We usually pick these references to A-series positions out in language by the use of tense, such 'it *is* raining' picks out a present event, in this case the copula 'is' is tensed. If the rain stops and I utter the sentence 'it *was* raining', I am using the past imperfect tense to mean that the event of it raining is in the past. Note that this makes it seem that we understand the past and future as they are in relation to the present. For instance, the sentence 'it *was* raining' is understood as denoting an event 'now' in the past. So the A-series is a series of relations, the relations of past and future as an ever-changing present (or 'now') moves along them. Swinburne describes this situation thus:

An A-sentence is then one which reports the temporal relation of some state or event to the present moment, either dating it by its temporal interval from the present (e.g. "it rained yesterday," or "the world will end in fifty years time") or simply stating whether it is past, present or future (e.g. "he has already been wounded") (1990: 117).

However, the above characterization is slightly ambiguous. There are two different but related notions in the quotation which should be unpacked for clarity's sake. Here we shall follow Mellor in his distinctions and terms. A-times are therefore the times defined in terms of their relation to the present. So an A-time is one which is constituted by how much earlier or later it is than the present. A-times can be indicated by words such as 'yesterday', 'tomorrow' or 'in three weeks'. These words give us temporal information from the current present position. So

when I utter the sentence 'Billy played Frisbee yesterday' I am asserting that from the position of 'today' Billy was playing Frisbee the day before, the word 'yesterday' picks out an A-time.

In an attempt to disambiguate McTaggart's initial terminology, Mellor describes the A-series as the series of events located at the A-times. The sequence formed by the A-times themselves falls on the 'A-scale' which is characterized as not just a composition of ordered A-times. A-times have an inner 'measure' which gives us the exact rate at which events in them follow on from one another and their duration in the yet to be defined present. "Thus David Hume, who was present on earth for sixty-five years, now occupies sixty-five past years of the A-time scale" (Mellor, 1998: 8). A birthday party is shorter and thus occupies less A-time on the A-scale, i.e. it is present for a shorter period. So an A-time is one which specifies its relation to the present and its present duration. A moment is an unit defined purely in terms of its temporal location, therefore an A-moment would be one defined in terms of its relation to the present.

The ambiguity in the previous quotation then rests in its failure to distinguish between A-moments on the A-time scale and events located in the A-series. When we speak of it raining *yesterday*, we are referring to an event located on the A-series at the A-time denoted by the word 'yesterday'. When we talk of someone *having already been* wounded, this complex tense picks out an A-moment on the A-time scale (in which the term A-moment merely refers to an interval of A-time).

Returning to the A-series, another facet of this series is that its positions are constantly changing which makes the series as a whole dynamic. We can think of a perpetually moving NOW which moves from events in the past to the remote future. This is by no means the only way to cash out this notion of 'temporal becoming', Prior says that "[s]uppose we speak about something 'becoming more past' not only when it moves from the comparatively near past to the comparatively distant past, but also when it moves from the present to the past..." (1968:

1). This could just as easily constitute our notion of ‘becoming’ or the ‘passage of time’. Whichever way we decide to describe it, the core idea remains the same.

I do not believe that we can put off defining the relations of past, present and future any longer. In this, we shall follow Mellor as well:

First, *the past* is the interval of A-moments open all the way from the remotest past up to, but not including, the present moment. Then other A-times are past if and only if *the past* includes them. Thus *yesterday* is past, as are *last week* and *the first moment of last year*. And any event is past while and only while its A-time -the shortest A-time that spans it- is past (1998: 9).

The same holds for the future. The future is the interval of A-moments which range from the most remote future to the present but not including it. A-times such as *tomorrow*, *next year* and *ten years time* are included in the future. All this seems very intuitive so far but things become a little more complicated when we start talking about the present. The present is quite different in character from the past and future. So far we can describe past and future respectively as:

(1) Past: {m: m is a moment \wedge m $<$ ¹ present}

(2) Future: {m: m is a moment \wedge m $>$ ² present}

So far we are describing past and future in terms of the set of moments before and after the present moment but those moments which do not form part of the present themselves. This prevents a moment (or event) from being simultaneously past and present and also from being simultaneously present and future. For example, the ‘yesterday’ is past on this model because it is defined as occurring before ‘today’ (which is present) and not including the present moment. Similarly, “any event is past while and only while its A-time – the shortest A-time that spans it – is past” (Mellor, 1998: 9).

¹ Strictly ‘earlier than’ and not including the ‘present’

² Strictly ‘later than’ and not including the ‘present’

I'll start by describing the common-sense notion of the present moment, something which McTaggart refers to as the 'specious present'. He describes it as follows:

The direct perceptions which I now have are those which now fall within my "specious present". Of those which are beyond it, I only have memory or anticipation. Now the "specious present" varies in length according to circumstances, and may be different for two people at the same period (1908: 472).

According to this notion, the duration of the present is not set and different people can have longer or shorter experiences of the present moment. What triggers the present moment's recession into the past? How long can a moment be present? How is it possible that the same event remains present for me and ceases to be present for you? The answers to these questions are not clear and McTaggart urges us to see the specious present as nonsensical.

The answer could lie in the fact that the specious present is some sort of psychological awareness of temporality, an inner appreciation of the flow or passage of time. In fact, A-theorists often cite the experience of time and its flow as evidence for the priority of the A-series. If time doesn't flow, how can we explain our experience of it doing so? It is this notion of inner experience which prompted theories such as Kant's that time was nothing but the form of inner sense. Time, like space, is a pure intuition, "the pure form of sensible intuitions in general, in which all the manifold of intuition is intuited in certain relations, must be found in the mind *a priori*" (B35). Kant is here referring to the underlying scaffolding which not only allows human beings to receive sensible intuitions but also allows these intuitions or sensations to appear in a specific order or arrangement. To Kant this was not just a matter of phenomenology but also objective reality. Nevertheless, whether or not we adopt a Kantian approach to time, we still have to define the present and it is not enough to merely state that it is some sort of inner awareness. The notion of the present may only be psychological, in fact many B-theorists believe that it is, but this goes no way in explaining what the present is. This task is one which A-theorist need to undertake in order to maintain its existence and a task onto which I shall now move.

Richard Gale noticed the problem with the defining the present which he attributed to larger problem of indefinability of time itself:

For, by definition, the past and future cannot now be pointed at. The present, which seems to be more available, turns out to be equally elusive; for there is no sensible property or thing which we can point to and say: 'This is the present.' Also, everything pointed at in giving an ostensive definition is present; and, therefore, the learner would never catch on that it was the present that was being ostensively defined since it could not be contrasted with something which is non-present (1968: 4).

What is the present if it is not the specious present? There are other notions of what the present could be which are equally problematic. Another candidate notion would be viewing the present as a sort of durationless point which separates the past from the future. It would have to be a moving point in order to explain the apparently constantly changing present moment. As McTaggart notes, this would result in the actual time duration of an event being completely different from the way in which we perceive it. He says "[t]he objective time has only two durations, separated by a present which has nothing but the name in common with the present of experience" (McTaggart, 1908: 472). He then asks what 'reason is there in our experience' to believe such a possibility. The present does seem to have duration and an explanation of the present would have to account for this. An account of the present would also have to explain the difference between the present and the past/future.

Mellor understands the need for a divide or 'cut' between the past and future and the present. For him, the criterion for being present is that any A-time which includes the present should be considered present. So in 2010, the Obama term is two years in the past and two years in future *ceteris paribus* and because this time-span includes the present it should be considered present. Thus, there is no strict restriction on the duration of the present, "[t]hat makes *this century* as present an A-time as *today* or *this moment*" (Mellor, 1998: 9). He goes on to talk

about a centenarian being present throughout the century. On that point, I am inclined to say that there is an equivocation between ‘present’ as in ‘was there’ and present as in the A-series position. Surely, the worry with this conception of the present is that it encroaches on the past and future. Mellor admits that there is overlap but claims that the stipulation which states that present A-times contain the present moment and bars past and future A-times from doing the same prevents any A-time from being present and past or present and future. “Similarly we should call any A-time ‘present’, however long it is, if and only if it includes the present moment” (Mellor, 1998: 9). The cut is then defined in terms of A-times which include the present (present A-times) and those which do not (past and future A-times). This allows for the possibility that all events have these A-properties (which are incompatible contemporaneously) successively which is the *sine qua non* of the A-series. As we shall see, there is a reason for why it is so difficult to describe the present and its relation to the other positions in the A-series, namely that the A-series is contradictory. We shall, however, leave that proof aside for now and move on to providing an overview of some of essential characteristics of the A-series. The description of the present at this stage is given by something such as (3) below:

- (3) X is a present time iff (a) X is continuous³ (b) $(\exists x)(x \in \text{Past moments} \wedge x \in X)$ and (c) $(\exists x)(x \in \text{Future moments} \wedge x \in X)$

To understand this description we would need to describe the ‘present moment’. This is not an easy task, but we should give a working account for the moment. We can characterize the present moment as the intersection of the set of present times as described above. So that x is an element of the intersection of ‘{Present}’ iff $\forall T \in \{\text{Present}\}, x \in T$. Therefore (4) below:

- (4) Present moment: $\cap \{\text{Present times}\}$

³ I assume here that this set is continuous and thus this is a feature of dynamic time.

This will serve our intuitive notion of the present for now; we shall see later that this is deeply problematic, as is the A-series itself. There are, however, certain other essential characteristics of the A-series, some of which I have covered and others which should be explicitly stated before continuing. The first is that there are three determinations of the A-series, the past, present and future. These are incompatible determinations, in other words, no event has more than one of them simultaneously. Another characteristic of this series is that it distinguishes between the ontological status of the past and future. This is due to the notion of 'temporal becoming' at the heart of the A-series. The last important characteristic of the A-series is that it provides us with an analysis of change onto which we shall move in the next section.

1.1.2. The A-series and Change

One of the key polemics in the metaphysical debate about time is whether or not a given theory can account for the phenomenon of change. Most A-theorists believe that one advantage it has over other views about time is that it can account for change in a philosophically sound way. I shall outline the basic A-theory view of change while refraining from a full critique of it at this point.

The first thing to determine when talking about change is whether we are locating change in the 'things' or in 'events'. So far we have been talking about moments and events as if they are interchangeable. This is not the case however and there are important distinctions to be made. Intuitively, the matter is quite simple. Moments are nothing but temporal individuals or rather they can be described purely in temporal terms, i.e. duration and position in time. Events have this dimension but in addition they have other characteristics which separate them from moments and from one another. For example, two events A and B could have occurred simultaneously and they may have lasted for the same amount of time but we would not identify them. Unlike the case in which two moments x and y are simultaneous and equal in

duration, these would be the same moment ($x=y$). In terms of events, there are many factors which could differentiate A and B. A could involve cars and B could involve the election of a president, A could be a scientific discovery and B a goal in a soccer match etc., the possibilities are innumerable. Furthermore, it seems that events happen at moments in time but not vice versa.

The view of change presented by McTaggart is in A-series terms. If we consider a 'change', something such as a poker becoming hot while being in contact with the fire from a fireplace.⁴ There are certain facts which obtain concerning the poker. Let's say that it is 1 meter long and 3cm wide, it has a sharp tip etc. Other facts about the poker include that it was cold at 5pm on Monday and after being heated by the fire it was hot at 6pm on Monday. What has changed? An initial answer to this question may be that the temperature of the poker has changed. But much like the fact that the poker is 1 meter long, the two facts that it is cold at 5pm and hot at 6pm on Monday do not change. The poker will always have been cold on Monday at 5pm and hot at 6pm. If these facts do not change, then what does?

On this view the only fact about the poker which can change is position in the A-series. In 'tensed' terms this means that we can say that 'the poker *was* cold, now it *is* hot and soon it *will be* cold again'. McTaggart describes the situation as this:

The fact that it is hot at one point in a series and cold at other points cannot give change, if neither of these facts change – and neither of them does. Nor does any other fact about the poker change, unless its presentness, pastness, or futurity change (1993: 28).

Later we shall see that McTaggart didn't believe in the reality of the A-series and therefore he believed in neither change nor time. An important thing to note at this juncture is that there is an assumption about change being in things and not events. The change was in the poker itself not in the event of the heating of the poker. One reason for locating changes in things in lieu of

⁴ McTaggart's example.

events is that events are changes. “[T]o say that such and such an event has occurred is generally to say that some thing has, or some things have, changed in some way” (Prior, 1968: 2). It is the matter of the universe which changes and these changes constitute events. And the facts about the objects of the universe (people, animals, plants, books, pokers etc.) which change are their positions in the A-series. Change on the A-series is not a complex notion but as we shall see shortly it is a deeply problematic one. But before advancing to arguments against the A-series or its account of change, I shall present and describe the B-series in some detail.

1.2. B-times and the B-series

The B-series is also a series of relations, but not to the present moment or any position in the A-series. The relations of the B-series are that of ‘earlier than’ and ‘later than’. These are relations events have to one another. If they were relations which events had to the present for instance, then ‘earlier than’ would be reduced to the past and ‘later than’ to the future. But there are reasons (which will be discussed) which prevent such reductions. Le Poidevin (following McTaggart) notes that the relations of the B-series are “transitive asymmetrical” in nature (1998: 13). This means that if we have three events, A, B and C, and A is earlier than B and B is earlier than C, then A is earlier than C (transitivity). However, if A is earlier than B, then B cannot be earlier than A, hence the asymmetry.

Another and perhaps the most important characteristic of the B-series is that its relations are permanent. Events in the A-series are constantly changing their positions with relation to the present. This is not the case with B-series relations. If an event is earlier or later than another event, it will always be earlier or later than the other event. Gale makes an observation when comparing the two series, unlike the A-series, the B-series relates completely and ‘objectively’ real events. The ontological distinction between the past and future which the A-series requires is not part of our conception of the B-series. For two events to be related by either ‘earlier

than' or 'later than' is for two events to be equally real (what 'real' means here will vary between B-theorists). Earlier, I said that the permanence of the relations of B-series is what prevents the reductions to the A-series mentioned above. But what if we are dealing with a reduction to a disjunction of A-series positions? If we consider this sort of reduction for a moment we shall see that it is untenable. The argument would be something like this: the 'earlier than' relation (for the sake of simplicity) of the B-series is just a disjunction of A-series positions. So 'A is earlier than B' is equivalent to "A is past and B is present, or A is present and B is future, or A is past and B is future, or A is more past than B, or A is less future than B" (Le Poidevin, 1998: 14).

The project aims at reducing statements made about B-series relations to A-series statements only. To show that this reduction is untenable we would have to show that there are cases in which we could assert the B-series sentences and not the A-series translations. Le Poidevin asks us to imagine a time-series independent of this one:

Suppose there to be another time-series, existing independently of this one, such that no time in that series bears any temporal relation to any time in our time-series. Of that time-series, we could say, 'Some events are earlier than others,' but we would not say, 'Some events are past, while others are present,' or indeed make any other unconditional A-series statement about that time-series (1998: 15).

The reason for this is that A-series statements presuppose a temporal relation to the present event but this temporal relation is lacking in the case of two independent time-series. Therefore, the reduction of statements about B-series relations to disjunctions of A-series statements is problematic and unsound. Another reason is that the A-sentences (or tensed sentences) can change truth-value depending on context of utterance, a token sentence such as 'The soccer World Cup is one month in the future' is true one month before the World Cup but false if uttered in a month's time (or after). Whereas "it is a part of the meaning of tenseless sentences that express temporal relations between events that different tokens of the same tenseless sentence have the same truth value whenever they are expressed" (Oaklander, 2004:

19). The problem of the failure of translation has caused many A-theorists to give up on the project of translation entirely.

As with the A-series, following Mellor once again, we shall distinguish between B-times on the B-scale and events on the B-series itself. Therefore the sequence of B-times falls onto a B-scale whereas the sequence of events at those times will fall onto the B-series. The next natural question to ask is what B-times are. An example of a B-time would be a date. Dates are B-times “because they are not defined by how much they are ‘earlier than’ or ‘later than’ they are to the present” (Mellor, 1998: 10), which is a characteristic of A-times. The contrast with the A-series is then that B-times are defined in terms of the events and their relation to one another.

To date an event is not necessarily to associate it with the present moment. If we say that ‘Krakatoa erupted 127 years ago’ we are stating that from the position of the present moment the volcano erupted 127 years ago. This is an A-time, since it tells us when this event occurred relative to the present. Now this information need not be given at all. To say that ‘Krakatoa erupted in 1883’ would be an example of a B-sentence referring to a B-time, in this case a date. An argument could be made that the verbal tense in the previous sentence does provide information about the A-series position of the event, namely that it is in the past. This temporal information is superfluous however. “[W]e can easily omit this gratuitous A-scale information by using or inventing a form of the verb which does not vary with A-time but can still be used with phrases like ‘in 2045’ to date events” (Mellor, 1998: 10). Modals in English are tenseless and it is believed that some other languages omit tense and temporal information in their verbs, examples would be Hopi and Paraguayan Guaraní. Whether or not this is in fact the case, it is only a matter of grammar and not necessity that our verbs admit such information. The point to be drawn from this is that dates are independent of A-times and that B-times relate the events which have them to one another and not the present. Next we shall move on to the B-theory account of change.

1.2.1. Russell on Time and Change

In terms of an account of change which relies entirely on the B-series, Russell's theory is a good starting point. In the *Principles of Mathematics*, section 442, Russell says that "Change is the difference, in respect of truth or falsehood, between a proposition concerning an entity and the time T , and a proposition concerning an entity and the time T' , provided that these propositions differ only by the fact that T occurs in one where T' occurs in the other". That is to say that change is constituted by the change in truth values of statements involving the same objects over time. If we return to our now tepid poker for the moment, a change in the temperature of the poker could be explained in terms of the truth values of statements at different times, i.e. 'The poker is hot at T_1 ' is true while 'The poker is hot at T_2 ' is false.

The schema which encapsulates this notion of change is something like "an object changes if and only if it has at one time a property which it lacks at another time" (Le Poidevin, 1998: 16). This analysis of time does not rely on the A-series positions of past, present and future. To say that something is true at one time and not true at another of a single entity is to make a claim about the properties of said entity changing. That's exactly what change is on this view. As Le Poidevin points out:

Change, then, is simply the variation of properties over time. Nothing, in Russell's analysis, requires these times to be ordered as an A-series. The B-series is sufficient for his purpose...Thus, according to Russell, the change that takes place when, for example, a poker cools down is captured by the facts that (i) it is hot at one time, and (ii) it is not hot at a later time (1998:16).

Russell's theory is based on what he believes to be a separation between 'mental' time and 'physical' time. The confusion in the metaphysics of time has largely been caused by a failure to appreciate the distinction between these two types of time according to him. Physical time is objective in the sense that if there were no humans there would still be physical time, but

mental time is subjective and only exists when we do. Physical time holds between objects and mental time between subjects and objects, such that “It will be seen that past, present, and future arise from time-relations of subject and object, while earlier and later arise from time-relations of object and object” (Russell, 1915: 212). Therefore the A-series is subjective and the B-series is objective.

The present moment is defined as a moment which is simultaneous with a sense datum of some sort. Russell has two notes about the present, (1) “An entity is said to be *now* if it is simultaneous with the present to me, .i.e. with *this*, where “this” is the proper name of an object of sensation of which I am aware” and (2) “The *present time* may be defined as a class of all entities that are *now* [defined in (1)]” (1915, 213). There are similar reductions for the other tenses. The claim is that the A-series expressions can be both ontologically and semantically reduced to B-series statements. We shall see several arguments against such reductions, including from B-theorists such as Mellor.

The reason why I have held off on offering objections to the A-series and its account of change and to Russell’s B-series account is because in the next section I will go into some detail concerning McTaggart’s 1908 argument on the ‘Unreality of Time’ which addresses both of these accounts.

1.3. McTaggart’s Argument against Time

There are a number of steps involved in presenting this argument. The first step is to establish that time involves change. This is something which McTaggart doesn’t think needs much work. The second step involves the dependence of change on the A-series and the inability of the B-series to account for change independently of the A-series. The third step is meant to prove

that the A-series is contradictory and from that we get the unreality of change (since change depends on the A-series) and the unreality of time (since time involves change).

1.3.1. Time and Change

McTaggart seems to believe that the claim that time involves change is uncontroversial. I would agree on this point, however, whether or not this is necessarily the case is another matter and beyond the scope of the present work. "In ordinary language, indeed, we say that something can remain unchanged through time. But there could be no time if nothing happened" (McTaggart, 1993: 25). McTaggart doesn't argue this point in much detail since he believes that it is as platitudinous as its reverse 'change involves time'. He does follow up by explaining the idea of relational change i.e. that when something changes then the relation it had to everything else in the world changes and hence those things change in some way too, like a relational ripple-effect.

1.3.2. No Change without the A-series

The next part of the argument is meant to prove that there is no change without the A-series. The way he sets about proving this is by first assuming that change can be accounted for by the B-series. What would change look like on a B-series model? According to McTaggart, it wouldn't look like anything. If we recall from above, the B-series relations are permanent. According to this reasoning, there are two ways in which things could change neither of which are accommodated by the B-series.

The first possibility is for an event to come to an end and another to begin. So let us call the event of throwing a ball X and the event of the ball flying through the air Y. When event X ends and event Y begins, then we have change. There is a problem with this model of change though. The relations of 'earlier than' and 'later than' are permanent relations as mentioned previously. Therefore if X is earlier than Y, it is always earlier than Y and will always have this position in the series. Event X thus will always be an event and can never cease to be one. Put in another way:

"[T]he B-series seems incapable of sustaining change. Any event that has occurred in the B series will always have occurred. It will always have the same position in time. It will always have been earlier than following events and later than preceding events...This is so whether they merge into succeeding events or are moments in absolute time" (Rochelle, 1998: 36).

This quotation has anticipated the second possibility for change in the B-series, namely that events could merge into one another. If this were the case, then event X' would merge into event Y', but maintain some original element, at least enough to be able to assert that event X' has changed into or 'become' event Y'. This however, relies on the same type of reasoning as the first argument. X' and Y' are not the same event because there would be no change if they were. But in order for X' to become Y', it would have to stop being X' at some point and Y' would have to start being Y' at some later point. This is not possible. As noted above, the relations of the B-series are permanent and do not allow for such change or change at all.

McTaggart then asks himself, if neither of the two possibilities above pertains, what could constitute change? A candidate for this might be the characteristics of the events, perhaps these characteristics change in some way? What would these be and how would they change? McTaggart thinks that only one characteristic can change. Let us take 'the death of Socrates' as a token event. Which characteristics of this event change? Firstly, we should identify what the characteristics of this event are.

The event 'the death of Socrates' is the death of someone, it was caused by hemlock ingestion, and took place around 399 BCE. Most of us would admit that none of these characteristics change at all. So if none of these characteristics change, then what is it that changes? How do we get a change into this picture? McTaggart thinks that the event stays the same "in every respect but one...It was once an event in the far future. It became every moment an event in the nearer future. At last it was present...such characteristics as these are the only characteristics which can change. And, therefore, if there is any change, it must be looked for in the A series" (McTaggart, 1993: 26). This is exactly the A-series account sketched above.

The conclusion of this part of the argument is that there simply is no possibility of accounting for change and time by the B-series alone. The A-series is necessary for both of these things, but that's not all that for which the A-series is necessary, according to McTaggart. It turns out that if the B-series is a temporal series, i.e. in time, then it involves and thus depends on the A-series in the same way as change and time do. Therefore there would be no independent B-series account of change as suggested by Russell above.

1.3.3. The Unreality of Time

Now that we have established that time and change are dependent on the A-series for their existence, if we were to show that there is something insurmountably flawed with the A-series, then that would affect the respective existences of time and change. This is the task which McTaggart sets himself next, to show that the A-series invariably involves a contradiction and has to be jettisoned.

There are two distinct arguments offered against the A-series. The first of which is, I think, somewhat problematic and the second I believe to be much stronger.⁵ The first argument is not elaborated upon much by McTaggart, mainly because he believed that the crux of the unreality of time rests with the second strategy, the argument which I shall now proceed to explain. The argument rests on the fact there is an apparent and unavoidable contradiction at the base of the A-series. The terms of the A-series (past, present and future) are incompatible in the sense that they cannot be held by an event/moment contemporaneously. If an event is in the past then we assume that it is not in the present and the future, if the event is in the future then we assume that it is not in the past and present, the same applies for the past. To say otherwise would be absurd. As we have stressed elsewhere, the A-series is a series of changing relations and the only facts about an event which change are the determinations of past, present and future. So change would not be possible if these characteristics did not change for any given event.

Notwithstanding the fact that no event can have all of these determinations, McTaggart claims that 'every event has them all'. If an event is present, then it *has been* future and *will be* past. Similarly, if an event is in the future, it will be present and past etc. It seems, however, that any event has all of these determinations. But does this contravene the claim that an event cannot have all of these determinations? It is necessary to first unpack what is meant by this

⁵ For the first, we have to accept that the characteristics of pastness, presentness and futurity are relations. The natural question to ask is then, 'relations to what?' It would not be appropriate to say that they are relations to each other. The reason for this is that the A-series is comprised of changing relations, but the relations to one another can never change. The 'death of Socrates' and the 'death of Plato' need to maintain their relations to one other within the time-series, "[h]ence, if the relations of the A series change, and they do, it must be because the members of this series are in relations to something else besides other members of time series" (Gotshalk, 1930: 31).

The problem is then to find the thing outside of the time-series to which these relations relate. We are asked to call this entity X and to understand that a series is an A-series when the terms within it have some relation to this entity. "This entity is itself not in time, yet it must be such that altering relations to it determine the other terms of the relations" (Gotshalk, 1930: 32). McTaggart believes that finding this entity outside of the time-series is both essential and impossible. Not much more is written about this point since he believed that his second argument was more powerful, and I would agree.

prohibition. Surely, it means that an event cannot have all of these determinations at the same time or rather simultaneously. But to say that some event *is present, will be past and has been future* does not suggest this; rather it seems to suggest that an event has these characteristics successively. This is only an illusion according to McTaggart.

The key to understanding why there is a contradiction here lies in the way in which tenses are formed in English. What does it mean to say that an event 'will be' future or 'has been' past? For that matter, what does 'is' mean in the sentence 'this event is present' (temporal as opposed to predicative meaning)? McTaggart explains it as follows:

"When we say that X has been Y, we are asserting X to be Y at a moment of past time. When we say that X will be Y, we are asserting X to be Y at a moment of future time. When we say that X is Y (in the temporal sense of 'is'), we are asserting X to be Y at a moment of present time" (1993: 33).

If we use this schema to analyze any sentence about events we will be perplexed at the outcome. For instance, take the sentence 'event A is present'. As mentioned above, this can be stated as X is present, will be past and has been future. But if we expand on the verb forms, we get, X is present at a moment of present time, past at a moment of future time and future at a moment of past time. An analogue of this reduction can be run for any statement involving any of the tenses. Hence the contradiction is unearthed. Every event is past, present or future (some combination of at least two determinations). In other words, there are a number of A-series properties which an event could have, every event is future at a moment of present time and is also past at a moment of present time etc. The set of all these properties is inconsistent and as stated above, no event can have more than one of these determinations and yet every event has them all.

There is no way out of this temporal quandary according to McTaggart. The contradiction leads to an infinite regress, no matter how we try to redefine the terms, as we shall see with Mellor's reconstruction of the argument. Since there is no way out of the paradox, we are left with the

conclusion that the A-series leads to contradiction. The conclusion which follows from this is that because both change and time depend on the A-series, they too ought to be rejected. There is no past, present or future, there is no 'earlier than' or 'later than'. We are forced to accept that neither change nor time is real and anything which exists in time is equally unreal. The way in which we perceive the world is not as it truly is but an illusion based on a contradiction.

1.3.4. The Paradox Unraveled

In order to grasp the nature of this paradox, it would help to formalize the argument. But before doing so, it would also be helpful to understand how the regress works and why it is vicious, if so.

As previously stated (following C.D. Broad's contention) there is nothing contradictory about an event possessing all the A-determinations successively (at different moments of time) in response to McTaggart's claim that all events possess all of these determinations which are incompatible. This view is brought out in the following quotation:

I cannot myself see that there is any contradiction to be avoided. When it is said that pastness, presentness and futurity are incompatible predicates, this is true only in the sense that no one term could have them *simultaneously* or *timelessly*. Now no term ever appears to have any of them timelessly and no term ever appears to have any two of them simultaneously.

What appears to be the case is that certain terms have them *successively*. Thus there is nothing in the temporal appearances to suggest that there is a contradiction to be avoided (1932: 313).

McTaggart's intuition, on the other hand, can be understood as something along the lines of: if there is temporal becoming or rather if time can be characterized by an ever-moving sequence

of A-determinations (the A-series) then all events will have all the positions in the sequence. To respond by saying that every event has these determinations of past, present and future at different moments of time does indeed resolve the contradiction but only at one level. The strategy employed here is only palliative. Gale explains it in this way:

What we have done is to explain away the contradiction of an event in the first-order time-series being past, present, and future by claiming that it has these determinations successively *at moments of time* in a second-order time-series (1966: 145).

We are resolving the contradiction by appealing to different moments of A-time which themselves are prey to the contradiction as well. In other words, if the predicates 'past', 'present' and 'future' are mutually exclusive, then using more complex predicates such as 'will be past' and 'is present' etc will not aid us. Simply because all events now possess the new predicates (nine in total) some of which are also incompatible with one another. "Admittedly the objector may again reply that the predicates which really apply to the same event are "is going to have been past" and "was going to be future," [as opposed to the incompatible 'was past' and 'will be future'] and that these are again incompatible" (Dummett, 1960: 497). Herein lies the infinite regress. The more we appeal to an event having these A-determinations at different moments, the more we are committed to more complex predicates which are victim to McTaggart's initial paradox.

The hierarchy of predicates resembles something of this sort. On the first level we simply have:

1st: 'Past' | 'Present' | 'Future'

On the second level we have:

2nd: 'will be Past' | 'is Present' | 'was future'

OR

2nd: 'past *in the* past/present/future' | 'present *in the* present/past/future' | 'future *in the* future/past/present' (adding up to nine predicates)

At level three we have now generated twenty-seven predicates:

3rd: 'past *in the* past/present/future *in the* past/present/future' | 'present *in the* present/past/ future *in the* present/past/future' | 'future *in the* future/past/present *in the* future/past/present'

And so on *ad infinitum*...

At every step, we may resolve the contradiction by reference to different moments of time, but this only leads to further contradiction at the next level. This is why the regress is vicious (we shall investigate the viciousness of the regress in the next section), because in order to dispose of the contradiction caused by the initial set of incompatible predicates we must make reference to second-order predicates (some of which are also incompatible) and thereby another A-series which only results in the contradiction showing up again. Nathan Oaklander explains the situation in this way:

In short, in order to account for something having incompatible temporal properties the defender of passage [of time] must assume that the term in question has those properties in succession, but in order for a term to be first future, then present, and then past, we assume that it has incompatible temporal properties. Thus, one cannot appeal to succession in order to explain how time and change are possible without falling into a vicious circle (1996: 211).

To see this even more clearly we can follow Mellor in his reconstruction of McTaggart's paradox. We can formalize the simple predicates as 'P', 'N' and 'F' which stand for 'past', 'present' and 'future' respectively [Then it follows that $(\forall e)(Pe \vee Ne \vee Fe)$ ⁶]. Any event is 'e' such that 'Pe' means 'e is past' (in the tenseless sense of 'is') and 'Ne' means 'e is present', 'Fe' means 'e is future'. From these we can build more complex tenses such as 'FPe' 'e will be past' or the future perfect passive 'FPNe' 'e will have been present'. These predicates coupled with our standard logical connectives of ' \sim ' is 'not', ' \wedge ' is 'and', ' \vee ' is 'or' and the double turnstile ' \Vdash ' for 'entailment' are all we need to illustrate McTaggart's argument formally.

The first step is a translation of the 'prohibition of tenses' clause, stating that the simple predicates are incompatible given by (i) below:

$$(i) \quad Ne \Vdash \sim(Pe \vee Fe); Pe \Vdash \sim(Ne \vee Fe); Fe \Vdash \sim(Pe \vee Ne) \text{ etc.}$$

McTaggart's claim is equivalent to (ii):

$$(ii) \quad Ne \wedge Pe \wedge Fe.$$

The argument then goes that (i) and (ii) are mutually exclusive as can be seen from the formalization above [since by De Morgans ' $\sim(Pe \vee Fe)$ ' is equivalent to ' $(\sim Pe \wedge \sim Fe)$ ' and similarly for the other clauses]. But the A-theory of time requires both (i) and (ii) to be true which is impossible, since (i) and (ii) lead to contradiction. The Broad strategy is then to say that 'e' does not have the properties in (ii) at once but successively, so to replace (ii) with (iii) 'e *will be* past and *was* future and *is* present' thereby removing the contradiction, therefore (iii) is consistent.

$$(iii) \quad FPe \wedge PFe \wedge Ne.$$

Thus, (i) and (iii) can both be true and the contradiction is seemingly resolved. Unfortunately, we have to accept the gamut of complex tenses in addition to those in (iii) and these are not

⁶ In the exclusive sense of ' \vee '.

compatible. These are the nine complex tenses mentioned above, in our language they would be represented by 'PP', 'PN', 'PF', 'NP', 'NN', 'NF', 'FP', 'FN', 'FF' and as in the case of the simple tenses, if an event has one it has them all, so too in the case of the complex tenses. But an event cannot be 'PP' and 'FF' thus (iii) entails (iv) which must be false.

$$(iv) \quad PPe \wedge FFe.$$

Also (ii) is equivalent to (v) thereby contravening our 'prohibition' clause:

$$(v) \quad NPe \wedge NNe \wedge NFe.$$

This paradox is brought about by all events having ever-changing A-determinations or positions in the A-series. More and more complex tenses are generated at each new level. Mellor writes:

The riposte will again be made, that *e* does not have these incompatible A-times all at once. But again, saying in A-terms just when they do have them simply generates even more complex A-times, including mutually incompatible ones like *PPP*, *NNN*, *FFF*, all of which every event has to have (1998: 74).

The regress is vicious precisely because it recurs at each new level of A-times. In this section I have shown that McTaggart's argument against the A-series does indeed lead to an infinite regress, one which is vicious. In the next section, I will investigate answers aimed at resolving or dissolving the paradox.

1.4. Possible problems with McTaggart's paradox

The responses to McTaggart come in two varieties: (1) the A-theorists' responses and the (2) B-theorists' responses. The former tend to attempt to prove that McTaggart was wrong in his argument against the A-series and discover flaws with this argument. B-theorists, on the other hand, tend to agree with his paradox and use it to affirm the rejection of tense, while claiming that the B-series can in fact account for change and time independently. In this section, I shall focus on A-theory responses to McTaggart's argument, I will show that none of them are

successful against the paradox. The following should not be seen as single independent arguments but rather families or types of arguments which have been leveled against the paradox. We have already dealt with one major objection to McTaggart's argument above and we now move on to some other potential strategies for ridding ourselves of the paradox.

1.4.1. Resolving the Regress

An initial and unconventional line which could be taken is to accept that there is a regress at the heart of the A-series but to deny that it is a 'vicious' one. Swinburne agrees that there is a regress here but does not believe that it is as damaging as McTaggart thinks. He believes that the fact that simple A-properties like 'E is present' do entail the duplicated and triplicated ones (*ad finitum*) in his terms, and the complex tenses in ours, is not enough to reject the A-series. Since the relation of entailment is such that we do not need to derive entailments even if they are only possible. Even though 'p' entails 'p is true' and 'it is true that p is true', says Swinburne, we need not generate these entailments, because 'p' alone suffices. The meaning of these statements is clear and we do not need to derive the further entailments even if they are equivalent. The same can be said of predicates such 'is present', 'is past' and 'is future', "[t]he regress is therefore benign" (Swinburne, 1990: 118).

The first response to this type of objection would be to deny that the entailments which are discovered are benign. If the predicate 'is past' entails a contradiction then deriving it is important and necessary. It is not enough to say that since we can understand the predicate or its meaning is clear, we need not derive the equivalent entailments. If A-properties entail an infinite regress of contradictory properties or a vicious circle, then how can the regress be benign? The argument is not that 'is past' or 'is present' entails a contradiction but rather that if any event possesses all of the A-determinations together that this leads to contradiction (something which seems to be required by the notion of temporal becoming). Whether or not

we have clear notions of the meanings of these predicates, when held together, they still entail contradiction. However, Swinburne believes that he has an answer to this problem.

In the 'Unreality of Time', McTaggart describes the positions of the A-series as being relations but mentions that his argument would work just as well had they been qualities. Swinburne not only disputes this claim but bases his critique of the paradox on the fact that 'pastness', 'presentness' and 'futurity' are non-relational qualities. It is true that this alternative analysis of the properties of the A-series has a different effect on McTaggart's argument but I am not certain that this strategy works. The rationale behind this move involves the claim that the paradox is only generated when we understand the properties of the A-series as relations and when we acknowledge that they are not, the paradox disappears. When viewed as relations, we understand the A-determinations as dyadic, i.e. as relating a moment or event to the present moment. Therefore they relate two or more things, but argues Swinburne "if pastness is a relation, then events cannot be "past" *simpliciter*" (1990: 119). The argument goes that if we had the simple predicates of 'past', 'present' and 'future' *simpliciter* then there would be no paradox. The vicious regress is generated by the search for 'complete descriptions' which can only be achieved when all the relations are spelt out (as in all of the entailments derived), but every time a new relation is introduced then it is in need of completion in the same way, hence the regress. However, if we understand the determinations of the A-series as non-relational when possessed by events, then the claim is that the regress is no longer vicious nor is it infinite. So event X would be present *simpliciter* on this view and this would be enough for our concept of time and the A-series.

One problem with this alternative is that although Swinburne speaks about clarity of concepts and 'clear meanings' of terms, he seems to lose that explanatory power when he reduces the A-series positions to non-relational primitives. How are we to understand 'the past' if not with relation to the present and future? How does an event pass from possessing the quality of 'present' to that of 'past'? Is there no distinction between the recent past and the distant one?

These questions are not addressed. I am inclined to believe that to understand the positions of the A-series in terms of independent primitives is to misunderstand them. When someone uses the predicate 'is past' to describe an event, we naturally assume that the event in question was present and future. Whether or not we believe in the specious present, we do understand that the A-series is dynamic. It is not at all clear how we would define the positions of the A-series if we did not know in which ways they relate to one another. The past, present and future 'simpliciter' do not explain how an event can first be future, then present and eventually recede into the past. There seems to be no way around the relations of these properties.

Even if the A-determinations are qualities, they have to be related to one another in order for the A-series to be dynamic and explicable in any way. This is why McTaggart didn't believe that viewing them as qualities made any difference to his argument and he seems to have been right.

It also seems as if tenses would be obsolete on this view and with them our powers of description limited. If an event X is present *simpliciter* and that's all we need for the concept, then do we not need to understand X as *having been* future and *going to be* past? There doesn't seem to be an entailment of these things from the initial statement. But how else are we to understand the proposition that 'X is past' in isolation from the other A-determinations? This is precisely the crux of McTaggart's argument, in order to understand statements such as those we need to involve the other A-determinations and when we do we are at an impasse, since they seem to be at odds when held together. Swinburne's suggestion is therefore unappealing and problematic.

For these reasons, I do not think that Swinburne's objection stands. However, a similar strategy can be found in Wisdom and Stebbing in which they question the entailments of the A-determinations and whether these lead to an infinite regress. Like Swinburne they assume that

the relation between the simple and complex tenses is one of entailment. Thus Swinburne may have been onto something, is the relation of entailment the key to dissolving McTaggart's paradox? Wisdom and Stebbing seem to think so:

Wisdom and Stebbing both argued that McTaggart's mistake was to suppose that 'X is present' *means* 'X is present at a moment which is present', which in turn *means* 'X is present at a moment which is present at a moment which is present', and so on. If this were so, the regress would be vicious. But, they suggest, these statements are not equivalent in meaning; rather, the first *entails* the second, which *entails* the third, and so on (1960, Mink: 256).

If 'Julia is Bob's spouse' entails 'Julia is Bob's spouse's spouse's spouse' entails 'Julia is Bob's spouse's spouse's spouse's spouse's spouse' then this does not lead to a vicious regress "because the truth of the second statement is a consequence, not a condition, of the truth of the first, and so on" (Mink, 1960: 267). What this means is that the truth of the first statement does not depend on the truth of the second or third and so similarly for the temporal case. This can be brought out by the absurdity of asking when an event is present. Surely this question will not be adequately answered by responding that 'X is present at a present moment' and therefore 'X is present' cannot *mean* 'X is present at a moment which is present'. But as Mink notes it is not at all odd to ask the question 'When was X present?'

Hence "'X is past' must mean rather than entail 'X is past at a moment of time which is present', because the latter is clearly equivalent with 'X was present at a moment of time which is past'" (Mink, 1960: 257). The mistake here is based on an equivocation of the 'is' in statements such as 'X is present', when taken temporally it naturally picks out the present moment which makes any iteration of the present moment superfluous. But in the case of the copulae 'was' and 'will be' the meanings need to be unpacked because the present is subtly implied but not explicated in statements containing these copulae. In order to understand statements involving 'was' and 'will be' (and complex tenses for that matter) we will need to rely on the meanings generated by McTaggart's analysis of A-determinations until an alternative can be presented, entailments have been shown to be no such alternative.

As proven above, neither Swinburne nor Wisdom and Stebbing have debunked the paradox. There are however more convincing arguments against McTaggart's paradox, one of which we shall move onto now.

1.4.2. Lowe and the Logic of Indexicality

Jonathan Lowe's attack on McTaggart is a direct argument against the paradox which Lowe believes is based upon a fallacy. He identifies the structure of the argument against time as follows (for this I will use my own lettering to avoid confusion with the numbers above):

- (a) Time essentially involves change
- (b) Change can only be explained in terms of the A-series
- (c) A-series involves contradiction and therefore is false of reality
- (d) Time is unreal

Not only does Lowe deny (c) but he also affirms (b). However, we shall not focus on his argument for A-series change but merely on his disavowal of the paradox at the heart of the A-series.

If we return to the paradox stated above. The problem was that although for the passage or flow of time to be an accurate aspect of reality we require that the A-determinations of 'past', 'present' and 'future' be mutually exclusive when applied to events (and moments), we soon discover that every event possesses all of them. The initial response was that indeed events possess all of these properties but none simultaneously rather a given event *is* present, *was* future and *will be* past. The event in question thus has these A-determinations *successively*. Unfortunately, as we saw above, this attempt was unsuccessful. Since this move involves

second order tenses or iterated tenses ('past in the present', 'future in the past' etc) which are susceptible to the contradiction as the first order ones were. The set of nine predicates (or second order tenses) generated by the first three simple predicates also have incompatible members and so on for the higher levels. In this way we are left with an infinite regress and a contradiction at each level which can only be avoided by ascending to a higher level which is also a victim to contradiction.

If we follow Dummett's reformulation of the paradox, we notice the use of 'iterated tenses'. An event can thus be 'present in the present' or 'past in the future' or 'future in the present' etc. Dummett uses these iterated tenses to represent McTaggart's paradox as we saw above (as McTaggart does himself to an extent). For instance, a tensed statement such as 'X is present, was future and will be past' can be rendered as 'X is present in the present, future in the past and past in the future' without loss of meaning. According to this reasoning it is a perfectly legitimate move in the language-game to assert of a future event that it will be happening now in the future or at a future moment. This usage is akin to saying of an event that although it is not happening 'here' it is happening 'here over there'. Words such as 'here', 'there' or 'I' and 'you' are what are known as indexicals. The truth-values of expressions which contain them are dependent on the context of use. If the sentence 'I am a philosophy student' is uttered by drama student it is false, but when the same sentence is uttered by me it is true. Dummett explains the situation in this way:

Every place can be called both 'here' and 'there', both 'near' and 'far', and every person can be called both 'I' and 'you': yet 'here' and 'there', 'near' and 'far', 'I' and 'you' are incompatible. It would be no use for an objector to say that London is nearby far away, but far away nearby, or that it is 'here' there but 'there' here, since it can also be called 'nearby nearby' and "'here" here', and so on. Similarly, it would be no use an objector saying 'You are "you" to me, but "I" to you', because everyone can be called both "'you" to me' and "'I" to me' (1960: 500).

The link between these indexical expressions and tensed statements or A-expressions is the fact that they are all token-reflexive. The truth-values of all token-reflexive expressions vary with

the context of utterance. The truth-value of a sentence involving an indexical expression such as 'I' depends on the speaker of the utterance in much the same way as that of a sentence involving 'here' which would depend on the location of the utterance. In the same way 'now' depends on the time at which the sentence containing it is uttered. The terms 'is past', 'is present' and 'is future' are token reflexive since any expression containing them may vary in truth-value in accordance with when it is uttered or expressed. The statement 'X is past' uttered while 'X' is happening is false but as soon as 'X' has ceased to take place it is true and similarly for expressions containing the other A-determinations. For instance, the statement 'the year 2010 is past' is false if uttered this year (or in any years before this one) but if uttered next year (or any after) it would be true.

MacBeath questions Dummett's claims about indexical expressions. This criticism is partly based on some inconsistent usage of quotation marks in Dummett's paper but it also stems from some deeper issues. "To start at the end [of the above quotation], Dummett's claim that 'everyone can be called both " 'you' to me" and " 'I' to me"' seems plainly false" (MacBeath, 1988: 113). Simply put it would be infelicitous to refer to someone as "'you" to me', and this type of statement would be a strange distortion of common language practice. MacBeath goes on to assert that "'You" to me are late for our (?) appointment"' makes no sense, and I allow that it is a linguistically strange creature but certainly not non-sensical. It means the person to whom I refer as "You" is late for our mutual appointment, and indeed it would be quite odd to refer to anyone in this way but certainly not uninterpretable. In addition, it doesn't seem to me that there is a claim about the way in which we actually use language being made by Dummett but rather how it could conceivably be used to convey meaning.

On the charge of inconsistent use of quotation marks, there is no defense. Where Dummett writes "London can be called 'nearby nearby' and "'here" here"' there seems to be a clear use and mention problem. Surely by 'nearby nearby' Dummett means to say that 'London can be called 'nearby' nearby' and 'London can be called 'here' here'? In the first place the words

'here' and 'nearby' are being mentioned and in the second they are being used. But what philosophical sense can be made of these statements? Lowe and MacBeath argue that none can be made. Lowe writes:

It is *not* legitimate to say that an event *e*, which is not happening *here*, but is happening over *there*, is happening *here over there*. All we can say really is that if *e* is happening there and not here, then an utterance *over there* of sentence 'e is happening here' is true (1987: 66).

On this view to utter the sentence 'e is happening *here over there*' is to make a contradictory statement. In this case the speaker is assuming a position *sub specie aeternitatis* and attempting to avoid the indexicality of the terms 'here' and 'there' which are mutually exclusive when used together. This, however, is not a legitimate move. The reason for our inability to use indexical expressions in this way is that they are semantically constrained by circumstances outside of personal reference. The reference of 'here' is not fixed by me but rather by other circumstances which hold, such as the location of the utterance in which it is expressed. It is much the same for the temporal case. The use of 'is present', 'is past' and 'is future' at the same time amounts to contradiction, *a fortiori* the claim that the present was future and will be past (or any variations of this sort). This is only so because we are relying on a mistaken use of indexical expressions. There is no *sub specie aeternitatis* position in which statements like 'here over there' and 'past in the future' make sense since token-reflexive expressions are context sensitive and cannot be used in this way. The requisite level of abstraction is simply not possible for such expressions given their context dependent nature. The way around this problem is by use of the following circumlocution. Once we understand that what is implied by 'X will happen' is that it *will be* possible to express the statement 'X is happening now' truthfully. So at some future moment the sentence 'X is happening now' is true and this is all that is implied by the use of the mistaken iterated statement 'X is present in the future' or the simple tensed statement 'X will happen'.

The natural question to ask is how this solves McTaggart's paradox. The answer is that Lowe's account amounts to a denial of iterated tenses and according to him only with them can the

regress be generated. The complex or iterated tenses such as 'past in the future' or 'present in the past' simply do not exist and without them the regress does not result. To claim that 'X will occur' implies that 'X is present in the future' would be indexically fallacious. The proper way to understand such statements is that it is possible to utter the sentence 'X is happening now' (or 'X is present') truthfully in the future. The fallacy would be to assume that the statement 'X is present in the future' is implied by 'X will happen' and the like.

If we assume the existence of these iterated tenses (or second and third order predicates etc.) then indeed we shall be stuck in an infinite regress of contradictory combinations of them. The denial of iterated tenses allows us to resort to the initial response proffered against McTaggart by Broad and others that events do not possess the A-determinations *simultaneously* but *successively*. This move does not leave us with inconsistent sets of complex tenses but rather with true assertible sentences at different moments of time. And hence the paradox is dissolved by avoiding the so-called 'indexical fallacy'.

1.4.3. Metalinguistic subterfuge

Le Poidevin and Mellor (1987) believe that the matter is not so easily resolved. They claim that Lowe commits himself to an equally vicious regress. If we return to our formalization above for the moment, we can see that Lowe is eliminating a formula such as 'FNe' "by exporting its second component ('F') into a simply tensed statement saying when the simply tensed statement 'Ne' is true" (Le Poidevin & Mellor, 1987: 535) and the same applies for the other possible complex tense formulas. They then introduce a set of new predicates 'NT' for 'is now true', 'PT' for 'was true' and 'FT' for 'will be true'. We can rewrite some of the old formulae using these new predicates, for instance 'NNe' becomes "Ne'NT' or 'the true statement 'e is happening now' expressed at the present moment' and 'PFNe' becomes " "Ne"FT' PT' or 'the true statement 'e is happening now' said at some time which was in the future'.

The problem with this strategy is one pointed out by Mellor in *Real Time II*. He writes:

Nor does it help to distinguish a so-called *object language*, the language we use to say that events or facts are past, present or future, from its *metalanguage*, the language we use to say which object language sentences are true...But this only generates a variant of McTaggart's proof, with truth and falsity as incompatible properties. For all the true A-sentences that concern us are also (sometimes) false (1998: 75).

The accusation being made here is that Lowe is doing just this, i.e. getting rid of the complex or iterated tenses in the *object language* by using simple tenses in the *meta-language*. The situation is such that we have replaced the incompatible tenses and iterated tenses with truth-predicates in the meta-language. However, the truth-predicates 'true' and 'false' are now our incompatible properties where tenses were before since sentences in the object language are both true and false, sentences such as 'Ne' and 'Fe' are sometimes true but at other times false.

An analogue of the Broad response can be constructed here. A defender of this view could state that no sentence in the object language can both be true and false simultaneously and thus we can use sentences in the meta-language to provide the conditions under which these sentences are true and those under which they are false thereby eliminating the contradiction. "But then his meta-language sentences will also be both true and false, since, for example, ' "Ne"NT' must always be true when 'Ne' is true and false when it is false" (Le Poidevin & Mellor, 1987: 536). Thus the contradiction is now present in the meta-language which in turn requires us to resort to a meta-meta-language to specify when sentences in the meta-language are true and so on *ad infinitum*.

Lowe has a response in which he denies that he is making such a 'meta-linguistic dodge'. He starts by maintaining that the claim that 'every event is past and present and future' is as absurd as saying that 'every event occurs both here and there' and 'that every person is both you and I'. In the case of one of the previous statements we should say "that every event is

such that there is a place at which it can be truly described as occurring “here” and a (different) place at which it can be truly described as occurring “there” (Lowe, 1992: 325) and a similar model applies in the case of the use of “you” and “I”. It is still incoherent to make mention of the iterated tense such as “future in the past” (PF) and “present in the present” (NN) and “past in the future” (FP) in order to capture the notion of temporal becoming. Rather we should say that a present event is truly describable as “present”, was describable as “future” and will be describable as “past”. Lowe claims to have avoided the contradiction by using only A-series terms and not iterated tenses nor a ‘meta-linguistic’ maneuver as described by Le Poidevin and Mellor. On the charge of resorting to a meta-linguistic version of McTaggart’s argument in which the infinite regress of incompatible properties ensues, Lowe distinguishes between two readings of the logical structure of premise (ii). The problematic premise is (ii) in the reconstruction of McTaggart’s argument given above. This was the ‘temporal becoming’ premise:

$$(ii) \text{ Ne} \wedge \text{Pe} \wedge \text{Fe}.$$

The metalinguistic version of the above to which Le Poidevin and Mellor claim that Lowe is committed is something along the lines of (vi).

$$(vi) \quad (\text{NT} \text{ “Ne”} \wedge \text{PT} \text{ “Ne”} \wedge \text{FT} \text{ “Ne”})$$

This characterization states that event ‘e’ is truly describable as “present”, was truly describable as “present” and will be truly describable as “present”. It would be correct to reject this claim, since a metalinguistic reformulation of just the first sentence of our ‘prohibition’ clause (i) above would be given by (vii) below:

$$(i) \quad \text{Ne} \vdash \sim(\text{Pe} \vee \text{Fe})$$

$$(vii) \quad (\text{NT} \text{ “Ne”}) \vdash \sim(\text{PT} \text{ “Ne”} \vee \text{FT} \text{ “Ne”})$$

From the above reformulation we can clearly see that (vi) and (vii) are as incompatible as (i) and (ii), hence McTaggart’s paradox is recast in the meta-language. However, Lowe denies that his account implies this reading of (ii). Rather we should replace the conjunctions with disjunctions

such that it states that an event *is* or *was* or *will be* truly describable as “present”. Thus (ii) should be represented by (viii):

$$(viii) \quad (NT \text{ “Ne”} \vee PT \text{ “Ne”} \vee FT \text{ “Ne”})$$

And this avoids the contradiction and renders iterated tenses and the like otiose.⁷ However, a further objection can be made to Lowe’s project, one which I believe is more damning. In his discussion of (ii) above, Lowe attempts to identify what he calls a “germ of truth” which it does contain. Lowe defends an A-series account of change and therefore believes that there is a ‘passage of time’ to be acknowledged, and which he believes is acknowledged by his reconstruction of (ii). In his earlier papers, he takes pains to account for the difference between temporal and spatial change. If there is a direct analogue between the spatial variety of change and the temporal case, then there would be cause to question and reject the account of change presented. A key aspect of any theory of change in time has to account for the uniqueness of the temporal case, which is mainly done by accounting for the unique direction of temporal change. Le Poidevin offers us an ingenious *reductio ad absurdum* argument against Lowe’s version of (ii) by showing that there is a direct spatial analogue of his reconstruction.

I present his argument here. The symbolic formalization of (ii) which avoids the ‘indexical fallacy’ while maintaining the ‘germ of truth’ is supposedly Lowe’s 6** or (ix) below:

$$(ix) \quad (NT \text{ “Ne”} \vee PT \text{ “Ne”} \vee FT \text{ “Ne”}) \wedge (NT \text{ “Pe”} \vee PT \text{ “Pe”} \vee FT \text{ “Pe”}) \wedge (NT \text{ “Fe”} \vee PT \text{ “Fe”} \vee FT \text{ “Fe”})$$

This apparently captures the notion of temporal becoming and is not at all contradictory. Indeed, it does not seem to harbour any contradiction of the sort (ii) does. The question then is

⁷ Lowe does provide a fuller symbolic representation which replaces all of the complex tenses/ A-predicates and accounts for the simple ones: $(NT \text{ “Ne”} \vee PT \text{ “Ne”} \vee FT \text{ “Ne”}) \wedge (NT \text{ “Pe”} \vee PT \text{ “Pe”} \vee FT \text{ “Pe”}) \wedge (NT \text{ “Fe”} \vee PT \text{ “Fe”} \vee FT \text{ “Fe”})$ (1992:326). Note that I have retained my initial logical notation throughout and the use of ‘e’ in lieu of Lowe’s ‘p’ as the individual constant.

whether or not it captures the notion of ‘temporal becoming’ or ‘the passage of time’. This is where the *reductio* comes in. If we follow Lowe’s reasoning about spatial indexicals, then we have to acknowledge that expressions like ‘here over there’ make no sense (as *per* the ‘indexical fallacy’). Rather what we can say is that at one place an object can be truly said to be “here” and at another place it can truly be said to be “there”. How would we transcribe this formally? Le Poidevin offers this as the logical structure of the previous statement (1993: 167):

$$(x) \quad (HT \text{ “Hy”} \vee OT \text{ “Hy”}) \wedge (HT \text{ “Oy”} \vee OT \text{ “Oy”})$$

The “Hy” and “Oy” represent the propositions “here” and “over there” for an arbitrary object “y” respectively. As with the temporal case “OT” and “HT” mean “the assertion that ‘_’ is true over there” and “the assertion that ‘_’ is true here” respectively. Now (x) seems to be perfectly reasonable and yet if we accept it then there are some serious consequences. For one, (x) is a perfect counterpart of (ix). This is a conclusion which Lowe has to accept but if so then there is a direct spatial counterpart to the notion of ‘temporal becoming’. This, however, is unacceptable and therefore there must be something wrong with (ix). Le Poidevin sums it up in this way:

Let us put the point more strongly: $S6^{**}$ [my (x)] represents a truth, whereas the proposition that there is a spatial counterpart to the passage of time is false. It follows that $S6^{**}$ [(x)] does *not* represent such a proposition. It also follows, since 6^{**} [(ix)] is the precise temporal counterpart of $S6^{**}$ [(x)], that 6^{**} [(ix)] does *not* represent the proposition that there is a passage of time (1993: 167).

The ‘germ of truth’ in (ii) which Lowe hoped to capture with his reformulation was not at all captured. With the failure to correctly formulate the paradox while avoiding contradiction, the project fails. Either we read it as a metalinguistic attempt at resolving the problem of incompatible properties, in which case it is unsuccessful, or we read it as a misrepresentation of the initial premises of the McTaggart’s argument, in which case it is misdirected. Whichever reading we opt for, McTaggart’s paradox survives another day. Therefore, in conclusion to this section, we have assessed various A-theory responses to McTaggart’s paradox and shown that

they are insufficient to refute or dissolve it. We now move on to the evaluation of another argument, one which also attempts to affirm the priority of the A-series.

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SECTION 2: THE LOGIC OF TIME

2.1. Temporal Logic and Time

Some of the previous arguments question fundamental representations of time in philosophy. The questions of logical entailment and the coherence of 'embedded' or 'iterated' tenses were used against McTaggart's argument. In the preceding chapters we have attempted numerous formalizations of certain arguments and realised the importance of understanding the logical structure and implications of various claims. These notions are dealt with explicitly in logic and more specifically in temporal logic. Before I go onto a positive account of time, a B-series account, I think that some notions of temporal logic need to be made clear. The realm of temporal logic has been a battlefield between rival philosophical views of time since its inception in the 1950's and 1960's (or rather re-inception given that it has been investigated since ancient times). I shall now provide a brief overview of the logical terrain paying special attention to elements of temporal logic which concern the debate between A and B-theories of time directly. The argument from temporal logic to the priority of the A-series will also be assessed and critiqued within the exposition. The purpose of this section is to evaluate whether logic itself can be harnessed in order to argue for a specific view of time. I will attempt to show that if Prior is correct then we would be forced to accept McTaggart's conclusion about the unreality of time due to the foundational nature of the A-series.

Arthur Prior introduced the four-grades of tense-logical involvement, a project which aimed at showing that all B-series relations are reducible to A-series terms. In what follows, I shall describe this project and show that it does seem achieve this goal, but that the hybridization of tense logic (which is needed for this achievement) leads to some disquieting results. Furthermore, I shall provide philosophical as well as technical evidence that the use of tense-logic in deciding which theory of time is more fundamental is unsuccessful.

If we consider one of the previous issues, then perhaps we could appreciate the important place which logic holds within this debate. Lowe attempted to deny the coherence of iterated tenses such as 'present in the past' and 'past in the future' etc. However as Le Poidevin notes, the issue of 'coherence' is not just a matter of common parlance but logical structure, "whether or not expressions containing iterated tenses are genuinely incoherent depends on how we construe their logical form" (1993: 163). The difference lies in whether we take tensed expressions as predicates attached to singular terms or as sentential operators just as we do with the modal operators of 'necessity' and 'possibility' in modal logic. If we derived our logical form from the predicate calculus as the former option suggests, then indeed Lowe was correct, since "(X is present) is past" is not a well-formed formula. But if we view tensed expressions as sentential operators, then the matter is quite different. This would lead us into what is known as 'tense logic'. In a footnote to 'Time: a Treatment of Some Puzzles', John Findlay wrote:

And our conventions with regard to tenses are so well worked out that we have practically the materials in them for a formal calculus...The calculus of tenses should have been included in the modern development of modal logics. It includes such obvious propositions as that

$x \text{ present} = (x \text{ present}) \text{ present}$

$x \text{ future} = (x \text{ future}) \text{ present} = (x \text{ present}) \text{ future}$ (Gale, 1968: 160).

It is apparently from this footnote that the inspiration behind tense logic was spawned. Arthur Prior believed that the insight ' $x \text{ present} = (x \text{ present}) \text{ present}$ ' was part of a more general truth namely, ' $x = x \text{ present}$ '. "The *formal* importance of this conception of presentness (' $x \text{ present} = x$ ') is that it underlies, and is required by, the systematic definition of complex tenses in terms of simpler ones" (Prior, 1967: 14). Prior held that in lieu of attaching tensed modifiers to timeless content, as in '(x is y-ing) past', we should let tensing operate over sentences which are tensed. Once we go deep enough into the complexity of any expression we will eventually discover that the tense or 'the kernel of complexity' of any statement is in the present tense.

Prior was a presentist and believed that only the present is 'real'. Thus "the past is not the present but it *is* the past present, and the future is not the present but it *is* the future present" (1968: 8). It is because our system needs to be able to form sentences from other sentences that he held that tense logic ought to be understood on the same lines as modal logic, which also uses operators such as 'not' (from propositional logic) and 'possibly' and 'necessarily' to do exactly that.

If we shift back to the case of iterated tenses, we can notice that what Lowe is denying is that we are able to embed one tense operator within another, altering the scope of the original operator. Consider the sentence 'It is now the case that p '. Tense operators could shift the tense of the expression from present to past or future, as in 'It was the case that (It is now the case that p)'. This statement does not entail the statement 'It is now the case that p ' but rather that the past tense statement 'It was the case that p '. This is due to the scope of the tense-operator 'It is now the case that' being narrower than the scope of 'It was the case that', the latter being the dominant operator in the given expression. Lowe argues that the operators 'It was the case that' and 'It is now the case that' have exactly the same scope and therefore an expression containing both of them would be incoherent (Le Poidevin, 1993: 164). But whether or not we actually do use natural language in Lowe's way is not important, since we can establish these conventions (that tense-operators can be embedded inside of one another) in our formal language. This is in fact what Prior suggests we do.

There is a reason I have headed this chapter 'Temporal Logic' and not 'Tense Logic'. The latter refers to the branch of temporal logic which derives its origin from the A-series generating a calculus of tenses and the term 'logic of time' is generally reserved for logic based on the B-series which generate a calculus of times. "Prior formally elaborated McTaggart's distinction between an A-series and a B-series conception of time...and showed that we can discuss time using either a tense logic, or using an earlier-later calculus" (Øhrstrøm and Hasle, 1993: 32). Temporal logic serves as a convenient blanket-term for the overarching logical domain. This

characterization may be somewhat misleading though, in that it suggests that temporal logic is a subset of the classical logic calculus. This is the opposite of what Prior believed.

It was Prior's view that, properly understood, all of logic is really temporal, and that logical languages without some kind of temporal operators were really devoted just to a proper subset of logic (Øhrstrøm and Hasle, 2006: 448).

In addition, he believed that logic was not only a matter of language but that it concerns the real world. Hans Reichenbach too believed that logic was the key to a better understanding of the nature of things, "[l]ogic is primary a theoretical science; and it proceeds by giving a determinate form to notions that until then had been employed without a clear understanding of their nature" (1947: 3). It is with logic that we achieve this understanding. Let us now move onto some features of temporal logic.

2.1.1. Minimal Tense Logic

There is a notion of minimal tense logic which has to be understood in order to proceed. This is the simplest logic referred to as system K_t . In this system, we have the modalities of F which stands for 'It will be the case that...' and P, for 'It has been the case that...' which serve as primitive symbols. Additionally, we have the duals of F and P – G, which stands for 'It will always be the case that...' and H, for 'It has always been the case that...' defined as $\sim F \sim$ and $\sim P \sim$ respectively (the inverse also holds by definition, i.e. $F =_{\text{def}} \sim G \sim$ and $P =_{\text{def}} \sim H \sim$).⁸ The minimal tense logic system K_t has the following axioms and rules of inference in addition to the axioms of propositional logic:

$$GA_1 : G(p \rightarrow q) \rightarrow (Gp \rightarrow Gq)$$

$$HA_1 : H(p \rightarrow q) \rightarrow (Hp \rightarrow Hq)$$

$$GA_2 : p \rightarrow HFp$$

⁸ Prior was greatly influenced by the Polish logicians and therefore wrote all of his logic in 'Polish notation'. I have translated his formulae using this key: $Np = \sim p$; $Kpq = p \wedge q$; $Apq = p \vee q$; $Cpq = p \rightarrow q$; $Epq = p \leftrightarrow q$; $\Pi xpx = (\forall x)Px$ and $\Sigma xpx = (\exists x)Px$.

HA₂ : $p \rightarrow Gp$

RG: If $\vdash p$, then $\vdash Gp$

and

RH: If $\vdash p$, then $\vdash Hp$.

The equivalent of *modus ponens* is given as RMP: If $\vdash p$ and $\vdash p \rightarrow q$, then $\vdash q$. We could deduce the contrapositions of GA₂ and HA₂ as PG $p \rightarrow p$ and FH $p \rightarrow p$ respectively. The semantics for tense logic like modal logic can be interpreted using Kripke models. A Kripke model is given as an ordered triple $\langle W, R, I \rangle$ containing W which is a non-empty set of possible worlds, R which is the accessibility relation ranging over W and I which is an two-place interpretation function such that for sentence letter p and any $w \in W$, $I(p, w)$ is 0 or 1. This is explained as follows:

Each MPL-model [Kripke model] contains a set W of possible worlds, and an accessibility relation R over W . $\langle W, R \rangle$ is sometimes called the model's *frame*. Think of the frame as giving the "structure" of the model's space of possible worlds: it says how many worlds there are, and which worlds are accessible from which. In addition to a frame, each model also contains an interpretation function I , which assigns truth values to sentence letters of worlds (Sider, 2010, 179).

The minimal tense logic K_t is interpretable on Kripke frames with no constraints on the accessibility relations, frames akin to system K in modal logic. In order to represent temporal properties such as continuity, discreteness etc. we can stipulate these properties by imposing constraints on our model thereby generating more complex models than the minimal tense logic of K_t . For instance, the density postulate which states that between any two instants of time there is a third instant, we may stipulate as an axiom: $Fp \rightarrow FFp$ (and similarly for the past $Pp \rightarrow PPp$) with the metalinguistic representation, $\forall(x, y \in W)(\exists z \in W) \text{ s.t. } xRy \rightarrow xRz \wedge zRy$. Interesting and informative proofs can be constructed by stipulating certain properties of a system.

2.1.2. The U-calculus (Prior on the 'prior' relation)

Temporal logic can also be understood as a logic of specific times, using the 'earlier-than later-than calculus' or the U-calculus. The propositions within this logical system are "temporally definite" and do not change their truth values. With the U-calculus we have two new operators $T_a p$ 'It is the case at instant a that p ' and Uab 'Instant a is earlier than instant b ' which is a relation between two instants. Prior states that the theses of K_t are exactly provable in the minimal U-calculus, preceded by T_a , "whether we use the one basis or the other, the tense-logical theses which are provable, preceded by T_a , in the minimal U-calculus...are precisely those of the minimal tense logic K_t and the addition of various special conditions on U " (1968: 117). As before we have postulates associated with this system (translated from polish notation):

$$T1: T_a (p \rightarrow q) \rightarrow (T_a p \rightarrow T_a q)$$

$$T2: T_a \sim p \leftrightarrow \sim T_a p \text{ (Prior's T2.1. and T2.2)}$$

$$UT1: T_a Gp \leftrightarrow \forall b (Uab \rightarrow T_b p)$$

$$UT2: T_a Hp \leftrightarrow \forall b (Uba \rightarrow T_b p)$$

This system is what Prior referred to as the lowest or first grade of tense-logical involvement. He believed that even philosophers who think that tense logic is dubious should not have trouble accepting this level of engagement with it. He adds that "[i]t is not *quite* to be taken for granted, however, that the U-calculus is philosophically simpler than a more substantial tense logic would be" (Prior, 1968: 118).

2.1.3. The Four Grades of Tense-logical Involvement

Modeled after Quine's "three grades of modal involvement", Prior developed his "four grades of tense-logical involvement", a framework which describes the four different approaches which can be taken with relation to temporal logic, each in turn providing a potential philosophical foundation for temporal logic itself. These grades can also be described in terms of the A-series determinations and the B-series relations. The ultimate goal of this logical development was to reduce all modal notions and U-calculus relations to the tense-logical primitives and thereby affirm that the A-series is the fundamental conception of time.

The first grade of tense-logical involvement was already gestured at above with the minimal tense logic and the U-calculus. On this grade we take tensed formulae, i.e. the formulae of system K_t , to be 'pure predicates' which are either true or false of instants. The tense logic of the system K_t is therefore reducible to the U-calculus. The operators of the U-calculus are based upon the 'earlier-than' and 'later-than' relations of the B-series (as are the tense logical primitives). Any talk of tense is just short-hand talk about properties of the B-relations. Instants as opposed to tenses are seen as primitive in this logical scheme. Rescher describes propositions involving the operators $T_a p$ and $U_a b$ of the U-calculus as "chronologically definite propositions" whose truth-values are time-independent. "Hence, in the first grade B-theory concepts are seen to be determining for a proper understanding of time and reality" (Øhrstrøm and Hasle, 1993: 33) and the A-theories of time are thus all mistaken.

According to the second grade of tense-logical involvement, tensed formulae or tenses are not to be seen as reducible to the U-calculus or B-series relations. The formulae of K_t are now to be understood on the same level as those of the U-calculus. The essential step here is to equate

the proposition p with the $T_a p$. Therefore an axiom of this system would be that from $\vdash p$ infer $\vdash T_a p$. Another important consequence is that the T_a operator is now embeddable, in other words, another axiom of this system is $T_a p \rightarrow T_b T_a p$, where $T_b T_a p$ is 'It is true at time b that (it is true at time a that p)'. "The philosophical implication of this second grade of tense-logical involvement is that one must regard the basic A - and B -theory concepts as being on the same conceptual level. Neither set of concepts is conditioned by the other" (Øhrstrøm and Hasle, 1993: 34). If we adopt this logical structure for tensed statements then we are permitted to embed tenses within other tenses and make sense of iterated tenses in this way, as in ' $T_c T_b T_a p$ ' or 'it is the case at c that (it is the case at b that (it is the case at a that p))'.

There is a worry about the second grade, however. If what is required on this on this view is that any sentence p and formula $T_a p$ be on the same logical level, then this seems to conflate syntax with semantics. The U-calculus formula $T_a p$ means 'It is the case at instant a that p ' or ' p is true at a '. Another formula of this grade would be ' Pp ' which means 'it was the case that p ' or 'there exists some moment X which is earlier than the present, and p is true at X '. Here we are to understand that A -series sentences have B -series relations as their truth-conditions, since understanding ' Fp ' and ' Pp ' in this way seems to generate truth-conditions in terms of the earlier/later than relation. Sentences with the primitive operators of K_t such as ' Fp ' and ' Pp ' in the object language are defined using the relations of the U-calculus: " $T(a, Fp) \leftrightarrow_{\text{def}} \exists b: a < b \wedge T(b, p)$ " (Øhrstrøm and Hasle, 1993: 34). Specifying when a tense-logical formula is true using B -series relations would constitute a distinction between the A -series concepts and the B -series concepts in terms of an object language and a metalanguage. But, as previously mentioned, these concepts are equated on the second grade. Indeed Prior was aware of this situation but averred that a language may contain its own semantics if and only if it also contains a law that "for any sentence x , x means that x is true" (Øhrstrøm and Hasle, 1993: 34).

There are good reasons for keeping our object and meta-languages distinct. For one, not doing so may admit strange semantic paradoxes into our language. The 'Liar paradox' is one such problem. The conventional 'liar sentence' often takes the form of the sentence "this sentence is false". Let us call this sentence X. Then let us assume that X is true. This would mean that X is false since that is what X is stating. We now have the strange situation in which this conditional has been established: if X is true then X is false. Now let us assume that X is false. Since what X states is that it is false, it is therefore true. So in other words, if X is false then X is true. Thus we have a biconditional: X is true iff X is false. Needless to say, this is an absurd conclusion.

Sainsbury notes that "one approach to identifying a semantic defect in L_1 ['This sentence is false' or X] starts from the idea that truth of a sentence must be grounded in something outside the sentence itself" (1995: 114). This 'something outside' is usually given by the meta-language in which one can specify the truth conditions for sentences of the object language and dissolve the semantic paradox. This way out of the problem was suggested by Tarski. On the second grade of tense-logical involvement this strategy is not available since the distinction between object and metalanguage is not made.⁹ As we shall see, this is due to Prior's foundational beliefs about the universality of logic.

In the third grade of tense-logical involvement, Prior suggests an even more controversial convention. In the previous grade, we were asked to blur the lines between the object language and its semantics, now the distinction between content description and ascription of time of a given event is to be done away with. Prior states it thus:

That the last step forward is not a very sensational one, is sufficiently indicated by the fact we are still left with variables ostensibly representing named or nameable instants as well as ones representing propositions. What I

⁹ This is not to say that the 'liar paradox' cannot be solved through some other means. Prior's solution involved claiming that the 'liar sentence' or X was in fact false. He claimed this by denying that we can go from the falsehood of X to the truth of X. However, further discussion of the liar paradox and possible solutions is beyond the scope of this essay.

shall call the third grade of tense-logical involvement consists in treating the instant-variables a, b, c , etc. as also representing propositions (Prior, 1968: 123).

On this view, an instant may be equated with conjunctions of the propositions which are true at that instant (just as possible worlds can be). L is added to our logical vocabulary as the new non-tense-logical primitive¹⁰. $T_a p$ can be redefined by saying that p is true at a (instant) if a (proposition) implies p at all times or ' $L(a \rightarrow p)$ '. Prior believed that the third grade of tense-logical involvement requires that we quantify over this new type of propositional variable instead of over instants.

These are some of the technical details, but here we are more interested in the philosophical implications of adopting this logical framework. The third grade of tense-logical involvement entails that the A-series is the fundamental one and that the B-series needs to be defined in terms of the A-series coupled with a notion of temporal possibility (the ' L ' primitive). "Then tense-logic, and indeed, all of temporal logic can be developed from the purely "modal notions" of past, present, future, and necessity" (Øhrstrøm and Hasle, 1993: 34). These modal notions are P and F (of system K_t) and L , the primitive necessity operator (also called 'universal modality'). Lp is here defined as 'for all instants a it is the case at a that p ' or Rescher's formulation: $Lp =_{\text{def}} \forall a T_a p$. Formulae from the U-calculus can be represented with the P , F and L operators and thus the B-series relations are no longer necessary and the U-calculus operators with them. The philosophical reason behind the third grade of involvement (and the progression of tense-logical involvement itself) was to provide a translation of the first-order logic of the earlier-later relation exclusively in tense-logical terms. Prior believed that he had achieved his goal in the third grade.

¹⁰ It is the modal necessity operator usually symbolized with the box ' \Box ', which means something which is true at all possible worlds or at all instants in tense-logical terms.

2.2. Hybrid Logic and the Fourth Grade of Tense-logical Involvement

The third grade essentially amounts to the construction of a hybrid tense logic. On this view, instants are akin to possible worlds or rather “in the context of modal logic, Prior called such propositions possible-world-propositions” (Braüner, 2008). The impetus behind hybrid logic was to increase the expressive power of normal modal logic. In modal logic we would be able to express statements like ‘it is raining’, but it would be insufficient to express statements such as ‘it is six o’clock 20 October 2010’. The reason for this is that modal logic can capture statements which vary in truth-value at different times (or across different worlds) but it cannot represent statements which are true only at one time and false thereafter. Hybrid logic can be used to formalize the latter type of statements. Braüner writes:

This is obtained by adding to ordinary modal logic a second sort of propositional symbols called *nominals* such that in the Kripke semantics each nominal is true relative to exactly one point. A natural language statement of the second kind (like the example statement with the time five o’clock 15 March 2006) is then formalized using a nominal, not an ordinary propositional symbol (which would be used to formalize the example statement with the rainy weather) (2008).

In the case of hybrid tense-logic, the instants or ‘possible-world propositions’ are the nominals. The instants are terms which like nominals refer to points (such as dates), whereas in first order logic terms are the arguments of the predicates. And indeed, as in the case of hybrid modal logic, hybrid tense logic has more expressive capabilities.

The final grade of tense-logical involvement is the fourth and closest to the view of time which McTaggart held. The fourth grade too is a hybrid logic which has instants as propositions but on this level the primitive necessity operator (‘L’) as well as the U-calculus can be defined by using only the tense logical operators P and F. In other words, the A-series is fundamental and both the B-series and temporal possibility are to be derived from it. “It appears that his reasons for wanting to reduce modality to tenses was mainly metaphysical” (Øhrstrøm and Hasle, 1993: 35)

and had something to do with his disavowal of the future (discussion of which is beyond the scope of the present paper).

The progression of the grades was meant to be established from the pure first-order logic of earlier-than later-than calculus to a pure tense logic admitting only tense-logical operators as primitive, “the goal being to be able to consider the tense logic of the fourth stage as encompassing the earlier-later logic of the first stage” (Braüner, 383: 2002). Prior further believed that only through tensed statements can sense be made of assertions which are about time, hence the fourth grade of tense-logical involvement is the essential one since it requires only tenses and generates everything else from those primitive tense operators.

Prior had philosophical reasons for favouring the A-series over the B-series, a bias which is clear from the progression of grades of tense-logical involvement. The first reason was Prior’s belief that the B-series involves an ontology of instants. The quantification over instants which the U-calculus required seemed to suggest this ontological commitment. Prior was skeptical of the existence of instants. The other reason is of particular importance here, since it presents Prior’s view on what a logic of time should represent. He believed that the B-series provides us with an “external perspective” of temporal ordering and since this *sub specie aeternitatis* view of time is not actually the way in which we experience time, there is something mistaken about it from a philosophical point of view (even if it has certain technical advantages).

This brings us to Prior’s conception of the nature of logic. He did not hold the model-theoretic conception, which claims that “logic is an interpretational game played in the confines of (some version of) set theory” (Blackburn, 2006: 359) but a stronger “foundational” conception or the universalist approach. In the universalist conception of logic, logic is not seen as a mere device for capturing certain linguistic phenomena or creating systems which mirror what we believe to be aspects of our concept of time. Rather logic is the very foundation of all of our reasoning

about time. If the correct temporal logic is tense logic and tense logic is based on an A-series conception of time then an A-series conception of time is fundamental and the foundation for temporal reasoning. The fourth grade of tense-logical involvement is supposed to show exactly this, that the A-series is the fundamental conception of time and all else is ancillary with relation to it. With this we can not only expel the untoward ontology of instants but also understand the true nature of time, its A-series nature.

The model-theoretic view is in contrast to this conception. According to this tradition, a formal language is a meaningless calculus which is only endowed with meaning when it is interpreted according to a model. Uninterpreted tense-logic or the U-calculus is just a string of symbols with a set of rules governing their combination. If we accept that the model-theoretic tradition is correct then it would seem that Prior's assumptions about the role of logic are misguided and the results of his reduction unconvincing or at least incomplete. This matter will be discussed subsequently in some detail.

2.3. Reichenbach and Temporal Reference

There are problems with Prior's logical reduction of B-series relations and temporal possibility to the primitive tenses of the A-series. The first problem was one which Prior himself recognized and which prompted his invention of hybrid tense logic. Standard tense logic as it stands, the logic of the first and second grade, is unable to deal with the complex structure of temporal discourse in natural language.

The problem is that tensed discourse is not a simple matter of reference to past, present and future times. Let us consider a token sentence *s* which stands for 'It rains in Seattle'. In line with minimal tense logic, by prefixing *P* or *F* to this sentence we arrive at a new tensed sentence, as

in P_s or 'It was the case that 'It rains in Seattle''. If the token sentence s were true yesterday at noon, then we could apply the tense operator P and thus have a true instance of P_s . The problem then is surely when we use tensed discourse we don't always mean to refer to some generic time, as when we use ' P_s ' we do not mean that at some undetermined past time it rained in Seattle. Rather I could mean when I make use of sentences such as those represented by sentences like P_s is that there is a specific time at which it rained in Seattle and it is this specific time to which I am referring now. I would not want to be committed to the claim that it rained at 11am yesterday morning in Seattle since this claim may be false.

The primitive operators of minimal tense logic are insufficient in capturing this feature of natural language. Reichenbach developed an analysis of tenses which incorporates temporal reference as a main tenet. His analysis of natural language tenses includes three elements. Every tense can be analyzed in terms of the point of speech (S), the point of event (E) and the point of reference (R). The definitions are simple enough; the point of speech is the point at which the sentence is uttered (often the point of evaluation), the point of event is the point at which the event which the sentence is referencing is occurring and the point of reference is the point which refers to the time at which the given event occurred. For instance in the pluperfect construction 'Frasier had Φ ', R is the past time and E takes place before that time, while both E and R are before S . Furthermore, the tripartite structure does not mean that the E , S , and R cannot coincide. In fact, as we can witness from the analysis of the simple past 'Frasier was doing', E and R do coincide and both fall before S . Figure 1 below represents some of the tenses of English (Reichenbach, 1947: 290):

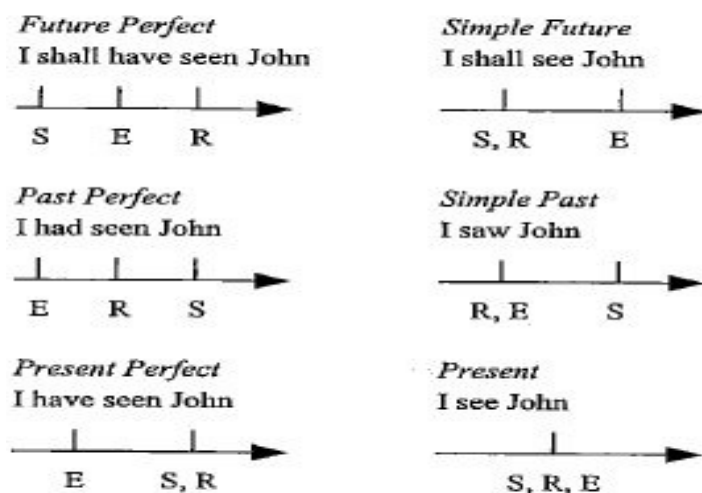


Fig.1

In these cases, the role of the point of reference is clear. R specifies the contextually determined time and thus picks out the specific past/future/present time and its relation to the points of speech and event. With this, we have the beginnings of an account of tenses which has temporal reference as a main component. The problem with the expressive power of standard tense logic is that it has no way of picking out specific times. Reichenbach's analysis of tenses has inspired many natural language semantists, an area in which much of tense logic has been ignored. "This is because temporal reference in natural language is ubiquitous, and without some way of capturing its effects, we cannot adequately analyse many temporal constructions" (Blackburn, 2006: 342).

The important thing to note from all of this is that Reichenbach's views are not incompatible with tense logic. In fact, as described above, hybrid logic was invented in order to introduce point references or nominals into a logical system. As Prior realised, a "richer logic" was needed to handle temporal reference, we can glean this need by the use of an example. Let us compare two formulae, the first is a standard formula of tense logic while the second incorporates nominals.

$$(5) P(r \wedge p) \wedge P(r \wedge q) \rightarrow P(p \wedge q)$$

$$(6) P(i \wedge p) \wedge P(i \wedge q) \rightarrow P(p \wedge q)$$

Given (5) and (6) we can immediately tell that the consequent only logically follows from the antecedent in (6). If it was the case that $(r \wedge p)$ and it was the case that $(r \wedge q)$ we cannot infer that it was the case that $(p \wedge q)$, since 'p' and 'q' may have been true at different moments of past time but ' $P(p \wedge q)$ ' means that they were true at the same time. Whereas in (6) we have included the nominal 'i' which is true at only one moment of time (or one point in the model), so if both 'p' and 'q' are true at the 'i' and 'i' is true at only one time then we can logically infer ' $P(p \wedge q)$ ' from ' $P(i \wedge p) \wedge P(i \wedge q)$ '. (6) is therefore a true conditional.¹¹

Adding nominals (and some other elements¹²) to a logical language is the key to capturing an important feature of natural language, namely temporal reference, and to the hybridization of logic. Hence the ideas of Reichenbach are merged with tense logic. Ironically it is hybridization which leads to a problem for Prior's project given his views of the role of logic and the priority of the A-series.

2.4. A Potential Problem with the Hybridization of Logic

Prior's main aim in his development of tense logic, from the first to the fourth grade of involvement, was to affirm his philosophical views concerning the priority of the A-series. After the first two grades, the U-calculus is left the stronger and more expressive logical language, one which is capable of representing the minimal tense logic, its operators and formulae. Prompted by both his goal of reducing the language based on the B-series relations to only A-series terms and his recognition of inadequacies in capturing certain features of natural

¹¹ The pluperfect can be rendered as ' $P(i \wedge P\phi)$ ' in hybrid logic and the simple past ' $P(i \wedge \phi)$ ' (Blackburn, 2006: 345).

¹² i.e. satisfaction operators, universal modality, and the universal and existential quantifiers binding the nominals.

language, Prior hybridized his logic (an account of this is given above). However, a problem arises, namely that the hybridization of tense-logic is not unique, in that hybridization can be introduced into any domain. In *Papers on Time and Tense* Prior addressed this problem explicitly:

Practitioners of tense logic are often asked the question, 'If you admit as genuine propositions ones whose truth-value depends on *when* they are propounded, why not also admit ones whose truth value depends on *where* they are propounded, or *by whom*, etc.?' (Prior, 1968:213)

One reason behind the move which made instants into 'world-propositions', or what we have been calling nominals, was to capture an element of temporal referencing in natural language, i.e. reference to specific context sensitive times at which statements are true. But natural language harbours other specifications upon which truth is dependent such as place at which a sentence is uttered or the person who is making the utterance. What of the elements of spatial or personal reference? Do we need nominal-like structures for these in our formal languages?

The answer is yes. If we accept nominals or propositions which are true at certain times then we would have to accept propositions which are true at certain people or places. Prior called this 'egocentric logic'. Egocentric logic is a logic in which propositions are true for individuals just as they are true for times where egocentric propositions are subject-less predicates represented by participles, 'standing', 'walking', 'making' etc. (Prior, 168: 193). The technical details are not important here, the only thing which becomes of extreme significance is that the existence of egocentric logic calls the entire tense-logical project into question.

The point behind the initial hybridization was prompted by Prior's beliefs about the metaphysics of time. Indeed the logical reduction of the B-series to A-series concepts only (the fourth grade) was informed by beliefs about the reality of temporal becoming. But egocentric logic shows us that any domain can be hybridized and thus there is no sense in claiming that

tense logic based on the A-series is prior to a temporal logic based on B-series relations in any special way. There is nothing special about tense-logic which allows for hybridization. The problem is that this means that our first-order theories can be hybridized as well, including the U-calculus. There seems to be a possibility, one which Prior recognized, of rendering any first-order calculus into something very much akin to tense-logic and thereby reversing the reduction. The only ingredients which we need would be similar to those needed in the hybridization of tense-logic, namely nominals *inter alia*. Prior writes:

There is, in short, a pretty detailed formal parallel between tense logic and this rather simple type of "egocentric logic". In fact, we can obtain something *more or less* like tense logic if we take *any* first-order theory whatsoever, treat its one place predicates as if they were propositions...(1968: 215)

The problem can now be clearly seen, if any domain or first-order theory can be hybridized in such a way that it has a similar form to tense-logic then there is nothing special about the reduction from the U-calculus to tense-logic which prevents a reversal of the reduction. Therefore there is nothing which establishes the priority of the A-series as Prior thought since the possibility of hybridization in other domains seems to allow for the reverse reduction and with this we can show that B-series relations are prior to the A-series positions. Prior did not respond to the difficulty in any satisfying way. But simply in terms of his intended logical reduction it is not clear that he had to.

The four grades of tense-logical reduction has not been refuted by the existence of egocentric logic. The reduction still works, if it does, notwithstanding the possibility of hybridized first order theories. The only thing that this issue shows us is that Prior's belief in the priority of the A-series is not firmly established by the tense-logical reduction, a point which is better served by the next section.

2.5. Logic as Calculus versus Logic as Universal Medium

In a seminal work 'Logic as Calculus and Logic as Language', van Heijenoort distinguishes between two traditions in the philosophy of logic. The first and dominant tradition (at least in the early part of the 20th century) is the logic as universal medium or universalist tradition as I have called it. Van Heijenoort attributes this view of the nature of logic to Frege. He states that in contrast to the 'abstract calculus' of propositional logic, predicate logic offers the logician propositions which express meaning not just truth-values. Predicate logic and its arsenal of quantifiers, variables and its inclusion of the propositional calculus offer the logician the chance to transcribe scientific knowledge (in the sense of *scientia*) into logic. "We now have a *lingua*, not simply a calculus" (van Heijenoort, 1967: 325).

The universality which accompanies Frege's logic restricts his logical system to one relevant universe of discourse, the *actual* universe. Interpretations of this language of logic are unintelligible on this view, "[h]ence there is only one thing which language can speak of, to wit, this one actual world" (Hintikka, 1988: 2). Accordingly, models and possible world talk are equally dubious. This leads to the contention that metasystematic considerations are never raised by pure universalists¹³. The argument goes that the consistency and completeness of a logical system is simply not considered by philosophers partial to this view of logic, since there is nothing 'outside of the system' from which to analyse it.¹⁴ Indeed, "Frege's conception of logic is that our language is the basis of all argumentation, and thus there cannot be a metalanguage point of view" (Müller, 2007: 4). We are trapped within our logical language which can be understood as a refinement of our natural language.

¹³ Hintikka and van Heijenoort claim that Russell was as much an adherent of this view of logic as Frege was. However, it is not at all uncontroversial whether Russell (or Frege for that matter) was committed to this view in its entirety; see Tappenden (1997) and Proops (2007).

¹⁴ Unless the language is specified as containing its own metalanguage.

The belief in the universality of logic brings forth a very unique conception of the purpose of logic in philosophy. In his 'Introduction to Mathematical Logic', Russell states that "logic is concerned with the real world just as zoology", granted, as Russell notes, it is not always the physical furniture of this world which concerns the logician (1919: 169). Hence, logic often has direct ontological import. Frege's universe was made up of objects and functions defined for all of these objects. Following this, Quine held that our entire ontology can be given by the 'variables of quantification' such that "we are convicted of a particular ontological presupposition if, and only if, the alleged presuppositum has to be reckoned among the entities over which our variables range" (1948: 7). In Prior's terms, for instance, a tense logic which does not quantify over instants as the U-calculus does, admits less entities into the world. He sees this ontological parsimony as an additional benefit of accepting his logical reduction of the B-series to the A-series alone (i.e. the fourth grade of involvement).

The more contemporary view or model-theoretic tradition challenges some of the main tenets of the supposed universality of logic. The key notion of this tradition is that any formal or natural language is interpretable through various models (if we use model theory). Unlike the one *actual* universe of Frege's *lingua characterica*, we now have numerous possible interpretations of a given language. "Indeed, my choice of the term "calculus" (or, rather, van Heijenoort's choice of the word) is calculated to highlight this re-interpretability of language" (Hintikka, 1988: 3). The model-theoretic tradition does not presuppose that the expressions in the formal calculus are already endowed with meaning. Logic can be seen as algebra on this view: an abstract calculus of symbols which can be interpreted in various ways.

This paves the way for model-theory which generates a semantics for a formal language. From the viewpoint of a metalanguage a given formal language can be scrutinized and formally studied itself (e.g. consistency and completeness of a system can be proven formally). Accordingly, we are not prisoners of our natural language anymore and there is something 'outside of it', something which can be used to study it and other formal languages. For

example, modal logic can be interpreted on Kripke frames; these frames provide a semantics for a system of modal logic in terms of possible worlds. We can understand modal system S5 in terms of the accessibility relations restricting the possible worlds in the set of worlds which form part of the frame. This constitutes reasoning outside of the system itself, something which is not possible on the universalist approach. As Hintikka notes, we also have a much richer concept of logical truth, as truth in all possible worlds, whereas previously it only pertained to this one.

In terms of ontology, the situation is also quite different. Peregrin's (2000) terminology is helpful here. He differentiates between the Realm of the Formal (RF) and the Realm of the Natural (RN). The latter he defines as the objects of everyday life, things which we 'find' and 'describe', he adds that these things are outside of mathematical proof. RF, on the other hand, is the realm in which "everything is precisely *defined* and sharply *delimited*", we stipulate the objects of this realm and prove facts about it (Peregrin, 2000: 81). This takes place under the auspices of mathematics. Conceptual life is a delicate balancing act between these two realms and it is often convenient or illuminating for us to understand our world through formal 'prisms'. These prisms can be mathematical structures like sets of objects or geometric shapes, they are not necessarily part of the world as we experience it but they do help us structure our world. This structure is something which we impose on the world, not discover within it:

To be formally provable (to be 'mathematically certain') and to say something about our real, human world (to 'refer to reality') are mutually exclusive: a formal proof, as we have seen, is a matter of RF, it can directly concern neither RN, nor a projection of RF onto RN (Peregrin, 2000:92).

Therefore, no proof in the formal calculus or RF can directly attest results in reality or inform our ontology. Logic concerns the realm of the formal and therefore cannot tell us about what there is. Interpretations of a given language may vary and with it the objects which we have assumed to exist, hence the model-theoretic tradition assumes that our ontology has to be a matter of convention. Let us move on to how some of these things affect Prior's 'four grades of tense-logical involvement'.

2.6. The Pitfalls of Prior's Project

Prior was a universalist and understanding his position is key to grasping the nature of his project and in turn understanding how it fails. In an unpublished work, Prior stated “philosophy, including logic, is not primarily about language, but about the real world” (Copeland, 1996: 45). Prior believed that logic was just a refinement of natural language and from logic we can delve directly into philosophical issues. In addition, Prior was a ‘temporal realist’ in that he believed that the flow of time or temporal becoming is a real feature of the world. Incorporating tenses into logic captures this aspect of temporal reality. He strongly advocated against a tenseless view of time (the B-series) or the ‘timeless tapestry’ view for which some philosophers and scientists claim special relativity provides evidence. The U-calculus would be most appropriate for formalizing this view. But the reduction of the U-calculus to a tense-logic which only possesses primitive tense operators shows us that the past, present and future are real properties of events and thus they are real features of reality.

The universalist foundations of his logical beliefs inform his entire project and the benefits he hoped to achieve by it. From the model-theoretic conception of logic we can see that the reduction of the U-calculus and universal modality to primitive tense operators established by the fourth grade of tense-logical involvement does not necessarily affect our ontology as Prior believed. If we understand the nature of logic as a formal calculus fitted with mathematical models which give us interpretations (and meaning) of this formal calculus, then it is not clear that the first-order logic of the U-calculus harbours an ontological framework any stronger than a modal tense-logic. The idea that it does was central to Prior's reduction, but “under the model-theoretic conception, both make use of the same set-theoretic structures, so their ontological commitments are at least *prima facie* identical” (Blackburn, 2006: 358). This belies the further assumption about the ontology of instants which was believed to be at the core of the U-calculus and absent from the fourth grade of tense logic. Prior would have had to go

further in showing that the intended models for these calculi are different in some significant way.

Another aspect of this problem can be seen when we return to something which was mentioned above in connection with the second grade of tense-logical involvement. Prior stipulated that 'p' and 'T_ap' can both be part of the same formal language, a contention which seems to be impossible if we understand model-theory correctly. Tarski developed model-theoretic semantics precisely to avoid the problems which result from a language which contains its own semantics. Languages like these are what Tarski called 'semantically closed' and he claimed that such languages are inconsistent. He used the liar paradox to prove this result, but the important thing to note is that Tarski claimed "that a language whose structure has been exactly specified and which resembles our everyday language as closely as possible would be inconsistent" (1944: 149). This is precisely what Prior believed tense-logic was, a formal language which derives its meaning from its close relationship with natural language. One way of avoiding this sort of inconsistency is by separating semantics in such a way that it is distinct from the object language and conducted in a metalanguage. Furthermore, a formal object language cannot merely be a refinement of natural language since this language would lead to inconsistency unless its semantics was conducted metalinguistically.

Clearly, metasystematic questions and proofs are not as unintelligible as universalists believe. In fact, as in the case of the liar paradox, they seem to be required to resolve certain philosophical problems and in other cases they tell us important things about our formal system. In Prior's book on formal logic, there is a marked absence of metalogical proofs. This was partly due to his universalist connection between natural language and logic. But the model-theoretic conception shows us that there is something 'outside' of natural language and that formal languages are calculi which can be interpreted (and endowed with meaning) through models.

Finally, Prior insisted that tense-logic is a form of modal logic. However, modern modal logic is interpreted through Kripke semantics and thus tense-logic would be as well. The modal logic calculus itself does not designate properties of reality nor does tense-logic. Interpretations can vary and one modal system can generate different interpretations to another and thus identify different modal realities. Similarly, it is not possible to identify aspects of temporal reality from the tense-logical calculus alone. As has been shown, proofs in the realm of the formal, of which logic is a subset, cannot attest direct results in the realm of the natural. The four-grades of tense-logical involvement attempts to do just that.

Tense-logic and Model theory

It certainly seems that Prior's four grades of tense logical involvement was based on a universalist view on logic and this has caused certain concerns for the validity of the project. However, there is nothing in the way of interpreting this project on the model-theoretic framework. For the reduction to hold we would need to interpret the tense-logical calculus in terms of the A-series positions or tenses and the U-calculus in terms of the B-series and B-times. In other words, provide models for the formal languages with which we are dealing.

Model theory deals with formal and natural languages and the set-theoretic structures which provide interpretations for them. The basic tenets of model theory are all we need to understand how Prior's reduction can be justified on this view. The central notion in model theory is that of an interpretation. The idea is that a sentence in a language is neither true nor false unless we know what the meaning of the components is (words, wffs, connectives etc.). Once we provide the meanings of the parts such that the sentence now has a truth-value, either true or false, we have interpreted that sentence. The terminology differs, but if we have an interpretation which makes a sentence or set of sentences true, then that interpretation is a

model which satisfies the sentence or set of sentences.¹⁵ Interpretations often consist of a class of structures (in the form of n -tuples), in the case of tense logic, these could be Kripke structures (as mentioned in 2.1.1) which consist of sets of possible worlds or first-order structures as in mathematical model theory.

In essence, by specifying a model for a set of sentences we are providing functions from atomic formulae to truth-conditions. The intended model for a theory in a formal language is one which makes the sentences in that theory come out true, and the idea (informally) is that if we specify the intended model for tense-logic in terms of tenses and specify intended model for the U-calculus in terms of tenseless B-series relations between events, then Prior's reduction actually goes through and reduces the B-series to the A-series (there are of course unintended or non-standard models for any formal system which also make the sentences come out true but these needn't concern us here).

The only problem with these interpretations is that the A-series has been shown to be deeply problematic, in fact, contradictory. In the first section, we attempted to disprove McTaggart's paradox against the A-series by various means. These attempts were shown to be unsuccessful and the A-series was left in doubt. The important point here is that the failure of A-theorists to defend the A-series against McTaggart's attack makes tensed talk a bad candidate for making sentences of tense-logic true and thus an inappropriate intended model for tense-logic. Without tensed talk as the intended model of tense-logic the reduction does not go anywhere. If tensed talk is not what underlies tense-logic, then what is? In the next section, I shall attempt to show that it is the same thing that satisfies sentences of the U-calculus, namely B-facts or facts about B-series relations between events. What makes tensed talk (and thus formulae of tense-logic) true are its tenseless truth conditions. I will do this by providing a semantics for tensed talk itself in accordance with Mellor's tenseless token reflexive account of time.

¹⁵ The double turnstile is often used to represent the satisfaction relation, " \models "

SECTION 3: A TEMPORAL SEMANTICS

3.1. Truth and Truth-makers

We now move on to a positive B-theory account of time, one which aims to resolve the paradox and explain the nature of time by specifying a semantics for all tensed talk in terms of tenseless truth-conditions. The first step to understanding this account is to reframe the debate in terms of the concept of truth. If we could show that both A- and B-beliefs are made true by B-facts alone, then we can prove that the B-series is all we need for any true statements about time. In other words, the argument which I shall represent here aims to show that all tensed truths have tenseless truth-conditions.

Firstly, in order to do this we have to view our A- and B-facts as A- and B-truths. What are A-facts or B-facts? A-facts are facts about A-times of events and B-times, they are facts like the fact that Krakatoa erupted in 1883 or that its eruption is in the past. B-facts, on the other hand, are facts about the extent of the 'earlier' and 'later than' relation of events. The fact that Eyjafjallajökull erupted 127 years after Krakatoa did is a B-fact. Technically so is the fact that '2+4=6'. The latter is a necessary fact but the former types of facts are contingent and very importantly do not entail A-facts in any way. To be exact, in order for the fact not to entail A-facts it would be something like 'The Eyjafjallajökull eruption is 127 years later than the Krakatoa eruption' in which the copula 'is' is taken tenselessly. As we can tell by statements of this sort, no A-times or A-facts are implied or entailed, i.e. to say that some event is earlier or later than some other event does not say anything about that events position in the A-series. The central issue for metaphysicians is whether or not there are A-facts in the world or which facts are fundamental, A- or B-facts?

Secondly, we do away with A-facts and replace them with 'A-truths' or 'true A-beliefs'. These are beliefs about the A-times of events. An example would be the belief that a given event is in the past which seem to underlie our use of tenses. We select an appropriate tense based on our belief of when a given event occurred or will occur. Such beliefs have truth values of either true or false. Certain facts make such beliefs true and Mellor attempts to show that these facts are B-facts.

The concept of truth is philosophically complex and its scope and precise nature are under perennial debate. However, for the purposes of this argument we can obviate most of the issues surrounding the concept. As to the scope of the concept of truth in this context, Mellor has this to write:

I shall apply [truth] to beliefs, to statements of them, to sentences expressing them, and to their contents, which I shall call 'propositions' and assume are what sentences expressing beliefs mean. And as anything I can believe I can also doubt, disbelieve, want, fear, hope etc., I shall also take propositions to be the contents of all these other so-called 'propositional attitudes'" (1998: 24).

Importantly, he takes a belief (and the other propositional attitudes) to be true just in case a statement of it is true as well as a sentence expressing it and the proposition which is supposed to capture its content and meaning.

The point is not to show that A-beliefs cannot be true but rather that what makes them true are B-facts. With this in mind, let us consider a token sentence such as (7) below:

(5) Niles got married yesterday

Now, it is Mellor's contention that this sentence is 'made true' by something stronger than the mere fact that 'Niles got married yesterday', i.e. 'Niles got married yesterday' is true iff Niles

got married yesterday.¹⁶The idea is that something must make the sentence above true and then it behooves us to identify the part of this ‘something’ which makes propositions (past, present or future) temporal. Firstly, Mellor calls these truth-makers ‘facta’ or ‘states of affairs’ (as he notes, they go by various appellations). A factum is something that will make X true iff it is a fact (is the case in the real world). So (6) is made true by some fact only if that fact is actually the case (as per the definition of ‘fact’ here). Thus,

(6) ‘Niles got married yesterday’ is made true by the fact N [the factum]

Mellor characterizes facta as atomic for simplicity sake. Since if two sentences are made true by two different facta, then there would be no need to postulate a special extra ‘conjuncting factum’ ($P \wedge Q$) to account for the truth of the two sentences (the same goes for the other Boolean operators). “Similarly, what will make ‘P’ false and hence ‘ $\sim P$ ’ true is that P does *not* exist, not that a negative not-P factum does” (Mellor, 1998: 26). Now that we have our facta, we can move onto the part of them that gives temporality. We have two options: A-facts or B-facts.

According to Mellor, the A-truthmaker for (6) would be that Niles gets married a day earlier than *today* and its B-truthmaker is that he does so a day earlier than today’s date. If we recall the first section, then we remember that words like ‘yesterday’, ‘today’ and ‘tomorrow’ denote A-times whereas dates are indicative of B-times. The B-series relation of ‘earlier-than’ is present in both of these facta. Given that “[t]he only real difference between A- and B-truthmakers is that the latter are, as the former are not, confined to B-facts” (Mellor, 1998, 26), it seems that we may have a similar problem to the problem which prompted the hybridization of logic discussed in the previous section. An A-fact, like the temporal indexicals which denote A-times (‘today’, ‘tomorrow’ etc.), seems to be able to account for the shifting truth-values of sentences

¹⁶ The reason for this need for a stronger truth-maker than the disquotational schema gives us is the disquotational schema only gives us trivial truth. These truths do not show us that there are things which make the sentences in question true or what those things are. We are in search of these truth-makers or facts.

such as (6). If Niles gets married to Daphne on the 10th of November, then the A-truthmaker is in existence on the 11th and if he gets married on the 11th then the truthmaker exists on the 12th and so on. But B-truthmakers are different since their existence is dependent on a specific date and thus always a fact. B-facts are eternal in the sense that they always exist if they do at all. Since A-propositions are sometimes true and sometimes false, Mellor's account and B-truthmakers need to make sense of this. This is not an easy task and Mellor's answer is not the easiest to swallow. He insists that no single B-fact makes an A-proposition such as the proposition generated by 'Niles got married yesterday' true but a potential infinity of B-facts do the job.

It is because B-facts, unlike A-facts, do not come and go that no single B-fact can make 'Jim races tomorrow' [or 'Niles got married yesterday'] true at some times and not at others. But if not one, then how many B-facts does it take to give an A-proposition its varying truth values? The answer is as obvious as it is discouraging: it takes as many B-facts as there times at which an A-proposition can have independent truth values (Mellor, 1998: 28).

This is not the end of the task since a B-theorist like Mellor would still have to locate these facts and for this he uses the idea of a token-reflexive account of the truth-conditions. Without a way of reducing our ontology of facts, B-theorists seem to be violating Ockham's Razor since we admit endlessly more facts than are needed by A-theorists. It is this matter that we move onto next.

3.2. Insert Tokens

The key to obtaining the necessary amount of facts to account for the truth conditions of A-propositions is grasping that believing agents believing A- or B-propositions at given moments are the facts of which we are in search. If the moment in question is a B-moment then whether or not the proposition is an A-proposition does not matter, it will still be made true by a B-fact. If Niles got married on the 20th of November 2010, knowing that he got married

yesterday does not entail the A-fact that he got married *yesterday* since that fact doesn't entail that the 21st of November is today. The A-proposition that he was married yesterday is made true by the B-fact, i.e. the moment at which Niles was married. Simply put the belief token which has the A-proposition in question ('Niles got married yesterday') as its content happened at a B-moment and therefore is a B-fact.

With this in mind we can account for the variability of the truth of A-propositions. Let's go back to our original A-sentence. Let us imagine that we have two tokens of this sentence: 'Niles got married yesterday'. And furthermore, Niles was actually married on the 20th of November. Token₁ occurs on the 21st of November. Token₂ occurs on the 22nd of November. It is uncontroversial to say that the first utterance is true whereas the second is clearly false. But which B-facts can account for the difference in truth values of token₁ and token₂? Mellor answers this by saying that what makes token₁ true is the fact that it is uttered one day after the event and the fact that token₂ is not uttered one day after that is what makes it false.

This is the basic idea behind the token reflexive B-theory. B-facts are the *facta* which make A-proposition true. Mellor offers this characterization which I shall call TR.

TR: "any token of 'P' [any A-proposition] is true if and only if it is as much earlier or later than e [the event which it concerns] as 'P' says the present is than e" (1998: 31).

If the proposition specifies an event in the past then the tokens are true just in case they are sufficiently (as in however many units of time the event is in the past) later than the event. The same reasoning applies to tokens involving future A-propositions. If the proposition refers to an event which is happening in the present, then the tokens would be true iff they are simultaneous with that event.

Thus, B-theorists have a way of capturing the varying truth values of A-propositions. If we take any token of any A-proposition we will see that the truth-value of that token changes with the B-facts of the event to which it is related.

3.3. Different Shades of Meaning

An initial point may be raised about this theory of the truth-conditions of A-sentences and propositions. How is this different from B-theories, similar to that proposed by Russell, which were mentioned in section 1? The answer to this question helps to identify the precise nature of this new B-theory and how exactly it may be the correct view of temporal discourse. Furthermore, understanding how the new B-theory is better than its predecessor is an important tool to grasping its profundity.

The old B-theory or tenseless theory made seemingly similar claims about the need to specify the tenseless truth conditions of tensed sentences. However, Russell and other philosophers believed that the tenseless truth condition sentence on the right hand side of the biconditional has the same meaning as the tensed sentence on the left hand side. Le Poidevin states it this way:

What characterizes the *old* tenseless theory is the notion of translation: tense can be eliminated from statements because they can all be translated into tenseless statements. What in part characterizes the *new* tenseless theory is the concession that this kind of translation cannot be done (1998: 28).

Hence, they believed that there was a single B-sentence which captured the meaning of every A-sentence. Oaklander differentiates between two senses of the word “meaning” (actually more than that). The first is ‘intentional meaning’; this type of meaning refers to the intended content of the thought conveyed by an expression. For instance, if I said that ‘A spy is on the

roof', I am using this sentence to express my belief or thought that a spy is on a certain rooftop. The second sense of the word meaning is what Oaklander calls the 'ontological or reference meaning'. It is this sense of meaning which is at the core of the token-reflexive theory. "If what is asserted by a sentence is true, then we can say that the meaning₂ [ontological meaning] of a sentence or thought is the fact that makes it true, its *truth maker*" (Oaklander, 2003: 275).

We can plainly see that some A-sentences do not have the same intentional meaning as B-sentences do even if they have the same ontological meaning or are made true by the same B-fact. One reason for this is that when I utter a sentence such as "I am hungry now" I do not necessarily mean that I am hungry at 2pm on the Saturday the 10th of November even if that time is contemporaneous with my utterance. There is a difference in how these sentences are used and this constitutes a further difference in terms of 'linguistic meaning'. According to John Perry (1979) tensed statements are related to thought and action in ways that tenseless statements simply are not. Dates and B-times do not capture the meanings (in the sense of 'intentional' and 'linguistic') of A-sentences. This is because "[a]ll tokens of a tenseless sentence-type have the same truth value, whereas the truth values of tokens of the same tensed sentence-type vary from time to time" (Oaklander, 2003: 278). In fact, this was the very reason which prompted the token reflexive account of the truth conditions of tensed or A-propositions.

Given the differences in meaning between tensed statements and the tenseless ones which provide their truth-conditions, reductions or translations of A-sentences into B-sentences are always going to be flawed. "Thus, to believe that the tenseless truth conditions sentence on the right side of the biconditional, which states the truth conditions of what is asserted by the tensed sentence on the left, can capture *all* the various notions of meaning is a mistake" (Oaklander, 2003: 279). Thankfully, this is not what the token reflexive B-theory attempts to do. But Graham Priest seemed to think that tensed sentences can be given tensed truth conditions

(or a disjunction of tensed truth conditions) and therefore that A-facts are not to be banished for good. We shall investigate this trenchant objection next.

3.4. Priest and Tensed Truth-conditions

The first thing which Priest does is to characterize Mellor's argument. He identifies two essential elements which lead to the disavowal of tense or A-facts. The first has been discussed above. We have a T-scheme that seems to provide the truth conditions for any sentence in our language without the use of tensed facts. Priest admits that the reasoning seems plausible, "tense is unreal if we can give the truth conditions of all sentences without using tensed sentences" (1986: 163). As before, on the right hand side of the biconditional we have the tenseless statement that our belief token happened in the appropriate B-relation to the event mentioned on the left hand side (in accordance with the appropriate time specified). Priest uses the token utterance 'u' of 'The Battle of Waterloo *occurred* in 1815'. According to our token-reflexive theory our biconditional would be something of the sort represented below by (7):

- (7) *u* is true iff the Battle of Waterloo occurs [tenseless verb] in 1815 and 1815 occurs before *u* (Priest, 1986: 163).

As before, there are no A-facts or tensed facts on the right side of the 'iff', so the token's truth is determined solely on the basis of tenseless facts or B-facts as we have been arguing. But Priest asks us what is wrong with the scheme in (8) below:

- (8) *u* is true iff the Battle of Waterloo *occurred* [tensed verb here] in 1815.

Here we are given tensed truth conditions which would admit A-facts back into reality. But what is wrong with doing this? Well, firstly, there is a version of McTaggart's paradox which seems to prevent the move. Let us imagine that someone uttered *u* in 1780 (by happenstance

not omniscience). Presumably, that instance or token of u would be false. On the B-theory we can see exactly why since both sides of the biconditional would be rendered false. If u is uttered in 1780, then our token and the event cannot be in the proper B-relation to one another since the event has not occurred and for u to be true it would have to have occurred before the utterance or token. In (8) the tensed sentence on the left of the biconditional is false (if uttered in 1780) while the tensed sentence on the right remains true. According to the definition of the biconditional this cannot be possible, our T-scheme is therefore dysfunctional. Priest describes this situation a little differently. He says that given the fact that the Battle of Waterloo had not occurred when uttered in 1780, u is false. But given our knowledge of history and (8) we can reasonably infer its truth. Hence, we have a contradiction.

Priest then goes on to show that the truth conditions of u and of all sentences can be given with tensed sentences in the metalanguage.¹⁷ The differing truth values of instances of u are explicable if we define a special type of verb for the metalanguage or right side of the biconditional. Priest writes:

Let us define, for any verb 'to v ' another verb 'to eternally v ' thus: ' x eternally v 's' is ' x has v 'ed or x v 's or x will v '. The important thing about a sentence whose verb is an eternal one is, as the name implies, that if it is true at any time it is true at all times (1986:165).

Apparently, we now have a T-scheme that accurately captures the truth of tensed sentences and u even when it is uttered prior to 1815. This is given by (9):

- (9) 'The Battle of Waterloo occurs in 1815' is true iff the Battle of Waterloo *eternally occurs* in 1815.

¹⁷ In fact, he states that "we can prove that *tenselessness* is not part of reality" (Priest, 1986: 164). This seems like a strange ontological statement to make. He seems to be trying to prove that a lack of something is not part of reality. In other terms, if we are arguing about whether unicorns exist or not, and I try to show that they do not. It seems that to oppose me you would have to show that they do exist and not that non-unicorn-ness is not part of reality which seems to be different from trying to prove that unicorns do exist. There is a reason for this strange claim and it will be discussed below.

The biconditional is now fixed such that it will have the same truth value on both sides. In addition, there are tensed sentences on either side and we seem to be able to account for the truth of a sentence with tensed facts. Very importantly, there is a stronger claim than the claim that there are A-facts. Priest is making a claim that the only reason Mellor's strategy seemed to work was because he assumed that truth was tenseless and therefore begged the question against A-theorists. This argument is meant to show that there is a fault in the use of the T-scheme since an analogue of the reasoning which showed (8) to be problematic can be run for (7). The conclusion is that whenever one side of the biconditional is tensed and the other side is not we will have problems using the T-scheme in times other than the present. Needless to say, this would be a devastating blow for Mellor and the token-reflexive account of time.

3.4.1. On Verbs, Truth and Tense

In order for the tenseless token-reflexive account of truth conditions to be successful, it needs to be defended from Priest's attack. Mellor's response is that the tensed T-scheme and the entire argument above are based on an equivocation. The problem is that there are two senses of 'tense' which are being used and once we discriminate between them, the outcome is significantly altered.

For Mellor any talk of tense is going to be about the A-series positions of past, present and future. "I then call a thought, statement or sentence TENSED if it explicitly or implicitly ascribes a TENSE to something, its TENSE being the tense it ascribes" (Mellor, 1986: 167).¹⁸ This is different for verbal tense or tense as an element of natural language. Verbal tense is not necessarily a way in which we can capture TENSE or ontological tense.

¹⁸ Mellor capitalizes the word 'tense' when he is referring to the positions of the A-series and reserves the italicized version for verbal tense as Priest does.

Even the simple PAST, PRESENT and FUTURE cannot be defined as the temporal reference of corresponding *tenses*, if only because these TENSES and *tenses* often do *not* correspond. (Think for instance of ‘She now leaves next week’, ‘She will be leaving Heathrow at this very minute’...) The fact is that *tense* in English is a function of TENSE (and other factors) but not vice versa (Mellor, 1986: 168).

Priest incorrectly assumes that his ‘eternal’ verbs are defined in accordance with the verbal tenses. However, eternal verbs are just normal verbs which do not reflect the ontological tense of the sentence which is used to represent it. Take Mellor’s sentence (S) or my version of it (10) which includes the tensed truth conditions:

(10) ‘John *is* dead’ is true iff John *eternally* dies

There is reason to doubt whether such verbs can actually be interpreted as ‘eternal’ or whether such T-schemes are legitimate. ‘John is dead’ (Mellor’s (S)) is in the past tense given the meaning of “dead”. But if all verbs can be read as eternal then ‘is’ in (10) can also be read as such. But John’s death was not always an event in the past and we could not *always* assert the sentence ‘John is dead’ as Priest claims is the case with eternal verbs. So he needs the ‘is’ in (10) to be present tensed rendering the event of John’s death ‘now past’.

The requirement on verbs to be present tensed in this way leads to some serious problems. First if by asserting any sentence P at any time we mean that “P is now true’ then we have a regress (one which Priest thinks is not vicious). And we haven’t settled the issue of whether or not the truth predicate is tensed or tenseless. Alternatively, if we assume that the main verb in P has to be verbal present tense then we would have trouble explaining past and future tense verbs.

This brings us to the main charge that Mellor is begging the question against A-theorists by assuming that truth is tenseless. Indeed, Mellor affirms that this assumption is exactly what he

holds and that assuming otherwise would be misguided. He shows this by arguing that the predicate 'is true' is untensed and cannot be otherwise.

Whether or not a predicate is tensed depends on some things pertaining to that of which it is predicated. Luckily, since it does not seem to matter whether we consider sentences or propositions or propositional attitudes, we can just evaluate the argument in terms of sentences without loss of generality. The type-token distinction, however, needs to be considered separately. Before doing so we should understand what goes into making a predicate tensed:

Since a sentence is TENSED when it ascribes TENSE, I take a predicate to be TENSED when it makes sentences containing it TENSED (or affects their TENSE). That is the obvious sense in which 'is past' and 'is dead' are TENSED predicates (Mellor, 1986: 169).

According to Mellor sentence types are not tensed in this way. There is no type of sentence that has a definite A-series position and if we call any type of sentence true we do not seem to be ascribing an A-series position to it. For instance, the quantified sentence-type indicated by words such as 'everyone' or 'someone' etc., are not suddenly ascribed A-series positions when they are predicated with 'is true'. Alternatively, saying that the predicate 'is true' is tensed may mean that it makes any sentence which it predicates depend on the A-series position of the content of that sentence. "But when 'X is true' is TENSED in that sense, what makes it so is not that 'is true' is TENSED but that X is, since 'X is true' always has the same TENSE as X itself" (Mellor, 1986: 169). This can be shown by noticing that a token 'Xt' of a sentence-type X asserted at a specific time has the same truth conditions as 'XTt' or "X is true' at t' because asserting XTt is the same as asserting 'Xt' as true (or their truth values are the same function of the specific time t as Mellor puts it). Therefore 'is true' is not a tensed predicate of sentence types.

Tokens could presumably have A-series positions and 'is true' may affect the ontological tense of tokens in some way. Showing that it does not, I believe, goes some way in further affirming the token reflexive account of the truth conditions of sentences. Therefore, I will take this as final justification for this B-theory of time in this paper.

Let us revisit Mellor's sentence 'John is dead' or (S). Furthermore, let us imagine that there are two tokens of this sentence, one said prematurely before John's death and one uttered after his death. We can call the first token *b* and the second *a*. The event of John's death constantly changes its A-series position along with *a* and *b*. There are thus two ways to view the truth conditions of these two tokens or rather the things upon which their truth is based, i.e. the truth makers. The first way is by claiming that their truth values depend on the B-series relations they have to John's death, i.e. how much earlier and later they are than the event. The other option is that these tokens depend on the A-fact or ontological tense of John's death for their truth conditions.

In the first case we get the result which we want in that *b* is false and *a* is true. Given the meaning of the sentence 'John is dead' all earlier tokens will be false while later tokens will be true. Although we have different truth values for the tokens, these truth values are constant in that earlier ones will always be false and later ones will always be true. The situation is somewhat different for the second option. All the tokens of 'John is dead' which occur before his death, like *b*, are false and *a* and the tokens after are all true. This seems to be the same result but it is not. For the A-fact which makes *a* true only comes into existence at the moment of John's death, before then it did not exist. Thus, all the tokens of (S) alter their truth conditions after his death such that after John's death both *a* and *b* are true. This, however, is absurd as Mellor exclaims "John's death posthumously verifies every premature announcement of it!"

Not only this, but in attempting to provide the truth conditions for a tensed sentence what we are trying to do is provide facts which account for the changing truth values of A-propositions. But until the A-fact of (S) makes the sentence true, all its tokens are false and then they miraculously change truth value *post mortem*. The token reflexive B-facts will allow for variation with relation to truth value but do not change themselves. The argument shows that the predicate 'is true' is not tensed for either tensed sentence tokens or types.

3.5. Where did the Time go?

We now have a fully formulated B-theory of language which offers us the semantics of natural language in terms of tenseless truth-conditions of any tensed sentence. But what does this mean? Have we banished tense from the universe? Have we solved McTaggart's paradox? The answers to these questions are very important as positive answers would mean that we have advanced from the flawed A-theory attempts at refuting McTaggart and describing time in the first section.

One thing which seems to have been established by this theory is that A-facts are no longer needed to explain tensed sentences, in fact the postulation of A-facts are inconsistent with our B-theory of truth conditions. Does this mean that there are no A-facts? The argument above as well as McTaggart's proof seems to suggest this, indeed most B-theorists agree with McTaggart's argument against the A-series. I have shown that some of the most appealing attempts by A-theorists to refute it were all problematic in some way. We have thus accepted McTaggart's claim that the A-series is unreal and attempted to explain the phenomenon of tense tenselessly. By showing that we do not need the reality of the past, present and future to verify our tensed discourse, we have gone a step further in showing that time is not characterized by the problematic concept of temporal passage. As *per* Mellor's argument, we have given the truth conditions for all tensed sentences without the use of tensed facts. This

allows us to make the ontological claim that tensed facts are not part of the furniture of the universe, “[t]hus, if we can spell out the truth conditions of all sentences (true or false) without mentioning a notion, that notion is certainly not part of reality” (Priest, 1986: 162). It seems that we can accept the unreality of tense without accepting the unreality of time. This is a big result, one which is arguably even gestured at by some of our best science. We have shown that despite some ingenious attempts at validating the existence of the A-series, the best option we have is to accept its non-existence while still making a case for the existence of time based on the B-series.

Conclusion

This paper has dealt with a number of issues pertaining to the philosophy of time from metaphysical arguments and logical reductions to a positive B-theory account of time and tense. In the first section, I focused directly on the metaphysical assumptions and nature of time. I provided characterizations of the A-series positions of past, present and future and explained the B-series and B-times. Also within this section, I described McTaggart’s 1908 result which aimed to show that the A-series is inconsistent and time is unreal. In the final part of this section, I tried to show that even the most sophisticated A-theories could not refute McTaggart’s powerful argument against the A-series.

In the second section, I investigated the logic of time or temporal logic with special emphasis on Prior’s argument in favour of tense-logic and the ontological priority of the A-series. I found that there were serious problems with his argument but his work on tense logic still serves as a useful tool in clarifying certain concepts concerning time. I also examined hybrid logic and Reichenbach’s analysis of tense. Eventually I argued that, given a model-theoretic framework, formal logic cannot give us the direct answers we need to solve metaphysical and philosophical

problems and once we interpret tense-logic, our intended model cannot incorporate tense since it was shown to be contradictory in the first section.

Finally, in the third section, I offered a semantics for tensed talk and a positive account of time in terms of the B-series. In this section, I aimed to present and argue for Mellor's tenseless token reflexive account of the truth conditions of natural language sentences. I have also tried to show that accepting McTaggart's argument against tense or the A-series need not mean that we have to accept his conclusion about the unreality of time itself. For the B-theory of time, in the form of a token reflexive account of the truth conditions of natural language, can account for tense and time without contradiction. However, this task is not complete since in order to refute McTaggart's argument against time, a B-theorist would have to account for change without the A-series as well. The resolution of this problem was beyond the scope of the present work, but what I have shown is that the A-series can be unproblematically explained in terms of the B-series which goes some way towards the goal of refuting McTaggart. The conclusion is therefore that there are no A-facts, tense-logic is based on the B-series, there is no A-series and past, present and future are unreal. However, the exact nature of this illusion is a matter for another B-time...

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