Time and Change.
Mc Taggart, Broad, Lowe, Smart, Prior: Problems, Difficulties, Hypotheses of Solutions
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1. Introduction: Times as dimension of Change and Reality

Abstract. This paper concerns the issue of time understood as the dimension of change. I want to discuss it in relation to the argument which had a considerable impact on modern philosophical and physical researches in the field: Mc Taggart’s ‘argument of unreality of time’. I will begin by briefly outlining such argument and then I will examine some of the major objections to it. I question if this kind of description does embody the reality of time. I will conclude by pointing out certain difficulties related to the explanation of temporal change in virtue of spatial representations.

1. Introduction: Time's Reality: the dimension of Change

Since the most ancient times, the reflection on time as dimension of change has been pointed out by several philosophers. In the Greek Philosophy a good example is represented by the Pre-Socratic tradition. Thales, Anaximander, Anaximenes and Heraclitus were committed to seek the timeless reality called arché: an undefined and unlimited substance without quality. It was the first principle of reality, out of this eternal and original substance the primary opposites (like hot-cold; moist-dry, etc.) became differentiated. So, the term arché was associated to an Eternal Reality in opposition to a Tensed Reality related to natural phenomena. Similar ideas have been made pressing after the Socratic tradition. Plato reported the contraposition between Tensed Reality and Eternal Reality, in terms of the contraposition
between the *World of Phenomena* and the *World of Ideas*. Similarly, Aristotle, who interpreted the relationship between Time and Change in terms of *cause-effect*, argued for the existence of the two opposed realities. The first regarded *natural phenomena* and *substances* (according to Aristotle, the “substance” is inseparable conjunction of *matter* and *form*; the *matter* is what things are made of and the *form* is what gives organization to the matter). Conversely, the second (the *First Cause* or *Unmoved Mover*) was defined as *transcendent pure form*, i.e. the only ‘form’ that exists without ‘matter’. Aristotle understood reality (the *Final Cause*) in terms of an eternal and teleological process in which *potentiality* (*First Cause*) acquires *actuality* (*substance* consisting of both *matter* and *form*). During the Modern Age, other thinkers took into consideration the idea that the Timeless Reality gives birth to the opposed Tensed Reality. Hegel, for example, affirmed that the order of events placed in time is just a distorted reflection of the timeless reality. Following Hegel, Mc Taggart argued that time does not apply to reality. His argument still represents one of the main reference in the contemporary debate of time. From the discussion of Mc Taggart’s argument two controversial positions were developed and branched in relation to the acceptance or denial of the so-called *A-series* and *B-series* views.

2. Mc Taggart’s argument of “Unreality of Time”

2.1 Preliminaries

In the essay “The Unreality of Time”¹ Mc Taggart aimed to demonstrate that time does not exist. Here he defined *moments* the positions placed in time and *events* the contents of such positions. Furthermore, he acknowledged *time’s passage* as an event that is moving from the future to the present and then to the past. Mc Taggart set out to demonstrate the unreality of time by considering the way we order events in time:

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• The A-series: where events find their temporal ordering by instantiating different temporal properties at different times: "the series of positions running from the far past through the near past to the present, and then from the present to the near future and the far future..". Mc Taggart declared that "the distinctions of past, present and future are essential to time and that, if the distinctions are never true of reality, then no reality is in time." He conceived A-series as the 'temporal' series, i.e. the true time series that embodies change.

• The B-series: where events bear a static and unchanging temporal relation to all other events: "The series of positions which runs from earlier to later..". The B-series is temporal since embodies direction of change. However, according to Mc Taggart B-series alone does not embody change.

• The C-series: "..this other series, let us call it the C series, is not temporal, for it involves no change, but only an order. Events have an order. They are, let us say, in the order M, N, O, P. And they are therefore not in the order M, O, N, P, or O, N, M, P, or in any other possible order. But that they have this order no more implies that there is any change than the order of the letters of the alphabet...". According to Mc Taggart C-series is not temporal because here events are fixed forever.

Mc Taggart claimed that we always take time to form both A-series and B-series. The main difference between these series concerns the way they indicate the relations between temporal objects like events and moments. A-series indicates momentary relations, where an event or moment that is now present necessarily has been past and will be future. Whereas, B-series indicates permanent relations, expressed in terms of being earlier-later than: where if an event or moment e has ever been earlier than another event è, therefore e is now and will be earlier than è forever. The structure of Mc Taggart’s argument is divided into two parts. In the first part, he argued that B-series alone cannot
guarantee the passage of time and thus A-series is necessary for time. The key-idea is that time requires change and neither B-series nor C-series suffice for change. In the second part, McTaggart demonstrated that A-series is incoherent. As every event that occurs into A-series will be at once future, at another time present, and at yet another time and forever henceforth past, then every event exemplifies and instantiates every temporal property: futurity, presentness, and pastness. But, according to him, these properties are mutually exclusive insofar as they cannot be co-instantiated, therefore A-series generates an absurdity. Any attempt to evade the contradiction of A-series entails an infinite regression. Then he concluded that, since no reality is in time, time does not apply to reality.

2.2 First part: the reality of time requires the existence of A-series

In the first part of his argument McTaggart raised the question: “whether it is essential to the reality of time that its events should form an A-series as well as a B-series.”\(^2\) When we think of an event in terms of being earlier or later than another event, we necessarily assume they to have the properties of presentness, pastness and futurity, insofar as we also refer to some event in terms of being earlier or later than something placed in the present. McTaggart took B-series and C-series to be ‘fixed’ series, and A-series to be the only series in which change continually occurs. Although we always perceive time to form both A-series and B-series, B-series alone cannot suffice to account for change. Since within B-series things have fixed positions and extents, these cannot be said to change: “no event can cease to be, or begin to be, itself, since it never ceases to have a place as itself in the B series. Thus one event cannot change into another...as the B series indicate permanent relations, no moment could ever cease to be, nor could it become another moment.”. Neither events can be said to change into C-series, this series is

\(^2\) McTaggart, op. cit. p. 458.
just the representation of sets of events running in the same unchanging sequence forever. Thus C-series does not describe any change either: “...that they have this order no more implies that there is any change than the order of the letters of the alphabet.”. So, time entails change and B-series alone is not sufficient for time in the same way the permanent relation that defines e to be earlier than è leaves no room for change. Furthermore, within B-series events cannot cease or begin to exist (if e is an event, e has ever been and will be an event) or change their B-determinations (if e is earlier than è, e has ever been and will ever be earlier than è). Consequently, events cannot change into one another either, since an event e cannot merge into another event è without ceasing to be e.

After this step, Mc Taggart took into consideration if the change that occurs in time really exists. Accordingly, what we can consider ‘genuine change’ is the inclusion of an event into the A-series: “But in one respect it does change. It began by being a future event. It became every moment an event in the nearer future. At last it was a present event. Then it became past, and will always remain so, though every moment it becomes further and further past. Thus we seem forced to the conclusion that all change is only a change in the characteristics imparted to events by their presence in the A series”. Thus, the only change that occurs in events is supposed to be represented by the event’s regression from the future to the further past. At the centre of this assumption is the example of the death of Queen Anne. This event represents a ‘death’, it has certain causes and certain effects, it is later than the physical object called Queen Elizabeth, etc.. However, none of these properties seems to change over time. The event of Queen Anne’s death does change exclusively in respect to its inclusion within A-series, that is its regression each moment into the further past: “a past event changes only in one respect - that every moment it is further from the present than it was before”. Not only A-series is necessary for time, also it gives direction to events/moments placed in it.
2.3 Second part: the incoherence of A-series entails that time does not exist

Afterwards, Mc Taggart demonstrated the incoherence of A-series by raising the question if positions an event takes within A-series could be thought as possible indicator of genuine change. Through this apparently obvious relation he meant to prove that A-series cannot exist. According to him, if we assume the position of events to record genuine change, we can define such change in terms of either 'quality' of events or 'relation' between events. Suppose the change occurring in events to be a sort of relation. But, as we take events to change in virtue of a relation by which they get ever further from the present, then we assume the first relational term to be the present moment placed into A-series and the second term to be something placed into the a-temporal C-series: "The relations which form the A-series then must be relations of events and moments to something not itself in the time-series". But, this seems absurd and thus we should abandon the idea that temporal change is a sort of relation between events. Consider now such change to be a 'quality' or 'property' of events within A-series. In order to identify temporal properties such as: being present, having been future or will be past we need a conception of time divided into past, present and future, and hence the appeal to A-series. Nevertheless, the definition of temporal change in qualitative terms entails this contradiction. Every event seems to exemplify all A-properties, such as being past/present/future, even if the terms future, past and present are incompatible to one another and thus cannot be all predicable for each event/moment:

3) if $x$ is past, then $x$ has been present and future;
4) if $x$ is future, then $x$ will be present and past;
5) if $x$ is present, then $x$ has been future and will be past.

In order to avoid the contradiction of A-properties, Mc Taggart suggested to assume that events do not possess all properties simultaneously but only successively. While exemplifying all
properties at some time, no event has these at once, that is no event is simultaneously past, present and future. Accordingly, we assume the A-series within which the event $x$ has been future, is present and will be past, to fall into another A-series equally divided between past, present, future. Thus, we add a second level of complex tense expressions defined in these terms:

1) $x$ is past-in-the-present & present-in-the-past & future-in-the-past;
2) $x$ is future-in-the-present & present-in-the-future & past-in-the-future;

Although the idea of "constructing a second A-series, within which the first falls, in the same way in which events fall within the first" makes sense, it entails the same contradiction which arises at each level of the complex tense expressions:

- If $x$ is past-in-the-present & present-in-the-past & future-in-the-past, then $x$ has been future-in-the-present & present-in-the-future & present-in-the-present, and will be past-in-the-future.

- If $x$ is future-in-the-present & present-in-the-future & past-in-the-future, then $x$ has been future-in-the-past, and will be past-in-the-present & present-in-the-past & present-in-the-present.

- If $x$ is present-in-the-present & future-in-the-past & past-in-the-future, then $x$ has been future-in-the-present & present-in-the-future, and will be past-in-the-present & present-in-the-present.

Since being past-in-the-present and future-in-the-present are incompatible as much as being present-in-the-future, present-in-

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3 Mc Taggart op. cit. p. 469.
the-past and present-in-the-present, if we want to evade the contradiction related to the second-level of expressions we need a third A-series within which the second falls. But, such contradiction will still appear, and therefore we would be committed to take a further A-series. So, the strategy suggested by Mc Taggart bumps at any step into the same contradiction. As far as we go in construing A-series levels of complex tense determinations, each A-series will be contradictory at any step. This process runs ad infinitum. Mc Taggart concluded that if we assign A-series to A-series the best we do is to assume time to explain time and this is absurd: "Accordingly the A-series has to be pre-supposed in order to account for the A-series. And this is clearly a vicious circle". It follows from this time is something unreal: "Our ground for rejecting time, it may be said, is that time cannot be explained without assuming time.".

2.4 Conclusions: “specious present” and unreality of time

We may sum up the argument of unreality of time in the following way:
1. Time involves change and in order to account for change we need A-series;
2. the application of A-series to reality entails a contradiction since the characteristics of A-series (defined as relations or qualities) are mutually incompatible and yet all true of every term;
3. the denial of A-series entails the denial of B-series;
4. unless this contradiction is removed the idea of time must be rejected as invalid;
5. the attempt to claim A-series characteristics successively but not simultaneously fails as it entails an infinite regress, and thus the contradiction remains unresolved;
6. Therefore neither A-series nor B-series really exist: the idea of time that apply to reality must be rejected because the contradiction cannot be removed.
Before concluding I want allude to the notion of *specious present* given by Mc Taggart in regard to the perception of temporal realities. It should be reminded that his considerations on specious present do not play any role for the argument. They are just meant to alleviate the worry that unreality of time somehow conflicts with our experience of it. He said that when individuals perceive events or moments in terms of A-series, they may have the following mental states:

- Everything *simultaneous* with my *direct perception* is present;
- Everything *simultaneous* with my *remembered perception* is past;
- Everything *simultaneous* with my *anticipated perception* is future.

According to Mc Taggart, direct perceptions of present events are simultaneous with what falls within the 'specious present'. Into the specious present events are perceived with some finite duration. Also, specious present may vary in 'length' both 'intrapersonally' and 'interpersonally': "...now the 'specious present' varies in length according to circumstances, and may be different for two people at the same period...the event M may be simultaneous both with X's perception Q and Y's perception R. At a certain moment Q may have ceased to be part of X's specious present. M, therefore, will at that moment be past. But at the same moment R may still be part of Y's specious present. And, therefore, M will be present, at the same moment at which is past...".  

The notion of specious entails the viewpoint that time is related to individual observes, according to the theory of special relativity. Suppose an event *m* to fall within X's specious present but not within Y’s specious present, then *m* would have duration for X but not for Y. This is to say that, on X’s perception *m* is still going on in the present, while on Y’s perception *m* is just a *durationless point* placed in the past. However Mc Taggart was not disposed to accept the theory of special relativity. He argued

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4 Mc Taggart, *op. cit.* p. 472.
for the reality of just one time true for all observes: “The present through which events really pass, therefore, cannot be determined as simultaneous with the specious present. It must have a duration fixed as an ultimate fact”. The view which takes time to be subjective does not guarantee an objective temporal order of events observed and thus, he said, it must be rejected. Note that his considerations on specious present can perfectly coexist with the claim that time, as well as A-series, has no genuine ontological status. Mc Taggart concluded that C-series is likely to be real. He agreed with Hegel who defined the time-series as: “distorted reflection of something placed in the real nature of the Timeless Reality”. Although this assumption can seem paradoxical, it does not conflict with any feature of our temporal experience.

3. The dispute between A-theorists and B-theorists: the reality of temporal properties and temporal passage

Mc Taggart’s argument has been and still is very influential. Philosophers have often claimed that there is something of obscure in it. As far we see from the discussion of A-series and B-series views of time two conflicting positions emerged. Proponents of tensed theories of time assumed the reality of A-series, whereas supporters of tenseless theories of time held the reality of B-series. The contraposition between these positions concerns the acceptance or denial of, at least, some part of Mc Taggart’s argument. Philosophers who have been convinced by the part of the argument regarding the contradiction of A-series, are called B-theorists. Unlike Mc Taggart, they do not deny the reality of time but do deny the reality of A-properties. Advocates of this approach assume time to requires only B-series and B-vocabulary and temporal passage to be just a psychological effect of the way humans perceive the change occurring in the space-time universe. These philosophers proposed two influential arguments against the reality of A-properties and temporal passage. With the first argument they aim to deny the concept of simultaneity. According

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5 Mc Taggart, op. cit. p. 474.
to the *theory of special relativity*, there is nothing that can be defined *simultaneously absolute* and thus nothing that can have objective A-facts of the form “*x is present*” or “*x has ‘now’ the property of futurity*”. The second argument takes into consideration the notion of *rate of change*. Accordingly, if time really flows, as A-theorists believe, it makes sense to ask how fast it does flow. But, trying to give a coherent answer to such question by appealing to the notion of rate of change entails a contradiction. Since the rate of change is incoherent, B-theorists conclude that time cannot be said to pass or flow.

In the opposite direction, A-theorists claim that temporal properties are *real* and genuine properties that cannot be reducible to B-facts and definable in relational terms of being earlier/ later than. Proponents of this view defend the picture that temporal passage is a sort of *flux* or *flow* where what occurs is what moves *irreversibly* from one time to another. These philosophers attempt to evade the contradiction of A-properties by relating the reality of temporal properties to the truth or falsehood conditions of *temporal tenses*. They argue that one should not abandon the verbal tenses of the verb *‘to be’* in favour of the references offered by B-vocabulary. Following the claim: “*take tense seriously*”, these thinkers hold that verbal tenses we ordinarily use in our language such as: “*it was the case that*...”, “*it is now the case that*...” and “*it will be the case that*...” are ‘tense-logical operators’ able to modify statements. Accordingly, there is no contradiction to be passed along to the different times $t^1, t^2, ..., t^n$ at which an event $x$ is future, present and past. If there is no contradiction in A-series, the definition of temporal passage is still valid.

### 4. Broad’s account of temporal passage and event’s becoming

Above the dispute between A-theorists and B-theorists was introduced. In the next sections I will examine some of the most popular objections to Mc Taggart’s argument. One of these has been proposed by Broad in his *The Examination of Mc Taggart’s*
Broad was committed to give a definition of temporal passage able to sidestep the traditional objections. According to him, Mc Taggart’s argument was flawed as it relies on an ambiguity in the use of the copula ‘is’. He considered the alleged contradiction of Mc Taggart’s argument in these terms:

- A₁) every event must have many, if not all, the A-properties (or A-determinations, as they are sometimes called),
- A₂) since the A-properties are mutually exclusive, no event can have more than one of them.

Broad suspected there were some peculiarities of our language which create or at least reinforce the credibility of Mc Taggart's anti-passage argument: “I felt from the first, and still feel, that the difficulty which arises is (a) embarrassing enough prima facie to demand the serious attention of anyone who philosophies about time, and (b) almost certainly due to some purely linguistic source (common, and perhaps peculiar, to the Indo-European verb-system), which it ought to be possible to indicate and make harmless.”

According to him, either we use tensed expressions such as “it is raining” or tenseless expressions such as “three is prime”, the copula ‘is’ is ambiguous anyway. Thus, he suggested to replace the copula ‘is’ with the copula ‘be’ after the following fashion:

- “S be F at t” iff “S was F at t’ or ‘S is F at t’ or ‘S will be F at t’”

Note that the verbs to the right of the ‘iff’ (i.e. logician's abbreviation for ‘if and only if’) are always tensed verbs. Given that the copula ‘be’ is not univocal, if we replace tensed expressions with tenseless expressions we can maintain that:

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7 Broad C. D., op. cit. p. 765.
$A_1$) is plausible if the copula is understood in some tenseless fashion. 
$A_2$) is be plausible if the copula is tensed.

However, Broad’s analysis does not concern only language. It further provided with an interesting viewpoint the contemporary physical debate of time’s flow. Broad argued that temporal passage is something that can be thought as like ‘motion’:

\[ \text{[i]he characteristic of presentness is...supposed to move along this series of event-particles, in the direction from earlier to later, as the light from a policeman's bulls eye [flashlight] might move along a row of palings}. \]

In any case he believed that representing temporal passage in terms of motion or qualitative change is doomed to failure. Consider temporal passage in terms of an event that has the property of presentness and then immediately loses it but gains (and loses in turn) a long and possibly endless series of properties that increase the degree of pastness. Suppose, for example, the substance $S$ to change in virtue of certain qualities or properties $P_1$ and $P_2$ only if it is so-determined: “$S$ is $P_1$ at $t^1$ and $P_2$ at $t^2$”. In order for $S$ to have a change from having $P_1$ at $t^1$ to $P_2$ at $t^2$, $S$ should persisted at least from $t^1$ to $t^2$. But, as the events involved in temporal passage are supposed to be ‘instantaneous’, that is they have no duration, then they cannot undergo qualitative change.

It is sometimes argued that the properties that make up the A-series (and so the change representing time’s passage) are special properties, insofar as even instantaneous events can gain and lose this special pleading. Anyhow, Broad maintained that physics has so far no need of such properties. Temporal passage is unlikely to be sympathetic to this special pleading. He pointed out the so-called problem of Queen Anne’s death. Accordingly, if we assume temporal passage to be a form of qualitative change, we take the acquisition of A-properties to be a second-order event placed in the history of a first-order event. As first-order events are, by hypothesis, durationless, then it is tempting to suppose that such history takes place in a second temporal dimension. Again, we are launched on what looks to be an infinite regress. Broad has
adopted this strong argument to show that the definition of temporal passage in terms of quality or motion is inconsistent. He proposed to define of temporal passage in terms of absolute becoming\(^8\). The ‘absolute becoming’ is what happens to events when they come into reality. According to Broad, an event that ‘becomes present’ is an event that happens or comes into existence: “Again, any subject of which we can significantly say that it “became louder” must be a more or less prolonged noise-process, which divides into an earlier phase of less loudness adjoined to a later phase of greater loudness. But a literally instantaneous event-particle can significantly be said to “become present”; and, indeed, in the strict sense of “present” only instantaneous event-particles can be said to “become present”. To “become present” is, in fact, just to “become”, in an absolute sense; i.e. to “come to pass” in the Biblical phraseology, or, most simply, to “happen”. Sentences like “This water became hot” or “This noise became louder” record facts of qualitative change. Sentences like “This event became present” record facts of absolute becoming.”. Given the geometric richness of a Newtonian space-time framework, we can order events in time by assuming that some event occurs before or after the class of simultaneous events which come into existence. Temporal passage would just be the successive happening of simultaneous sets of events\(^9\).

5. B-theories and the denial of temporal passage: Indexicality and rate of change

Thus, the debate about the existence of temporal passage focuses on the merits or incoherence of A-series. B-theorists take modern physics to be skeptical of entities that constantly shift temporal properties. They repeat such properties play no role in modern physics and thus temporal passage cannot be thought as feature of physical reality. B-theorists refuse to accept the reality of tenses

\(^8\) Broad C. D., *op. cit.* p. 280-281.
\(^9\) Broad C. D., *op. cit.* p. 79.

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and argue for the reality of the classic static space-time structure (B-series). There is a recent version of such view, most notably held by Horwich\textsuperscript{10}, Lowe\textsuperscript{11} and Mellor\textsuperscript{12}, which establishes that tensed terms are indexical terms. Accordingly, the term ‘\textit{now}’ is, as well as the term ‘\textit{here}’, a \textit{token-reflexive} or indexical term. It follows that the truth or falsehood conditions of sentences like “\textit{S is now F}” or “\textit{S is future}” depend on tenseless facts concerning events and on the time of utterance. According to Lowe, although complex tense expressions such as: “\textit{past in the future}” or “\textit{future in the past}” are incoherent, the first-order expressions: “\textit{past in the present}”; “\textit{present in the present}”; “\textit{future in the present}” are still valid. Lowe’s analysis determines exclusively first-order A-determinations that must be related to the context of use:\textsuperscript{13}

- “\textit{x is present}” means “\textit{x occurs now}”
- “\textit{x is past}” means “\textit{x occurs before now}”
- “\textit{x is future}” means “\textit{x occurs after now}”.

Above the term ‘\textit{now}’ is thought as an \textit{indexical temporal function} analogous to indexical spatial functions such as ‘\textit{here}’, ‘\textit{there}’ and ‘\textit{I}’. In virtue of such indexical terms one can assign truth or falsehood value to tense expressions in relation to some given \textit{space} and \textit{time}. For example, the sentence “\textit{x is happening now}” is true only if the token-reflexive term \textit{now} is uttered at time \textit{t} such that \textit{x} is happening at \textit{t} is true. Similarly, the sentence “\textit{x is happening here}” is true only if the token-reflexive term \textit{here} is uttered at place \textit{p} such that \textit{x} is happening at \textit{p} is true. Consequently, the definition of temporal passage in terms of an event that recedes into the further past must be rejected because it

\textsuperscript{11} Lowe E. J., \textit{The Indexical Fallacy in McTaggart’s Proof of the Unreality of Time} (1927) in Mind vol. 96 (p. 62-70).
\textsuperscript{13} Lowe E. J., \textit{op. cit.} p. 67-69.
cannot be said of an event that is present in the Future or present in the Past. On
the other hand, among B-theorists there are other thinkers who do not feel comfortable with the
indexicality of A-determinations. Smart, for example, said that an excessive attention to the
tensed notions of now, past, and future serves to project a sort of anthropocentric idea on the
universe at large. According to him, if we assume tensed temporal locutions to be
anthropocentric insofar as they locate us in the universe, it may still be asked whether
they refer to a static structure (represented by the four-dimensional continuum of space-time
entities) or instead to an unfolding and dynamic universe. Smart dismissed the latter view
because this would endorse the obscure or mistaken idea that events “become” or “come into
existence”. He said that absolute becoming and temporal passage are mistakes and harmful
ones: “Our notion of time as flowing, the transitory aspect of time as Broad has called it, is an
illusion which prevents us seeing the world as it really is.” In the essay “The River of Time”
Smart moved his attack to the definition of temporal passage understood in terms of
‘motion’. He raised this question: as motion is supposed to be a sort of change of spatial
positions in relation to time, then it may be asked if time does really move. Smart argued that
when we think of time as a sort of motion we generally recur to two metaphors. These result to
be particularly compelling because provide us with some pictures of the irreversibility of
time. The first metaphor gives us a picture in which we are moving through time from the
past to the future. Accordingly, we think of ourselves to advance through time as if “we sail
through the sea”. Instead, the second metaphor gives us a picture in which the
direction of temporal passage is determined from the future to the further Past. When we recur
to this picture we imagine time passes through us like a river that flows. So, while in the
former we are moving, in the latter we are stationary. Anyhow, Smart said that

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15 Smart J. J. C., Philosophy and Scientific Realism, (1963), p.132.
only the second picture endorses the irreversibility of ‘motion’: ‘...I understand the assertion that the flow of river is irreversible while the flow of the tides is not. It is motion that is or not reversible. Hence to say that time is irreversible is to elaborate our old metaphor of the flow of time...’\(^{17}\). Nonetheless, Smart concluded that no metaphor conveys the true of temporal passage. He attempted to show the fallacy of the idea that time is like motion by taking into consideration the rate of change of the alleged temporal passage. According to Smart, if we assume ‘motion’ to be a sort of change of spatial positions in relation to time, we may understand temporal motion to be a sort of change of temporal positions in relation to something. Suppose such ‘something’ is, by analogy with motion, ‘time’, so it makes sense to question how fast time does change in respect to itself. If we take ‘velocity’ to be the ratio of distance and time, we may give the answer that time does change at this rate of change:

- Rate of temporal change: \[ \frac{1 \text{ second of temporal distance}}{1 \text{ second of time}} \]

Once it is assumed that time flows at the rate above, one may ask if such flow is regular. Suppose, for example, that time has flown faster today than yesterday. So-doing, the temporal references ‘today’ and ‘yesterday’ become systematically ambiguous:

- ‘today’ sometimes refers to a position or stretch of time (it lasts 24 hours);
- ‘today’ sometimes refers to a position or stretch of super-time (i.e. the dimension along which normal time flows)

If we say that ‘yesterday’ time has flown at the rate of ‘one hour per hour’, the 24 hours making up ‘today’ must be said to flow at the rate of ‘two hours per hour’ of super-time. As ‘today’ time has passed at the rate of ‘two hour per hour’, then such time should have passed at a rate higher than the rate in which case its change must be measured in terms of ordinary time per super-time. But

\(^{17}\) Smart J. J. C., op. cit. p. 484.
the time in the denominator of the ratio expressing the rate of
temporal motion is supposed to be different than the time in the
numerator. Then, in order for it to be genuine time we need a
further temporal dimension and this may be seen as the beginning
of an infinite regress: “just as we thought of the first time-
dimension as a stream, so will we want to think of the second
time-dimension as a stream also; now the speed of flow of the
second stream is a rate of change with respect to a third time-
dimension, and so we can go on indefinitely postulating fresh
streams without being any better satisfied. Sooner or later we
shall have to stop thinking of time as a stream...”. Smart
concluded that, even the claim that time does flow always at the
same rate is far from being a compelling story about temporal
passage. This claim will not help us to determine how fast time
flows: “Nor will it help matters to say that time always flows at the
same rate...the most we could hope for would be the not very
illuminating remark that there is just one second in every
second...”. If there is no rate which can be assigned to time’s
flow, time’s flow does not exist.

7. Smart’s account of temporal change: change in things vs.
   Change in events

If the definition of temporal change, as well as the notion of rate of
change, is incoherent, why the river-metaphors are so suggestive?
According to Smart, these picture are suggestive because
individuals have a natural inclination to hypostatize time. When
we communicate or talk about the change occurring in events, we
think of temporal passage as if it should be the physical liquid
filling the river. So, we substantialize and spatialize temporal
change, insofar as we take A-properties of events to be identical to
properties of physical objects: “Substance exist in space; they are
related to one another in a 3-dimensional order. Events are in
time; they are related to one another in an order of earlier and
later (4-dimensions). Now if we think events as changing, namely
in respect of pastness, presentness, and futurity, we think of them
as substances changing in a certain way”\textsuperscript{18}. Smart said that the illusion of thinking time like a river depends on the syntactical similarity between our talks about time and our talks about river. Both refer to transitive and asymmetrical relational properties: “This shows how misleading it is to think of pastness, presentness and futurity of events as properties, even as relational properties. It shows how utterly unlike ‘this event was future and became past’ is to ‘the light was red and became green...’”. The linguistic analysis he proposed attempts to nullify the confusion related to talks about time, by distinguishing events from physical things. Accordingly, it can be said of things and processes to change, but it cannot be said that they happen. On the other hand, while events clearly ‘happen’ or ‘occur’, it cannot be said of them to change, ‘become’, ‘come into existence’ or ‘cease/begin to be’. Smart repeated that an event is a sort of changing of things, but this changing cannot be said to change by itself. Unlike events, objects or processes can change from being green to being red. But the greenness loss and the redness acquisition is an event, that is a form of ‘changing’ shown by the objects that share a particular property. So, the changing of an object should be thought as an actualization in the sense given by Aristotle. Smart argued that talks about physical things or processes refer to continuant-expressions, whereas talks about ‘actualizations’ refer to event-expressions. Consider the example of the Battle of Waterloo. One can claim both: “the battle of Waterloo took place on 18th June in 1815” or “the battle of Waterloo began or ended fiercer”. In the former claim we think of the battle of Waterloo as an ‘event’ and thus we refer to it by an event-expression. While, in the latter claim we think of this battle as a ‘process’ and thus we refer to it by a continuant-expression. Smart said that when we hypostatize time and events we mistake the meaning of event-expressions for that of continuant-expressions. He defined this linguistic phenomenon the “shifting of syntax”.

\textsuperscript{18} Smart J. J. C., \textit{op. cit.} p. 493.
8. Tensed accounts for Temporal Passage: Prior’s tense analysis of change in events

On the other hand, proponents of tense theories of time, and most notably Prior, defend the reality of A-properties and temporal passage by recurring to tense logic. Adherents of this view of time hold that our ordinary picture of world defined as the totality of tensed facts reflects the world as it really is. Historically, tense logic was developed in close connection with modal logic. The most remarkable tenets of tense logic include:

a) the idea that tense inflections function like adverbs or sentential operators modify or embed whole sentence such as:
   - “(X will be Y)” is to say:“(It will be the case that [X will be Y])”;

b) the idea that tense operators are governed by logical laws such as:
   - “(it is the case that p)” is to say:“(it was the case that [it will be the case that p])”.

Structurally, tenses expressions are supposed to work in the same kind of way as do modal expressions, consider the following fashions:

- “(X could be Y)” is to say:”(It is possible that [X is Y])”;
- “(it is the case that p)” is to say:”(it is necessary that [it is possible that p])”.

This kind of analysis is defined in terms of tense grammatical language. It is supposed to endorse the view of Presentism, according to which only the present is real, as well as only the actual word is real. As it seems implausible to most philosophers of modality that mere possible worlds should be as real as the actual world, in the same way Prior and many philosophers of time claimed that it is unacceptable to assume times other than the present to be as real as the present. According to Prior, the idea of temporal passage is consistent with the presentist claim that events do exist only in the present. He argued that one mistakes tense
expressions when he thinks that many expressions refer to ‘names of objects’ and ‘verbs’ when in reality they refer to concealed *conjunctions* and *adverbs*. According to Prior, putting a verb into the past or the future tense is exactly the same kind of thing as adding an adverb to a sentence. He applied this method in order to replace ‘verbal phrases’ with ‘adverbial phrases’:

“To say that a change has occurred is to say that at least this much: that something which was the case formerly is not the case now. That is, it is at least to say that for some sentence \( p \) we have: ‘It was the case that \( p \), and it is not the case that \( p \)’”.

Consider the following tense expressions:

1. “(I will be eating my breakfast)” is to say:“(It will be the case that [I am eating my breakfast])”,
2. “(I was eating my breakfast)” is to say:“(It was the case that [I am eating my breakfast])”.

In the tense expressions to the right, the past is understood as *past present*, and the future as *future present*. Such analysis takes into consideration only *genuine present tenses* containing tense-logical operators. In virtue of tense-operators we are able to turn tense verbal forms like: “I was born” or “it was 2 years ago since _____” into tensed adverbial forms like: “it is now 10 years since it was 2 years since I was born”. Also, we can repeat iterations of tense-operators in order to modify complex tense expressions such as:

3. “I will have eaten my breakfast” is to say:“(It will be the case that (It was the case that (I am eating my breakfast)))”

Note that the linguistic constructions above do not entail verbs (i.e. predicates that form statements out of names) but just adverbs or auxiliaries which form statements out of statements such as ‘not’. Prior concluded that such genuine present tenses reflect the *law of projection* of temporal passage:

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“It’s (now) \( m \) years since it was \( n \) years since \( p \)” is to say that: “It’s (now) \( m+n \) years since \( p \”).

9. Prior and the solution to Broad’s problem

Prior defined talks about events as talks about real things, and talks about changes in events as talks about changes in things. A positive aspect of his tense grammatical approach is that it is able to translate event-talks into talks that make no mention of events. This aspect is guaranteed by tense-adverbial operators that modify statements about ‘events’ into statements about ‘things’. Prior restated that although talks about temporal passage are metaphorical, the river-metaphors convey the truth that events recede in the further past. He defended the definition of ‘becoming more past’: “…the date of his birth, in fact, is receding all the time further into the Past, just as a leaf on a river flowing past us is all the time receding further into the distance. Would anyone wish to deny? And was ‘time’s flow’ ever intended to mean anything more?” 20 Yet. One may object that the assumption that events ever change is incoherent. In fact, while things clearly change, events do not change but simply happen or occur. But Prior asserted that we think that events change when we wrongly identify events with the changes that occur in things. According to him, we should distinguish between two kinds of change. The first one is the change that occurs in events or processes while these are still going on in the present: “things that change are existing things, and it’s while they exist that they change...and such changes as the change in the rate of movement are similarly changes that go on in the events or processes while they exist, that is, while they exist in the only sense in which events and processes do exist, namely while they are occurring.”21 This kind of change is represented by the ‘acceleration’ \((1 \text{ feet} \times \text{second} \times \text{second})\), that is a sort of change in the rate of movement (a slow movement which suddenly becomes rapid; a dull lecture which ended

interesting, etc.). Prior was disposed to define the changes that occur in the present, like ‘accelerations’ or ‘processes’, as changes that occur in things rather than in events. He said that while changes do change, events do not do change at all. In contrast, the second kind of change is nothing that occurs while events are occurring in the present. That is represented by the regression of an event into the further past, namely the ‘becoming more past’:

> the change from past to still further past isn’t one that occurs while the event is occurring, for all the time that an event is occurring it isn’t past but present, in fact the presentness of an event just is its happening, its occurring, as opposed to its merely having happened or being merely about to happen...

Nevertheless, we previously noted that the assumption of event’s regression seems to conflict with the general idea that if an event $x$ changes, $x$ must exist throughout that change. According to Broad’s problem, the claim that events continually recede into the distant Past entails the following contradiction. In order for a momentary event to recede from the future to the past, it must take to be both something momentary and something which has an indefinitely long history, which is absurd. Though one may suggest that there is no contradiction if we distinguish the piece of history an event is (that may be very short) from the history an event has (that may be indefinitely long), Broad has argued that such solution appears tricky and problematical. For, usually we think that the history of an event $x$ is the sum of all what has happened to $x$ while it occurred. Yet, whatever goes on for some time has future and past phases and not all of them are present as, according to Augustine, the present hath no space. Nevertheless, it still seems odd to take the event $x$ whose long history is the sum of all what happens to $x$ while it occurs, to be the indefinitely short time that $x$ occupies in time. So, how can there be change undergoing Queen Anne’s death if the thing called Queen Anne does not exist anymore? In order to maintain the reality of temporal passage and evade the problem of Queen Anna’s death, Prior suggested to distinguish between general facts and individual facts. Although both facts are supposed to embody the following formula: ‘It was the case that $p$, and it is not the case
that \( p \)' statements about individual facts, or individuals like Queen Anne who do not exist anymore, do not record a proper change. Consider as following:

I: “It was the case that it was the case that only 250 years ago that Queen Anne is dying, and it is not now the case that it was the case only 250 years ago that Queen Anne is dying”.

According to Prior, statements about individual facts do not meet certain further conditions in respect to individuals they make reference. In fact, since Queen Anne has ceased to be, there cannot be change undergoing her death. Conversely, statements about general facts are still able to record genuine change, that is the change that occurs in events when these become more past. These statements do not refer to any individual or particular entity but just to the facts they are about:

G: “It was the case that someone was called ‘Anne’, reigned over England, even though there is not now anyone whom it was the case that she was called ‘Anne’, reigned over England...”.

Though statements about individuals commit us to saying that temporal flow is metaphorical (since they do not entail a literal sense of ‘motion’), Prior affirmed that statements about general facts are able to record genuine change in events: “But the recession is still a change or quasi-change in the sense that it fits the formula ‘It was the case that \( p \), but it is not now the case that \( p \)’ — this formula continues to express what is common to the flow of a literal river on the one hand, and the flow of time on the other...”

Prior refused to accept the idea that events are concrete and unrepeatable individuals or ephemeral particulars with specific positions in time and space. Rather, events would be abstract entities such as universals or states of affairs. He concluded that if we understand events as abstract entities we are still committed to maintain the truth of formula: “it was the case that \( p \) and it is not now the case that \( p \)”. Hence, to say that an

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22 Prior A., op. cit.
event \( x \) becomes more past is to say something like: “it was the case that \( x \) is occurring and it is not now the case that \( x \) is occurring”. That is supposed to be the change undergoing temporal flow.

10. Conclusion: do spatial representations reflect temporal change?

Let me conclude this paper with some personal considerations. As far as we have seen the idea that time is something that we can hypostatize or spatialize entails many problems. I believe that difficulties with Mc Taggart’s description of time arise since it relates temporal change (A-series) to static spatial representations (B-series and C-series). I ask if this kind of representation does reflect the reality of temporal dimension. Perhaps, individuals can only determine time and the change in it in virtue of spatial analogies. In any case I do not believe they embody the reality of time, hence I will try to give some reasons below.

I: In the first place I am doubtful in regard to the idea that non-instantaneous events are consistent with their A-determinations. A similar worry was expressed by Mellor in his “Real Time II”\(^{24}\). My doubts regard the assumption that moments and events share ‘indistinctively’ the same A-determinations. Mc Taggart defined moments the positions placed in time and events the contents of such positions. Accordingly, moments and events bear two kinds of relations: one momentary (A-series) and another permanent (B-series). Thus, time is supposed to form A-series as much as B-series relations, insofar as an event/moment that is present is also earlier or later than another one. But, following the problem of Queen Anne’s death, while moments or events placed in the future/past have no duration, events placed in the present may have it. Though one can perfectly relate moments to moments or events to events, on the other hand, I do not see how events-

duration can be related to instantaneous moments/events. Suppose an event-duration $x$ that is occurring in the present at certain durationless moments. Given a fixed plan, let us represent the moments at which $x$ occurs by the inextensible points $p$, $q$, $r$ and the duration of $x$ by the segment of line $L$. If the segment of line $L$ is supposed to be collectively intersected by the points $p$, $q$, $r$, by analogy, one may ask if $x$’s duration is simultaneously constituted by its durationless moments. The claim that these moments are simultaneously present entails the kind of contradiction we noted in regard to the second part of Mc Taggart’s argument. Then, each moment must have just one A-determination at once, insofar as $x$ does occur at $q$ and simultaneously does not at $p$ or $r$. If $x$ is present at $q$ and $q$ is intermediate between $p$ and $r$, in the same way it is earlier than $r$ and later than $p$, necessarily $p$ is past and $r$ is future. But, why one should assume that $p$ and $r$ are constituent of the present event-duration though they do not have the property of presentness? As items belonging to this class can only share successively the property of presentness, then it is difficult to see how such class of items could be equivalent to the class of items of $L$’s spatial points. Consider these pairs of claims:

$a^1$): “the present event $x$ occurs at some instantaneous moments which taken simultaneously constitute $x$’s duration”.
$a^2$): “the segment of line $L$ intersects some inextensible points which taken collectively constitute $L$’s extension”.
$b^1$): “the present event $x$ occurs at some instantaneous moments which taken successively constitute $x$’s duration”.
$b^2$): “the segment of line $L$ intersects some inextensible points which taken individually constitute $L$’s extension”.

The claims above have not the same truth-conditions, indeed while $a^1$) and $b^2$) are not valid, $a^2$) and $b^1$) are still valid. One may object that there is no contradiction if we reduce the duration of the present event to the instantaneous moments it takes for a while. Yet, it might be suggested to represent both relational terms by particular spatial points of the fixed plan. Then, it must take this spatial point to refer to both: something with an unfolding and dynamic reality and something with a static reality, which is
absurd. As far as we go in representing temporal change by recurring to fixed spatial analogies, these will not embody the reality of time.

II: Secondly, I express some worries about the definition of temporal change in terms of ‘motion’. I ask if this definition can be threatened by a paradox similar to that of ‘Achilles and the tortoise’. Zeno proposed this argument in order to demonstrate the impossibility of motion. Accordingly, since space is supposed to be divisible ad infinitum, if we take motion to be a sort of change in respect to certain times and spatial positions, we embark on an infinite regression. The argument alluded to the race between Achilles and the tortoise. In spite of the fact that Achilles is faster than the animal, he will never overtake it. Suppose Achilles is ‘10 times’ faster than the tortoise so that he allows it a head start of some distance Y. Furthermore, suppose each runner to start running at some constant speed. After some finite time, Achilles has moved forward and run the distance Y, bringing him to tortoise’s starting point. In the meantime, the tortoise has run a much shorter distance which corresponds to 1/10 of Y. Afterwards, it will take Achilles some further time to run the distance “Y + 1/10 of Y”, while the tortoise has advanced further and run the distance of 1/100 of Y (1/10 of 1/10 of Y), and thus left him behind. Again, it will take some more times for Achilles to run the third distance, as much as, some more times for the tortoise to move ahead. The paradox shows that every time Achilles will succeed in bringing even more near to the tortoise, the animal will continue taking the lead, since it will have an ever more narrow but present margin of distance. Wherever Achilles will go, the tortoise will have been there yet, therefore Achilles will have a bit further to go forever. The process runs *ad infinitum* because there is an infinite number of spatial distances Achilles has to run in order to bring himself near to the tortoise. The paradox consists in the fact that the hero will never overtake it. In spite of the fact that modern calculus has solved the mathematical aspects of Zeno’s paradox, the problem of defining temporal change in terms of motion remains tricky. Suppose now
to formulate an similar paradox. As ‘motion’ is a sort of change of spatial positions in relation to time (where ‘velocity’ is the ratio of distance and time) and acceleration/deceleration is a sort of change in the rate of movement, then temporal motion can be thought as a sort of change of temporal positions in relation to time. Hence, we may assign to such forms of change the following rates of change:

- Rate of motion: \([1 \text{ feet of distance} \times 1 \text{ second of time}]\)
  - Rate of acceleration: \([1 \text{ feet of distance} \times 1 \text{ second of time} \times 1 \text{ second of time}]\)

- Rate of temporal motion: \([1 \text{ moment of temporal distance} \times 1 \text{ second of time}]\)
  - Rate of T-acceleration: \([1 \text{ moment of temporal distance} \times 1 \text{ second of time} \times 1 \text{ second of time}]\)

Now, consider two events to recede within A-series at certain constant velocity and at rate expressed above. Furthermore, take them to be related to one another in these terms: the event \(X\) is later than the event \(Z\), insofar as \(X\) is at moment \(m\) and \(Z\) is at moment \(n\) of some length of temporal distance \(Y\). After some finite time \(t_1\), \(X\) has receded from \(m\) to \(n\) and covered the temporal distance \(Y\). Given that events recede into the further past at the rate of: \([1 \text{ moment of temporal distance} \times 1 \text{ second of time}]\), we may assume that within this length of time events recede into the further past at the rate of: \([1 \text{ moment of } Y \times 1 \text{ second of time}]\).

Suppose, for example, that events which recede within \(Y\) become “100 times more past \( \times 1 \text{ temporal position of } Y \times 1 \text{ second of time}”\. Anyway, while at \(t_1\) \(X\) covered the distance \(Y\), on the other side, \(Z\) has receded a much shorter length of time, say \(Y^2\), elapsing between moments \(n\) and \(o\). Given that \(Y^2\) corresponds to 1/10 of \(Y\), if we maintain the above rate of change we can maintain that, when \(Z\) was covering \(Y^2\) it receded into the further past at a rate of: “10 times more past \( \times 1 \text{ temporal position of } Y^2 \times 1 \text{ second of time}”\. Afterwards, it will take \(X\) some further time \(t_2\) to recede until \(o\) and cover \(Y^2 (1/10 \text{ of } Y)\). But at the same time \(t_2\) \(Z\) will
have receded a much shorter temporal distance $Y^3$, elapsing between moments $o$ and $p$, that corresponds to $1/100$ of $Y$ ("$Y^3 = 1/10$ of $Y^2$, where $Y^2 = 1/10$ of $Y$"). As, into this length of time, events recede into the further past at a rate of: ["1 moment of $Y^3$ (0.01 of $Y$) × 1 second of time"], then $Z$ became: "1 time more past × 1 temporal position of $Y^3$ × second of time". Consequently, each $Y^3$'s position records an increase in the degree of pastness corresponding to the 0.01% of the degree of pastness of $Y$’s positions. Yet again it will take $X$ some more time $t^3$ to recede until $p$ and cover the distance $Y^3$, as much as, some more times $t^3$ for $Z$ to move ahead until moment $q$ and cover another temporal distance $Y^4$ (1/1000 of $Y$). Hence, at time $t^3$ $Z$ was supposed to recede into the further past at a rate of: ", "1 moment of $Y^4$ (0.001 of $Y$) × 1 second of time", as well as, to become: "0.10 times more past × 1 temporal position of $Y^4$ × second of time". It follows from this that each $Y^4$'s moment will record an increase in the degree of pastness that corresponds to the 0.001% of the degree of pastness of $Y$’s moments. As there is an infinite number of temporal positions within $A$-series, then we embark on an infinite regression. Paradoxically, this picture entails that events that go on immutably for all their duration will become less past than before, which is absurd. At any time $t^n$, the positions of a given length of time $Y^n$ will record an ever more narrow and marginal increase in the degree of pastness ("$x$ times more past × 1 moment of $Y^n$ (x of $Y$) × 1 second of time") which will not be able to guarantee genuine change. But this sounds like the claim that $X$ and $Z$ will never lose the property of presentness. Such claim is absurd especially if we take the $B$-relation between $X$ and $Z$ to be fixed forever into the same unchangeable way and they to recede within $A$-series at some constant velocity expressed by the rate of change. The contradiction arises since we understand $X$ and $Z$ as two first-order events and their regression as two second-order events or processes that are going on in the present. The matter is that such second-order events do not seem to apply to the same reality. Although $X$ and $Z$ are related in the same unchanged way for all their duration, insofar as $Z$ is always earlier than $X$, their
regressions will take different temporal dimensions (i.e. the lengths of time \(Y^\circ\)) which entail at any step different rates of temporal change. Then the concepts of ‘present’ and ‘past’ become systematically ambiguous. I believe that this picture does threaten the definition of temporal passage in terms of motion. To conclude I want to allude to Augustine. He raised the question if events or intervals of time have short or long duration. According to him, if an event \(X\) is past, it has ceased to be. Since what is non-existent cannot have any properties, it follows that \(X\) cannot be long or having the property of pastness either. This seems to anticipate Broad’s problem of Queen Anne’s death. Augustine answered that although an event is a mind-independent item, what we experience when are measuring its duration or temporal interval, is something in our memory. He concluded that time is something in our mind.\(^{25}\) Mc Taggart said that reality is timeless. Perhaps time does exist in our minds only in form of spatial representations, even though these do not reflect its reality. The mind represents time as unique dimension of reality by relating ordered events to our experiences.

**Resources**
