

# Dynamic time

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## C D Broad (1887-1971): growing block universe



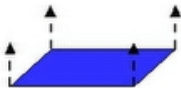
- *Scientific thought* (1923)
- dynamic alternative to the natural view: growing block universe
- like meat slicer more and more “slices” of reality are accumulated
- primitive, fundamental absolute becoming
- contemporary defender of similar view: Michael Tooley

“The past is thus as real as the present. [...T]he 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. 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.” (1923, 88f)

## 3 METAPHYSICS OF TIME

### Presentism

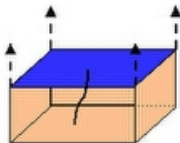
"Nowism"



The Present

### Possibilism

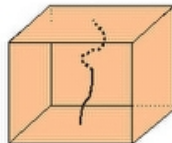
"The Tree Model"



Past & Present

### Eternalism

"The Block Universe"



Past, Present, & Future

## Incremental or continuous becoming?

Two options:

- 1 slices are instantaneous, becoming continuous
- 2 slices have finite, but minimal duration, becoming is incremental

But there's another issue...

## How *fast* does the universe grow?

One second per second?!?

- But, this would only be meaningful if there would be some sort of time *independent* of becoming, a kind of background time wrt which becoming occurs at a certain rate:
- One  $\text{second}_1$  per  $\text{second}_2$ , where  $\text{second}_1$  and  $\text{second}_2$  are units of different times:  $\text{second}_2$  is a measure of the pre-existing background time, while we express in  $\text{seconds}_1$  how much has become during a unit of this background time.
- Important: without the existence of such a background time, the question asked above is not meaningful.

## No pre-existing substantival time

- Growing block universe cannot grow by filling pre-existing times with events on pain of an overdetermination problem
  - Overdetermination problem: if there exist such pre-existing times, they will possess incompatible attributes of being empty (they're not yet filled), and not being empty (once they're filled)
- ⇒ moments of time come into being together with the events and objects they contain, i.e. there are no future moments

## Remnants of the overdetermination problem

- Dainton claims that there still are inconsistencies:
  - 1 The sum total of existence to which an event  $e$  at  $t_1$  belongs consists of  $S_1$ .
  - 2 The sum total of existence to which an event  $e$  at  $t_1$  belongs consists of  $S_2$ .
- where  $S_i$  is the sum total of existence at  $t_i$  and  $t_2$  is later than  $t_1$ .

Resolution (Tooley 1997):

- Proposition: accept notion of *being actual as of a particular time* as ontological primitive and *truth as of a time* as a semantic primitive.
- Consequences:
  - 1 same proposition can have different truth-values at different times
  - 2 three truth-values: true, false, and indeterminate

## Storrs McCall's thinning tree

- captures intuition that past is fixed, present is real and transitory and future is as yet undetermined and open
- basis idea: attrition of modal branches

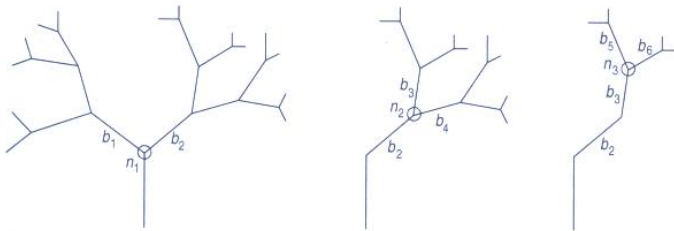


Figure 6.3 The thinning tree.

- How many branches to the tree? depends: number of logical possibilities > number of physical possibilities; if universe nomologically deterministic: one branch only
- How fast does attrition proceed?

## How can a block grow?

**Question:** what guarantees that the block grows rather than shrinks? Consider the following inequivalent situations in a universe with three time slices  $S_1$ ,  $S_2$ ,  $S_3$  at three times  $t_1$ ,  $t_2$ ,  $t_3$ :

- 1 Starting at  $t_1$  with  $S_1$ , the process of **absolute becoming** successively produces  $S_2$  at  $t_2$  and  $S_3$  at  $t_3$ .
- 2 Starting as of  $t_3$  with  $S_1$ ,  $S_2$ ,  $S_3$ , the process of **absolute annihilation** successively extinguishes  $S_3$  at  $t_3$  and  $S_2$  at  $t_2$ , leaving at  $t_1$  a sum total of existence consisting of  $S_1$ .

Both scenarios are sequential, which sequence is temporal?

**Problem:** with independent justification to choose one direction of time over the other, both scenarios accurately describe this universe!

## Broad's answer

- Stipulate that times of larger blocks are later than times of smaller blocks!
  - But how can such a stipulation be justified?
  - perhaps via content-asymmetries: if direction indicated by these asymmetries (fork, causation, entropy etc) coincides with stipulation, we're done
  - candidate: **traces** of the past but not the future and Broad's account explains this: times we call "future" are not real as of the times we call "present, whereas the times we call "past" are
  - **Problem**: this is inconclusive, as is evidenced by consideration involving symmetrical Gold universes
- ⇒ still no guarantee that content-asymmetries and stipulated direction of time coincide

## Tooley's answer in argument form quoted from Dainton, 77

- 1 Events in our world are causally related.
- 2 The causal relation is inherently asymmetrical. Effects depend on their causes in a way that causes do not depend on their effects.
- 3 This asymmetry is only possible if a cause's effects are not real as of the time of their cause.
- 4 Causes occur before their effects: 'X is earlier than Y' means (roughly) that some event simultaneous with X causes some event simultaneous with Y.
- 5 Our universe must, therefore, be a growing block.

### Problems:

- If causal arrow is not "invisible", but grounded in physical processes, and these processes are time-reversible, then we encounter the problem with Gold universes again.
- But if it's invisible (noumenal), then how can we know that the causal arrow and the stipulated direction of time coincide?

# Presentism

## Position (Presentism)

*Presentism maintains that only present events and objects exist. Furthermore, it is usually assumed that there is a succession of presents, i.e. a moving Now.*

Presentists must face two challenges:

- 1 How long is the present? It is instantaneous or finite but brief?
- 2 The “problem of the past”: by virtue of what are propositions on past events true?

## The problem of the past

### Principle (Truthmaking principle)

*“[A]ny contingent statements about the world that are true are true by virtue of something in the world that makes them true—their truthmaker.” (Dainton, 80)*

- ⇒ If the past doesn't exist, there are no past facts that could act as truthmakers.
- How can a presentist react?
  - One option: deny the truthmaking principle
  - Another: bite the bullet: there are no true statements about what happened in the past
  - More promising: there are truthmakers of statements about the past, but they all exist in the present.

## Reductionism about the past

Two unpalatable consequences:

- 1 Since different presents contain different traces of the past, the past becomes unstable if it's defined by virtue of these traces.
  - Note: this is not a problem for someone who thinks that there is only one (static) present.
- 2 Truths about the past are restricted by what exists now, i.e. sentences about past events whose traces have all been erased can no longer have any truth-value.
  - Note: a related problem emerges in an indeterministic world, where many inferences from present facts to past states of the universe are no longer licenced.

## Solipsistic presentism

**Hypothesis of the very recent genesis:** what if the world popped into existence five minutes ago, complete with highly complex structures, dinosaur fossils, light rays from distant galaxies sufficient close to reach us now and other seeming traces of a pretended past (cf. Young Earth creationism)

### Position (Solipsistic presentism)

*There has only ever existed one present: this one.*

- immune to decisive refutation—but hard to take seriously
- it seems as if there was a past for the above reasons
- *pace* Dainton, such a present exists eternally, it didn't have “to pop into existence” as suggested above

# Many-worlds presentism

## Position (Many-worlds presentism)

*The sum total of existence consists of a timeless ensemble of momentary worlds, i.e. of many presents. These static presents are not temporally related.*

- “Pluralist” presentists need not be reductionists about the past: since others presents exist, there are potential truthmakers about other times.
- Analogy: block universe is carved up into momentary slices, and then shuffled like a deck of cards; each combination corresponds to possible history of the world
- If additional conditions of continuity are imposed, most of these possibilities will not correspond to physically possible history—perhaps there will only be a unique ordering of slices (but perhaps more than that)

- “best match” method
- reductionism can be avoided: a statement about the past (or future) is true *iff* the following conditions are met (Dainton, 83):
  - ① sum total of existence contains at least one slice that the statement accurately describes;
  - ② time at which the events described in the statement “are said to occur corresponds to the location of the slice(s) in the ordering generated by the ‘best match’ method.”

## Julian Barbour: *The end of time*

- Surprisingly, developments in fundamental physics may offer support for many-worlds presentism.
- Barbour: time doesn't exist at the fundamental level of reality
- quantum gravity: attempt to marry quantum physics with relativity
- Wheeler-DeWitt eq: dynamical equation that arguably shows that the universe doesn't evolve, but remains in stationary state
- Parmenides' revenge: change is illusory—it doesn't exist in an important candidate for the most fundamental description of physical reality!
- We experience an illusion of change bc  $\exists$  momentary fragments in timeless ensemble of three-dim "worlds" that contain apparent traces of change and of earlier and later events.

# Dynamic presentism

## Position (Dynamic presentism)

*Dynamic presentism maintains that only the present exists, that at any time only one present exists, that each present is followed by another, and that successive presents are causally related.*

Although initially appealing, dynamic presentism has a severe problem (John Bigelow: “[argument from relations](#)”):

- 1 “If dynamic presentism is true, then events in earlier presents are causally related to events in later presents.
- 2 “Dynamic presentists also claim that only one present is real.
- 3 “Causation is [an] existence-entailing [two-place relation].
- 4 “It follows that if one present is causally related to another, both must be real.
- 5 “Hence 2 is false, and so is dynamic presentism.” (Dainton, 86)

## The continuum problem

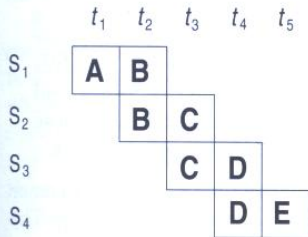
Both many-worlds and dynamic presentism suffer from a continuum problem:

- If time is a continuum, like the real numbers, it doesn't make sense to talk of "the next moment": there are uncountably many moments bw any two moments.
- Only if time is discrete, i.e.  $\exists$  a bijective mapping from moments to natural numbers  $\mathbb{N}$ , we can speak of the one moment following another.
- If time is continuous, there are always uncountably many more "cards" that go bw any two in the deck of many-worlds presentists...
- Also, in this case, dynamic presentists are not allowed to speak of one present being followed by another, and that two presents are "successive".

## Compound presentism

### Position (Compound presentism)

*Compound presentism is a dynamic presentist position that allows more than one present to coexist s.t. the sum total of existence consists of at least two coexisting slices. The present is “extended”.*



**Figure 6.5 Compound presentism.** A doubly dynamic reality: the sum total of reality is not limited to a single present, and absolute becoming is matched by absolute annihilation.

## Intransitive coexistence

- the set of events occurring at  $t \neq$  the set of events that are real as of  $t$
- Immune from the “argument from relations”
- but coexistence can no longer be transitive (on pain of collapsing to the static block universe): if  $e$  coexists with  $f$ , and  $f$  coexists with  $g$ , then in general  $e$  will not coexist with  $g$
- Reply: while spatial coexistence is transitive, temporal coexistence cannot be transitive in a dynamic account
- in fact, failure of transitivity of coexistence is inevitable if passage of time involves becoming and annihilation
- real vs. unreal pasts: real past are those events which can still be reached by transitivity, unreal past are those events which don't coexist with reference event, but are linked by sequence of pairwise coexisting events (“indirect coexistence”)

## The factual inheritance principle

- How can statements about the unreal past be true? Can reductionism be avoided?
- It can by the transitivity of “facticity” assumed by the **factual inheritance principle**:

### Principle (Factual inheritance principle)

*“What is true (or factual) as of a time  $t$  is also true (or factual) as of all other times that coexist with  $t$ .” (Dainton, 90)*

- argument, if successful, establishes that there can be facts about past (and future) events that exist no longer (or not yet)

## Two final considerations

- 1 Direction of time:
  - Again, it turns out that it is impossible to justify an assumption to the effect that time runs in one direction rather than the other.
  - Dainton concludes, correctly in my view, that “any apparent direction within time must be a product of the asymmetries that exist among the contents of time.” (91)
  - I am more optimistic than Dainton that this is perfectly possible in compound presentism!

## 2 Continuity again:

- Rather than a compound of two or more slices, like Dainton, we will be forced to think of the extended present as a thin slice of finite temporal extension which enjoys continuous temporal passage (rather than jumping to the next present).
- There's an emerging consensus among philosophers that pointlike time-slices face serious difficulties in modern physics and that an extended present may be more adequate.
- An extended present like this also seems to conform with how humans process experiences.