The Growing Block: From Broad to Tooley

1 Introduction

I start by emphasising C. D. Broad's main argument for his 1923 growing block theory: its ability to explain the directionality that distinguishes time from the dimensions of space. The explanation is that time's *later than* direction is that in which what Broad calls 'the sum total of existence' *grows*. I then sketch the explanation given by the theory Broad aims to displace: that of J. E. McTaggart's 1908 'The Unreality of Time'. McTaggart argues that time's direction is that in which events are forever changing their locations in his tensed 'A series' of temporal positions, from future to present to past, a change whose directionality has no spatial analogue. But he also argues that this kind of change is impossible, and hence that this non-spatial and non-directional series of events (his 'C series') cannot be temporal. Broad takes his own theory to avoid this conclusion by deriving time's direction, not from an ever-changing A series, but from his ever-growing 'sum total' of tenseless (McTaggart's 'B series') existents.

I turn next to the first serious successor to Broad's theory, that of J. L. Mackie's 1974 *The Cement of the Universe*. This links time's direction to that of causation by taking events to become 'fixed', i.e. irrevocable, when they or their sufficient causes become present. Unfortunately, because this otherwise appealing theory lets some events – those with present sufficient causes – be fixed while they are still future, it appears to conflict with a basic premise of any growing block theory, namely that nothing exists that is later than the present.

I then show how the next major causally-based growing block theory, that of Michael Tooley's 1997 *Time, Tense and Causation*, can avoid this conflict, and let the present precede nothing at all, not even future regions of space-time. As Tooley's theory is also the most comprehensive and best-argued growing block theory to date, I expound it in some detail, and make the best case for it that I can. I conclude by sketching the three main challenges that I think Tooley's and other growing block theories still face: those posed by modern physics, the indexicality of the present, and an analogue of McTaggart's disproof of the reality of his A series.

2 Broad's Sense of Time

In §4 of Chapter 1, Emily Thomas tells us how and why Broad's view of time changed from his 1921 'Russell-style eternalism' to his 1938 'new kind of eternalism'. But Broad's best-known view, and the ancestor of later growing block theories of time, is the intermediate theory of his 1923 *Scientific Thought*:

> The sum total of existence is always increasing, and it is this which gives the time-series a sense as well as an order. A moment t is later than a moment t' if the sum total of existence at t includes the sum total of existence at t' together with something more (pp. 66–7).

As this quotation shows, and as Thomas emphasises, Broad held this view largely because it explained what he called time's 'sense' and is now called its 'direction'. This is the difference between being *earlier* and being *later* than something, relations which, unlike their spatial counterparts (like *above* and *below*), have important correlates: there is, for example, no spatial analogue of effects rarely if ever preceding their causes.

This does not contradict what eternalists assert, namely that time is a dimension of space-time. For all that tells us is that time and the three dimensions of space provide the only four ways in which things can fail to be in contact, i.e. to be capable of unmediated interaction. It does not tell us how time differs from space-time's other dimensions: why, for example, clocks can no more measure spatial distances than rangefinders can measure temporal ones; let alone why what clocks measure has a direction and what rangefinders measure doesn't. Eternalism may accommodate a profound resemblance between time and space, but it tells us nothing about how they differ.

Nor does 'presentism', the theory that only what is present exists. For 'presentism' means *temporal* presentism, the view that only what is *now* exists, not its spatial analogue, that only what is *here* exists. Presentism, like eternalism, simply takes the distinction between time and space for granted, as it does time's direction, since for presentists the (now non-existent) past is what was present *earlier* than now, and the (now non-existent) future is what will be present *later* than now.

3 McTaggart's A and B series

A theory which, as Broad knew, does distinguish time from space, and gives it its direction, is that of J. Ellis McTaggart's 1908 'The Unreality of Time'. McTaggart shares the eternalist view that Broad's 'sum total of existence' never changes. Nothing in McTaggart's world ever comes into existence, as it does in Broad's, nor does it cease to exist when it becomes past, as it does in the presentist's. But McTaggart differs from eternalism in one crucial respect: where eternalists only

order times like 1 January 2000 in one way, by how much earlier or later they are than other such times, McTaggart orders them, and the events which happen at them, in two ways:

> I shall speak of 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, as the A series. The series of positions which runs from earlier to later I shall call the B series (p. 458).

McTaggart's argument for his two series is that an event like the death on 1 August 1714 of Queen Anne (Britain's last Stuart monarch) can only change by being in an A series:

> That it is a death, that it is the death of Anne Stuart, that it has such causes, that it has such effects – every characteristic of this sort never changes … 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 present. Then it became past, and will always remain so, though every moment it becomes further and further past. … all change is only a change of the characteristics imparted to events by their presence in the A series (pp. 460–1).

McTaggart then argues that, 'since time involves change', there can be no time 'without the A series', and hence no B series, 'since earlier and later, which are the distinctions of which it consists, are clearly time-determinations'. There can only be a non-temporal 'C series … of the permanent relations to one another of those realities which in time are events' (p. 461).

All this is well known, as is McTaggart's controversial proof that no A series can exist, because

> Past, present, and future are incompatible determinations. Every event must be one or the other, but no event can be more than one. … But every event has them all. If M is past, it has been present and future. If it is future, it will be present and past. If it is present, it has been future and will be past. Thus all the three incompatible terms are predicable of each event, which is obviously inconsistent with their being incompatible, and inconsistent with their producing change (p. 468).

What is less well remembered is McTaggart's view that

> More is wanted, however, for the genesis of a B series and of time than simply the C series and the fact of change. For the change must be in a particular direction. And the C series, while it determines the order, does not determine the direction. If the C series runs M, N, O, P, then the B series from earlier to later cannot run M, O, N, P, or M, P, O, N, or in any way but two. But it can run either M, N, O, P (so that M is earliest and P latest) or else P, O, N, M (so

> that P is earliest and M latest). And there is nothing either in the C series or in the fact of change to determine which it will be (p. 462).

This is why McTaggart thought time's direction can only be explained by his A series and the flow of events and their unchanging B series times, from future to past *via* the present, that it entails: a flow that distinguishes *earlier* events and B times from *later* ones as those which were, are or will be present when the later ones are still future. It is therefore also why anyone who agrees with McTaggart that his A series is unreal, but denies that this makes time itself unreal, needs a different account of time's direction. Hence the appeal of growing-block theories, on which, as we saw in §2 that Broad puts it,

> a moment t is later than a moment t' if the sum total of existence at t includes the sum total of existence at t' together with something more.

4 Time and Causation

Growing block theories must of course do more than give time *a* direction: they must link that direction to what, in §2, I called its 'correlates', Barry Dainton, in chapter 4 of his 2001 *Time and Space*, calls its 'asymmetries' and Dieter Zeh (2007) and others call its 'arrows'. Zeh's arrows include, for example, (a) the expansion of the universe, (b) the overall increase of entropy, and (c) the direction of irreversible processes. However, while these three arrows do mostly point in the *later* direction of time, none of them can define it, because:

> (a) time would not stop if the universe stopped expanding;
> (b) entropy can, and sometimes does, decrease locally, which it could not do if that change reversed the local direction of time; and
> (c) as any irreversible process linking (say) *P*-states and *Q*-states, offers two directions, *P* to *Q* and *Q* to *P*, only by definition can it tell us that *P* (say) is the earlier, a definition that can then not tell us which member of any other pair of states, *R* and *S*, *T* and *U*, etc., linked by a different irreversible process, is the earlier.

For these and other reasons given in my 2009 'The Direction of Time', I follow Hans Reichenbach (1956) and others in taking the asymmetry of cause and effect mentioned in §2 to be what gives time its direction, a direction which time's other arrows are then correlated with by laws of nature or by the universe's boundary or initial conditions.

Justifying this view requires our theories of time and causation to explain between them why their directions generally, if not always, coincide. This is not a trivial task, for even when David Hume, in his 1748 *An Enquiry Concerning Human Understanding,* defines

> a cause as an object, *followed* by another, and where all the objects similar to the first are followed by objects similar to the second (sect. VII, part II, §60; my italics),

he immediately adds that

> in other words, if the first object had not been, the second never had existed,

two definitions that are not obviously even approximately co-extensive.

One theory that does partly reconcile Hume's two definitions is that of J. L. Mackie's 'The Direction of Causation' (chapter 7 of his 1974 *The Cement of the Universe*). This was the first serious successor, after fifty years, to Broad's 1923 growing block theory. In it, Mackie says that

> an effect cannot be fixed [i.e. unalterable] at a time when its cause is not fixed (p. 181),

and that all events (a) become permanently fixed by becoming present, and then (b) transmit their 'fixity' to all the future events of which they are sufficient causes. This, while making most causes precede their effects, by stopping future events causing present or past ones, also permits some exceptions by letting future events fixed by present ones cause *less* future ones. Thus, Mackie says,

> We seem to have found then, in this notion of fixity, a basis for the concept of causal priority which does not reduce it merely to temporal priority, which leaves a small gap into which backward causation (but not the bringing about of the past) might conceivably be fitted … while still allowing us to explain … why temporal and causal priority tend so strongly to go together (p. 183).

However, the fact that Mackie's theory makes present events cause future ones makes it hard to reconcile with any growing block theory on which

> the essence of a present event is, not that it precedes future events, but that there is quite literally nothing to which it has the relation of precedence (Broad 1923 p. 66).

These theories cannot, for example, be reconciled by letting the present 'fixity' of future effects entail only that they *will* exist when they become present, but not that they exist now, while they are still future. For even if present fixity fails to entail the present reality of future effects, causation, like other relations, still needs real relata, a need which can then only be met if *all* presently possible future events are real. But this, unless all possible futures but one are eliminated by

(a) all events having sufficient causes, and

(b) all causation being metaphysically necessary,

will make many presently possible but mutually incompatible futures equally real. And that, with only one presently possible past, the actual one, will entail not a *growing* block but the *shrinking* one that Dainton calls the 'thinning tree' of Storrs McCall's 1994 *A Model of the Universe*:

> Whereas the growing block model posits an *increase* in the sum total of reality, in McCall's model there is a progressive *decrease*: with every advance of the present untold billions of perfectly real [because previously possible] stars, planets and people wink out of existence (Dainton p. 74; his italics).

While if all events (after the first, if there is one) *do* have sufficient causes, and causation *is* metaphysically necessary, 'McCall's universe-tree is so slender (and branch-free) that it is indistinguishable from a static block universe' (Dainton, ch. 6, note 3, p. 337).

This may suggest that growing block theorists can only accept an otherwise congenial theory of causation by accepting that all presently possible futures are real, if not yet actual, and therefore that what grows is not 'the sum total of existence' but merely the sum total of *actuality*. Fortunately for the growing block's appeal, that is not so, as we shall now see.

5 Tooley's Causal Growing Block

One growing block theory based on causation that can deny the present existence of all future entities is that of Michael Tooley's 1997 *Time, Tense, and Causation*. There are other post-Broad growing block theories too, of course, such as that of Richard Jeffrey's 1979 'Coming True', but none that I know of is as detailed, comprehensive and well-argued as Tooley's. For me, his theory sets the benchmark, which is why I shall devote most of what follows to it. In this section and the next I shall make the best case for it that I can, before concluding in §7 by listing the three main challenges that I think this theory and its successors still face.

Tooley's theory of causation requires causes to give their effects probabilities of the objective and empirical kind that, for brevity, I and others call 'chances', a condition which, because it lets the chances of effects be less than 1, can be met by indeterministic causation. His theory does however require causes to *raise* the chances of their effects: a requirement which explains, for example, why smoking can cause cancer and not smoking generally can't, and which, although disputed by Wesley Salmon (1980) and others, has strong independent support (Mellor 1988).

Tooley takes his chance-raising requirement to be met, where it is, by causal laws, like those that give most healthy, well-fed and otherwise unthreatened people a greater chance of dying young if they are smokers, or shot, or stabbed, than if they are not. Tooley also asserts, I think rightly, that while causes raise the chances of their effects, effects do not raise the chances of their causes: a man's dying of lung cancer may raise the *epistemic* probability, or someone's *credence*, that he smoked, but not his *chance* of having done so. (I defend this three-fold division of applications of mathematical probability in chapter 1 of my 2005 *Probability*: *A Philosophical Introduction*.) It is this asymmetry, between causes raising the chances of their effects, and effects not raising the chances of their causes, which, for Tooley, gives causation its direction.

Another crucial if less obvious feature of Tooley's theory is that it does not require causes and effects to be the events that Donald Davidson (1967) and other philosophers of causation say they are. By this I mean that they need not be the spatiotemporal particulars which Davidson, in his 1970 'Events as Particulars', calls 'events' and which from now are what I too shall mean by 'events'. (I emphasise this to forestall misreadings of what follows, since some philosophers of causation who also call causes and effects 'events' mean something different, as Jaegwon Kim does in his 1971 'Causation and Events', where he defines an event as 'the exemplifying of an empirical property by an object at a time' (p. 71).)

One reason Tooley's causes and effects need not be Davidsonian events is that his paradigm causal laws, of the form 'events of type *P* causally give rise to … events of type *Q*' (p. 79), can equally well be taken to link existential facts, i.e. to say that *there is* a *Q*-type event at a B time t_Q because *there is* a *P*-type event at a B time t_P. Suppose for example that Julius Caesar dies at some time t_D during the Ides of March of 44 BC because he is badly stabbed at another time t_S on that day. Tooley need not take the cause of Caesar's dying at t_D to be a specific event *s*, such as Brutus's stabbing of him in the heart: he can take it to be the existential fact S that Caesar is badly stabbed at t_S, i.e. that there is some such stabbing of him then. Equally, the effect of that cause need not be the specific event *d* that is in fact Caesar's death: it can just be the existential fact that Caesar dies at t_D, i.e. that *a* death-of-Caesar event occurs then, an event which could, for example, take more or less time, or be more or less painful, than *d*.

This distinction, between the facts S and D, and the events *s* and *d*, is important because

> 'That Caesar died' is really an existential proposition, asserting the existence of an event of a certain sort … The event which is of that sort is called the death of Caesar, and should no

> more be confused with the fact that Caesar died than the King of Italy should be confused with the fact that Italy has a King (Ramsey 1927 p. 37).

The present relevance of Ramsey's distinction is this. For Caesar to die because he was stabbed, i.e. for a causal 'D because S' to be true, the event *s* that makes 'S' true need not cause the event *d* that makes 'D' true: 'S' and 'D because S' could be made true by a quite different stabbing event *s′*, e.g. a stabbing of Caesar not by Brutus but by Casca, and not in the heart but in the neck.

Moreover, Tooley's causal laws, linking existential facts about instances of properties *P* and *Q*, need not only link *event*-types: *P* and *Q* can also be properties of enduring things. Suppose for example that *P* is the property of bones that makes them insoluble in water and *Q* is solidity. Then there is some law that makes remaining *P* cause any bone *b* to remain *Q,* i.e. to *not* dissolve, while immersed in water. This is a law that makes the *non*-occurrence of an event of one type (*b* ceasing to be *P*) cause the *non*-occurrence of an event of another type (*b* ceasing to be *Q*). This causation cannot be a relation between events, since what makes '*b* is *Q* at *t* because *b* is *P* until then' true is that *no* events of the relevant types occur then. Similarly with Caesar: had he worn a dagger-proof toga on that fatal Ides of March, he might have stayed alive, i.e. *not* have died, because, despite his would-be assassins' best efforts, he was *not* badly stabbed.

Of course not all causal laws either make events (i.e. positive existential facts about them) cause other events, or make non-events (i.e. negative existential facts about them) cause other non-events. Some laws make events cause non-events, as when a falling object's hitting the ground causes it to remain stationary; or *vice versa*, as when a radium atom that decays is caused to do so by its having been radioactive until it decays. Causal laws cover all four cases equally, as indeed they must if they are to be impervious to redescriptions that make non-events look like events, as when an unchanging velocity is redescribed as a change of position; or *vice versa*.

This is why Tooley can and should deny, as we shall see in §6 he has another reason to do, that causation must be a relation between Davidsonian events. In other words, causes and effects that are positive or negative existential facts about events need not be linked by a relation represented by truths of the form '*c* causes *e*' where *c* and *e* are events. Indeed, as I argue in chapter 13 of my 1995 *The Facts of Causation*, causation need never be a relation between entities of any kind, and can therefore always be represented by truths of the form 'E because C', such as 'Caesar died because he was stabbed'. And if causation is not a relation, then it need not entail the present existence of the future effects of present causes: all that the entailment of 'E' by 'E because C' need imply for a growing block theory is that 'E because C' will only become true when 'E' does. So provided

Tooley's theory never makes any presently true conjunction containing 'C' entail 'E', it can, as it should, let the present precede *nothing*. And his theory can certainly do that, even when causal laws make the truth of 'C' raise the present chance, *ch*(E), that 'E' will be true to 1. For on some tenable and widely-held theories of chance, notably the limiting frequency theories of Richard von Mises (1957) and others, even '*ch*(E)=1' does not entail 'E'.

So far so good for Tooley's growing block theory, though not of course far enough. For, as noted at the start of §4, his theory must do more than give causation *a* temporal direction: it must make that direction the direction of time. Specifically, it must make causes *earlier* (rather than *later*) than their effects, as Tooley's saying that 'causal laws … determine what states of affairs will be *added* to what is already actual' implies. This is what Tooley sets out to do in the detailed causal account of time he gives in his chapter 6, 'Causation and Temporal Relations', an account which has other implications for the scope and prospects of his growing block theory that we now need to assess.

6 Time, Space and Space-time

In the 1717 Leibniz-Clarke debate between relational and substantival theories of time and space, we might expect theorists who derive time's direction from that of causation to back Leibniz against Samuel Clarke's Newton. For on Leibniz' relational theory, their causally-defined temporal relations will be all there is to time.

Tooley, however, argues for 'embedding a causal theory of time in a substantival theory of space-time' (p. 262). He starts by invoking the 'causal dependence of later temporal parts of an enduring entity upon earlier temporal parts' (p. 260) to argue that

> if one accepts a substantival view of space and time, space itself is an enduring entity, and thus the idea that later temporal parts of space are causally dependent upon earlier ones is no more strange than that later temporal parts of an electron are causally dependent upon earlier ones (p. 261).

Tooley sees of course that, to apply to space as well as what it contains, his causal theory needs to yield 'an account of temporal relations that will apply not merely to events, but to spatiotemporal regions as well' (p. 261), a need that is also entailed by his second argument for realism about space-time, the empirical possibility

> that there are locations where there *could*, at a given time, be a physical object even though, as a matter of fact, this is not the case (p. 262; his italics).

For as this possibility is clearly not obviated by space-time's being *actually* filled by electro-magnetic or other fields, it too requires Tooley's causal account of temporal relations to apply to possibly empty regions of space-time.

Fortunately, as we saw in §5, Tooley has an account which can do this, and which he needs anyway to apply to 'the causal dependence of the later parts of an enduring entity upon earlier temporal parts'. For this causation can also not relate Davidsonian events, as §5's bone *b* failing to dissolve in water shows, since remaining insoluble and (therefore) solid are not events in Davidson's sense. And if Tooley's causal laws can make non-events cause non-events, as in this case they must, and as we saw in §5 that they can, they can certainly make the emptiness of one region of a real space-time cause – and therefore precede – the emptiness of another region, even if the ubiquity of fields in our space-time makes this something they never actually need to do.

Tooley's real space growing with whatever it contains gives his theory other advantages too. One is that, unlike a theory of events filling up already real but presently empty future regions of spacetime, it really can let the present precede nothing, not even future times or regions of space-time. Another is that a real space can grow continuously, moment by moment, without needing a constant stream of instantaneous events (or temporal stages of enduring things) to enable it to do so.

But for me, as for others, the greatest appeal of a real space-time is the sense, whether causal or geometric (Nerlich 2013 ch. 11), that it promises to make of Einstein's General Theory of Relativity (Einstein 1923), a theory which says, roughly, that

> the curvature of space-time is determined by the matter present, and it, in turn, determines how bodies will move (Tooley p. 259).

This however is no help to Tooley because, in a space-time devoid of matter, Einstein's General Theory (GTR) reduces to his Special Theory (STR), a theory which notoriously fails to support an assumption that Broad and Tooley both need: namely, that whether two spacetime points, however far apart they are in space, are simultaneous is a purely factual matter, i.e. that there is only one right way of dividing space-time separations into temporal and spatial distances. For unless that is so, there can be no universe-wide times t and t' such that, to requote Broad,

> a moment t is later than a moment t' if the sum total of existence at t includes the sum total of existence at t' together with something more.

7 Challenges for the Growing Block

(1) *Physics.* This then is the first of the three challenges that I said in §1 I think growing block theories still face: how to reconcile them to modern physics in general, and to STR in particular. Tooley tackles that particular challenge in his chapter 11, 'The Special Theory of Relativity and the Unreality of the Future', by constructing

> a theory which is closely related to the Special Theory of Relativity, and which does entail that events stand in relations of absolute simultaneity (p. 139).

He then offers three reasons to prefer his theory, the first being that

> if an absolute, or realist view of space-time is adopted, then there are states of affairs for which the Special Theory of Relativity specifies no causes, but the modified theory does. The predictive and explanatory power of the modified theory is, accordingly, greater than that of the Special Theory of Relativity (p. 140).

The details of Tooley's second and third reasons for preferring his theory, and of how he constructs it, are too technical to be briefly stated and discussed here. The best critical examination of them that I know of is in §5 of John Earman's 2008 'Reassessing the Prospects for a Growing Block Model of the Universe'. An adequate response, if there is one, to Earman's conclusion, that

> a surprisingly large number of problems crop up when one tries to construct [growing] block models, even in the friendliest environment of Newtonian spacetime with absolute simultaneity; and the problems get progressively worse as one progresses from Newtonian to special relativistic to general relativistic spacetimes (p. 31),

must be left to others. All I will say here is that one response, that of Howard Stein's 1968 'On Einstein-Minkowski Space-Time', will certainly not do. It will not do to say, as Stein does, that

> For an event – a man considering, for example – at a space-time point *a*, those events, and only those, *have already become* (real or determinate), which occur at points in the topological closure of the past of *a* (p. 14, his italics),

i.e. in *a's* 'past light cone' of events able to affect *a* given STR's finite maximum speed of causal influence, that of light. For that speed's invariance – its sameness in every STR reference frame – will make the past light cones of any two points *a* and *b*, spatially separated because neither is in the other's past light cone, contain many other points that are also not in the other's cone. And this means for Stein that some events which have become real at *a* have not become real at *b*, and *vice*

versa. But if what is real at *a* differs from what is real at a spatial distance from *a*, then at no space-wide B time, in any frame of reference, will there be the unique 'sum total of existence', varying only with time, that any growing block theory worth the name must posit. There can be no space-wide growing block if what is real at a space-time point depends on *where* as well as on *when* it is.

(2) *Presentness*. My second challenge to growing block theories is that presented in Craig Bourne's 2002 'When Am I?' and David Braddon-Mitchell's 2004 'How Do We Know It Is Now Now?'. The problem here is how to reconcile our conviction that, as Bourne puts it,

> Given that we do know we are present, and that it is absurd to doubt it, any adequate theory of time must find a way to guarantee such knowledge (p. 359),

with the growing block definition of the present as being such that, in Broad's words (quoted in §3),

> there is quite literally nothing to which it has the relation of precedence,

which seems to guarantee no such thing.

The trouble is that the obvious explanation of our indubitable presentness is that 'present' is an indexical term which makes 'I am present' true *when* (and only when) it is thought (or said), just as 'I am here' is true *where* (and only where) it is thought or said. And if what always makes *me* present when I think I am is that 'I am present' is true when and only when I think it, then what makes a B time *t* present when it is, namely at *t*, is that '*t* is the present time' is true at, and only at, *t*. But if being at *t* is what makes a token of '*t* is present' true, that token will be true whether or not *t* precedes nothing, which is what growing block theories say makes a time present.

One response to this problem, in Peter Forrest's 2004 'The Real But Dead Past: a Reply to Braddon-Mitchell', is that it is a spurious one generated by conflating two independent meanings of 'now' (and hence of 'present'): the indexical one and the growing block one. Whether that appeal to an ambiguity in 'now' solves or dissolves the problem is a moot point (see for example Trenton Merrick's 2006 'Good-Bye Growing Block') which I must leave for others to debate.

(3) *McTaggart*. My third and final objection to growing block theories is that, despite their apparent independence of McTaggart's A series (see §3), his disproof of its reality disproves them too. I applied my argument for this to Mackie's 1974 'fixity' theory, discussed in §4, and to Jeffrey's 1979 'coming true' theory, mentioned in §5, in my 1981 'McTaggart, Fixity and Coming True'. When Tooley's theory appeared in 1997, I applied it to that too, in chapter 7.5 of my 1998 *Real Time II*, and it is a variant of this version of the argument that I shall now conclude by presenting.

To say that an event *d*, e.g. Caesar's death, exists at a B time *t*, e.g. 4 pm on 15 March 44 BC, may mean either that *t* is *d*'s temporal location or that the B (i.e. tenseless) proposition '*d* exists' is true at and only at *t*. Growing block theorists must of course mean the former, since they think '*d* exists' is true not only at *t* but at all later (but no earlier) B times, i.e. that its truth value changes at *t* from FALSE to TRUE. Now suppose that, before *t*, someone says or thinks that *d* exists, meaning not that an A proposition like '*d* exists *now*' is true then but that the B proposition '*d* exists' is. On a growing block theory, this token of '*d* exists' – call it '*k*' – must be false, because it is located at a B time earlier than *t*, when *d* does not yet exist. After *t*, of course, when *d* does exist, any new token *k** of '*d* exists' will be true.

But what then, on a growing block theory, is *k*'s truth value after *t*? *k* need not be true then just because *k** is, any more than a sign in Cambridge saying 'Ely', meaning 'Ely is here', must be true just because an 'Ely' sign in Ely is true. But for *k* to be false when *k** is true, the truth conditions of '*d* exists' must be as temporally indexical as those of 'Ely is here' are spatially indexical. Specifically, tokens of '*d* exists' at any B time will only have the right truth values – FALSE if that time is earlier than *t* and TRUE if it is or is later than *t* – if '*d* exists' has the same truth conditions as '*d* is past or present'. But then '*d* exists' will *be* that A proposition, and growing block theories will not be tenseless after all. Worse still, the truth conditions of '*d* exists' will then be the very ones that eternalists say the A proposition '*d* is past or present' has. And if they are, then what makes *k* false (because it is earlier than *t*) and *k** true (because it is later than *t*) will be that '*t* is *d*'s temporal location' is true at and after *t*. Whether '*t* is *d*'s temporal location' *becomes* true then, because that is when '*d* exists' and '*t* exists' become true, or whether all three propositions are always true, as eternalists hold, is irrelevant.

It follows from this that growing block theories can differ from eternalist ones, but still be tenseless, only if, at and after *t*, *all* tokens of '*d* exists' are true, including those like *k* that are earlier than *t*. But that, I say, is to credit *k* with being both false and true, attributes of tokens that for me are as incompatible as we saw in §3 that McTaggart says pastness, presentness and futurity are of all events, including tokens like *k*. To this the stock reply is of course that *k*'s truth isn't a *non*-relational attribute of *k* but a relation *k* has to B times later than *d* but not to those before it; just as the stock reply to McTaggart is that *k*'s pastness is a relation it has to B times later than *k* but not to those before it. That, I take it, is the import of Tooley's reply to my objection to Jeffrey:

> If one is willing – as Jeffrey is – to hold that 'the world grows by accretion of facts' [Jeffrey p. 253], then it is not only possible, but very natural, to explain the truth conditions of '[*d*]

> happened at time *t*' in terms of a *relational* property that an event lacks at the time of its occurrence but then immediately acquires – the property, namely, of there being something later than it (p. 334; his italics).

That won't help here, however, since on Tooley's theory the truth values of tokens of '*d* exists' are never relative to times. Before *t*, when *d* comes to exist, *k* is false at all the times that exist when *k* does (i.e. at and after *k*), since these don't yet include *t*; just as, after *t*, *k* is true at all the times that will then exist, including *t* and all times earlier than *t*. So on Tooley's theory *k*'s truth value isn't a relational property: it'*s* a non-relational property that changes at *t* from one value, FALSE, to the other value, TRUE.

But it can't. The idea that *k*'s truth value, instead of being fixed by the B time it is at, varies with B times it is *not* at, is absurd, as Frank Ramsey's example of A saying 'I went to Grantchester this afternoon' and B replying 'No I didn't' (1925 p. 247) demonstrates. The idea comes from confusing the variable truth value of '*d* exists' with those of its tokens. But as Ramsey's example shows, the fact that the truth values of propositions can vary from person to person, place to place or time to time can't make their tokens' truth values do so too. Those are fixed for everyone, everywhere, and always, by whose tokens they are, or by where or when they're located in space and time.

A closely related objection, put to me by Graham Nerlich, starts by noting that Tooley needs two sets of times: those within his spacetime block, and those in which the block grows. These two sets of times are exactly analogous to those in McTaggart's B and A series: positions in his B series, ordered by their unchanging later-than relations to each other; and those in his A series, ordered by their ever-changing later-than or earlier-than relations to the present.

Now if McTaggart's and Tooley's two sets of times formed two time dimensions they could indeed make their theories internally consistent: McTaggart's would let Caesar's death be future at some times in his A-series dimension and past at others, just as Tooley's would let Caesar's death exist at some times in the dimension in which his block grows and not at others. Yet neither theory postulates two time dimensions: Tooley's spacetime block would no more *grow* in another dimension than landowners can increase their acreage by building upwards or drilling downwards; and similarly for McTaggart's A series. Their two sets of times can only be two ways of ordering the same events and times in a single dimension: in Tooley's case, that in which *d* and its time are *added* to what existed earlier; in McTaggart's, that in which they were future and are now past.

Hence the two theories' inconsistency: a single time dimension can't make *d* exist (or be past), and *k* be true, at some times and not others. The pity is that while McTaggart saw this and inferred

(rightly) that his A series is unreal and hence (wrongly) that time itself is unreal, Tooley and his successors still think, as Broad did, that their spacetime blocks can both contain all times and events and add to them. They can't.

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