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Notes #10: Paradoxes of Infinity

Important philosophical points about infinity:

- Infinity exists in nature:
  - Space, time are infinite *in extent* and infinitely *divisible*.
  - The infinite series of numbers (if numbers exist).
- Old (Aristotelian) views of infinity:
  - 'Infinity' is not a number/determinate quantity. 'Infinite' just means 'without limit.'
  - There are only *potential* infinities, not *actual* infinities.

Galileo on infinity:

- Lines & points:
  - A line is made up of points. Points are indivisible bits of space. Lines are divisible.
  - But: A divisible quantity cannot be made up of indivisible ones. For
    - If 2 points together made up a divisible quantity (a line?), then 3 points, 5 points, etc. would also be divisible.
    - In that case, we could divide the line in two. But then a point would be divided in two (since there are an odd number), which is impossible.
    - Answer: a 'divisible' quantity [I think he means a line, which is *infinitely* divisible] requires an *infinite* number of indivisibles to make it up.

- Can one infinity be greater than another?
  - Yes, for a line can be longer than another line.
  - No, for consider:

    Let S = the number of perfect squares (1, 4, 9, 16, ...)
    N = the number of natural numbers (1, 2, 3, 4, ...)

    $S > N$, $S = N$, or $S < N$?
    - $S < N$, for: N includes S, plus many other numbers. As *n* increases, the proportion of the first *n* natural numbers that are perfect squares decreases, approaching 0. Thus, there are *infinitely* many more N's than S's.
    - But $S \geq N$, for: every natural number has a (distinct) square; hence, there are at least as many squares as there are natural numbers.
    - Galileo's conclusion: infinities are incommensurable (cannot be compared in terms of greater, lesser, equal). Further implication: 'infinity' is not a determinate quantity; there are no such numbers as S and N.
    - Answer to above argument: Neither line contains 'more', 'less', nor 'equally many' points, since both contain infinitely many.
    - Important lesson: We cannot understand infinity by applying to it the same properties as apply to finite numbers.

- How many finite parts does a line segment (of finite length) contain?
  - Infinitely many? No, for then it would be infinitely long.
  - Finitely many? No, for then there would be a limit to how many times you could divide the line.
  - Answer: neither; rather, the parts "correspond to every assigned number." [I.e., for every number

n, the line segment contains exactly *n* parts of some length *x*.]

Zeno's Paradox

• You drop a ball. The ball cannot reach the ground, for:

1. In order to reach the ground, it must complete the series, (1/2, 3/4, 7/8, ...)
2. The series, (1/2, 3/4, 7/8, ...), is a series with no end. (It is infinite.)
3. A series with no end cannot be completed.
4. The series, (1/2, 3/4, 7/8, ...), cannot be completed. (from 2,3)
5. The ball cannot reach the ground. (from 1,4)

A math paradox:

• What is the sum of the following sequence of numbers:
1, -1, 2, -2, 3, -3, ...?

• It is 0, for:

1 + -1 + 2 + -2 + 3 + -3 + ...
= (1 + -1) + (2 + -2) + (3 + -3) + ...
= 0 + 0 + 0 + ...
= 0.

• It is +∞, for:

1 + -1 + 2 + -2 + 3 + -3 + 4 + ...
= 1 + (-1 + 2) + (-2 + 3) + (-3 + 4) + ...
= 1 + 1 + 1 + 1 + ...
= +∞

• It is -∞, for:

1 + -1 + 2 + -2 + 3 + -3 + ...
= -1 + 1 + -2 + 2 + -3 + 3 + -4 + ...
= -1 + (1 + -2) + (2 + -3) + (3 + -4) + ...
= -1 + -1 + -1 + -1 + ...
= -∞

• Conclusion: There is no such sum. (Or: commutativity and associativity do not apply to 'infinitely long' sums.)

The Thomson's lamp paradox:

• Thomson's lamp starts out on. After ½ second, it switches off. After another 1/4 second, it switches back on. Etc. For every *n*, after $(1/2)^n$ seconds, the lamp switches again. No other changes occur.

• At the end of 1 second, is the lamp on or off?

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Notes #11: Modern conception of infinity

Modern conception of numbers:

- This is based on Frege's conception, but with 'concepts' replaced with sets.
- Understand the notion of a one-one function.
- Important technical notions: These are all 2-place relations between sets (see text):
  - 'has the same cardinality as'
  - 'has a higher cardinality than'
  - 'has a lower cardinality than'
- The noun usage of numerals:
  0 = The set of all sets with the same cardinality as {}
  1 = The set of all sets with the same cardinality as {0}
  2 = The set of all sets with the same cardinality as {0,1}
  etc.
- The adjectival use of number terms: There are *n* F's = the set of F's is an element of *n*.
- Every set has a number that 'belongs to' it.

The first 'transfinite' number: ω

- ω is the number which belongs to the set of all natural numbers, {0, 1, 2, ...}, the set of all sets with the same cardinality as {0, 1, 2, ...}.
- Other sets that are members of ω:
  {1, 2, 3, ...}
  {2, 4, 6, ...}
  {1, 2, 3, 5, ...} (set of prime numbers)
  {1, 4, 9, 16, ...} (set of perfect squares)
- An infinite set can be mapped one-one onto a *proper subset* of itself. This is not true of any finite set.

The next (?) transfinite number: c

- *c* is the cardinal number that belongs to the set of all real numbers, or (what is the same) the set of all real numbers between 0 and 1.
- *c* has a higher cardinality than ω. This is shown by the diagonalization argument (see text).
- By the way, there is an infinite hierarchy of ever larger transfinite cardinals.

Philosophically:

- There is a clash between at least two conceptions of 'infinity':
  1. The Aristotelian/Galilean conception. Infinity is not a number; there are 'potential infinities' but not 'actual infinities.' "Greater than" doesn't apply to infinite sets.
  2. The modern, Cantor conception. There are many infinite numbers (as described above). Numbers are equivalence classes of sets with the same cardinality. "Greater than" means "has a higher cardinality than" as described above.
- Cantor did not 'prove' his conception of infinity; nor did anyone else. He assumed it. (This is the usual method in mathematics.)
- Advantages of Aristotelian/Galilean conception:

  (a) The 'transfinite numbers' are odd anyway--normal rules don't apply to them. This supports that they aren't genuine numbers. E.g., the rule "$x + 1 > x$", "$x - x = 0$", etc.

  (b) Allegedly removes the paradoxes of infinity.
    1. Zeno's paradox.
    2. The paradox of the infinite sums.
    3. Galileo's 'paradox'.
    4. Thomson's lamp paradox.
    5. The banker paradox.
- Problems with the Aristotelian conception of infinity: Aren't all of these 'actual infinities':
  - Infinite divisibility of space & time.
  - Infinite extent of space & time.
  - The infinite series of natural numbers.
- Now, compare to the following possible (?) kinds of infinity; is there a difference?
  - An 'infinite force'. (What happens when the infinite force meets the infinite mass?)
  - An object with an 'infinite velocity', or an infinite rate of change.
  - An infinitely large (massive, etc.) universe. An infinite number of particles.
  - A particle of infinite mass / infinite density in a given region.

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Notes #12: Lewis on Possible Worlds

Review from last time: 2 conceptions of infinity. Advantages/disadvantages of Aristotelian conception. Different kinds of (alleged) infinities: an infinite temporal series; an infinite extensive, physical magnitude; an infinite intensive, physical magnitude; infinite abstract objects.

Lewis' craziness:

- There are 'possible worlds.'
- Other possible worlds are worlds, in exactly the same sense that the actual world is one.
- They exist, in exactly the same sense that the actual world exists.
- They each have their own spacetime, disconnected from our own spacetime. Like parallel universes, with no possible way to travel between them & no spatiotemporal relations between worlds.
- 'Actual' just means "pertaining to the world that I'm in."

An initial argument for the existence of 'possible worlds':

1. Some modal statements are true. (e.g., "I could have had a V8.")
2. Modal statements are best interpreted as assertions about possible worlds, as indicated below:
   "It is possible that p" = "In some possible world, p."
   "It is necessary that p" = "In every possible world, p."
   "It is impossible that p" = "In no possible world does p hold."
3. Therefore, possible worlds exist.

Alternative views:

1. Modal expressions are unanalyzable.
   Objection: "This is not an alternative theory at all, but an abstinence from theorizing."
2. 'Possibly, P' = ' "P" is a consistent sentence.'
   Objection: What does "consistent" mean?
   a. "consistent" means "could be true." Then the theory is circular.
   b. "consistent" means "whose denial cannot be derived from some formal system." Problem: From Godel's theorem, for any (consistent) formal system, there are truths of arithmetic that cannot be derived from it. The negation of such a sentence is therefore 'consistent' according to (b). But the negation of a truth of arithmetic is not possible.
3. 'Ersatz possible worlds': there are 'possible worlds', but they're really just sets of sentences.
   Objection: this will run into the same problem as (2).

Objections to possible worlds:

1. Only our own world actually exists.
2. Realism about p.w.'s is unparsimonious: there are too many entities in your theory.
   Reply:
   • Distinguish (a) qualitative simplicity: reduction in the number of *kinds* of things in a theory, (b) quantitative simplicity: reduction in the number of *instances* of a given kind.
   • My (Lewis) theory has qualitative simplicity.
   • Qualitative simplicity is all that matters.

3. Quine says possible objects are hard to individuate. Not so on my (Lewis') theory, since they are just exactly the same sorts of objects as the objects in our world, except that they happen to be in other worlds. Each possible object occupies only its own world.
4. (Not really an objection.) Tell us more about p.w.'s. How many are there? Are there multiple qualitatively indistinguishable p.w.'s?
   Reply: I don't know, and I don't know any way to find out.

Methodological/epistemological points:

- We start out with pretheoretical 'opinions.'
- Philosophy should seek a *systematic theory* that *respects (or explains the truth of?) those opinions*.
- Also, we seek qualitatively simpler theories, ceteris paribus.

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Notes #13: Kripke on Possible Worlds

• Review Lewis' theory, Lewis' methodology. Does Lewis make a correct application of that methodology?

• From Lewis theory: the problem of transworld identity:
What are the conditions for 'identifying' an object across possible worlds? What makes the 'me' in the other possible world count as (a counterpart of) me?

• Instead of "possible worlds": Alternative ways of speaking:
- talk of "possible states/histories of the world"
- talk of "counterfactual situations"
- Replace with modal talk: "It is possible that . . ."

• The dice example:
- You have two dice, die A and die B. Each has 6 faces, so 6 possible ways of landing.
- Throwing the dice yields 36 possible results. These are 'possible worlds.'
- The 'actual world' is the result that actually occurs.
- It should not be confused with the physical object, the pair of dice itself. The 'possible states' are all possible states of *that* thing. There is only one pair of dice (not 36, with the other 35 existing in another dimension).
- Nor does this imply the existence of a 'bare particular.'
- There are no counterparts, nor is there a problem of transworld identity. The 'me' in the other 'possible world' is me because I stipulate that I'm talking about me.

Essential vs. accidental properties:
- Accidental property: A property a thing has but could have failed to have; a property that a thing has in the actual world but lacks in some possible worlds.
- Essential property: A property a thing must have; a property a thing has in every possible world in which it exists.
- Quine's objection to the meaningfulness of this distinction: Consider the two sentences,
  a. "The President of the United States might not have been President of the United States."
  b. "George W. Bush might not have been President of the United States."
  - (a) is false but (b) is true. But "The President of the United States" and "George Bush" are just two descriptions of the same person. Thus, the property of being President of the United States can appear 'accidental' or 'essential', depending on which way you describe that person.
  - Response: the distinction between rigid and non-rigid designators.
    - *Rigid designator:* A term that refers to the same entity in (every description of) every possible world (in which it refers to anything). "George W. Bush" is a rigid designator.
    - *Nonrigid designator:* A term that designates different things in (descriptions of) different possible worlds. "The President of the United States" is a non-rigid designator.
- Notice that the question, "Could Nixon have not been a human being" is metaphysical, not epistemological: We know he *was* a human being, in actual fact.

Bundles of properties vs. 'bare particulars':

- A particular is not a bundle of qualities. If a quality is an abstract object, so is a bundle of qualities.
- Nor are particulars things *without* qualities that 'stand behind' qualities.
- Instead, particulars are things that have qualities.

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Notes #14: Causation

Regularity theories of causation:

- Derive from Hume's first definition of causation, take the idea that causation is just constant conjunction, or the instantiation of regularities in nature.
- State something like this: c causes e when
  - (i) C and E are true, where C is a proposition stating the occurrence of c, E is a prop. stating that e occurs.
  - (ii) L & F imply ($C \supset E$), where L is a statement of the laws, and F is some statement of initial conditions (or 'particular facts').
  - (iii) L & F don't imply E, nor does F imply ($C \supset E$).
- Problems:
  1. Don't differentiate cause from effect; c might instead be an effect of e.
  2. c and e might instead have a common cause. (E.g., d causes both c and e.)
  3. c might be a preempted potential cause of e. (c would have caused e, but d caused it first.)

Counter-factual analysis of causation:

- Similarity of worlds: w_1 is closer to *a* than w_2 is, when w_1 is more similar to *a*.
  - This similarity is a 'primitive' relation.
  - Similarities may be in two respects: (a) with respect to laws, (b) with respect to particular facts.
  - Generally, laws are more important than particular facts.
  - However, large regions of *exact* similarity of particular facts are specially important.
- Counterfactuals (Stalnaker-Lewis analysis):
  A $\Box\!\!\rightarrow$ C = In the nearest world(s) in which A holds, C holds.
  Or: Some world in which A and C hold is closer to the actual world than any world in which A and ~C hold.
- Causal dependence:
  e depends causally on *c* = O(c) $\Box\!\!\rightarrow$ O(e) and ~O(c) $\Box\!\!\rightarrow$ ~O(e).
- Causation:
  - Casual dependence implies causation, but causation does not imply causal dependence. Because causation is transitive, but causal dependence is not.
  - Causation is *the ancestral* of causal dependence. *c* is a cause of *e* iff there is a causal chain from c to e.
    - Good concept to know: If R is a non-transitive or intransitive 2-place relation, the ancestral of R is the relation that holds between *a* and *b* whenever there exists a finite series of objects, beginning with *a* and ending with *b*, such that each successive pair is related by R.
- Nomic dependence: ignore this.
- The problems for the regularity theories:

1. The problem of effects
   - Assume that *c* causes *e* and *e* doesn't cause *c*. Assume *c* had to cause *e*, given the circumstances and the laws. Then if *e* hadn't occurred, it would have to have been because *c* hadn't occurred. Thus, if *e* didn't occur, *c* wouldn't have occurred.
   - Solution: No, if *e* didn't occur, *c* still would have occurred, but would have failed to cause

e. The circumstances or the laws would have been different.

• Why: to maximize the region of spatiotemporal match with the actual world, we choose a possible world in which everything is exactly the same up to the time of *e*, and then a 'divergence miracle' occurs (a violation of the actual world's laws of nature), whereby *e* fails to happen. Then we continue the laws forward from there.

[• Problem: we could also introduce a 'convergence miracle' right after the time of *e*, to bring the course of the world back to the course in the actual world. Lewis presupposes a spurious asymmetry between the past and the future.]

2. The problem of 'epiphenomena.' [Actually the problem of common causes.]
   - Assume *c* causes both *e* and *f*, *e* doesn't cause *f*, and *e* happens before *f*. Then if *e* didn't happen, *f* wouldn't have happened.
   - Solution: No, as above: if *e* didn't happen, then *c* and *f* would still have happened, but *c* would have failed to cause *e*.
3. The problem of preemption.
   - Suppose c_1 causes *e*, but another event, c_2, was standing by, ready to cause *e* if c_1 hadn't been there. Then $\sim O(c_1) \mathrel{\Box\!\!\rightarrow} \sim O(e)$ fails.
   - Solution: So there is no causal dependence of c_1 on *e*, but c_1 still causes *e*, because:

     • There is some chain from c_1 to *e*--e.g., $\sim O(c_1) \mathrel{\Box\!\!\rightarrow} \sim O(d) \mathrel{\Box\!\!\rightarrow} \sim O(e)$.

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Notes #15: Events

Davidson on events:

- A distinction: *particular* events vs. event-*types*.
  - *Ex.:* A particular event: the War of 1812. An event-type: War.
  - Note that Davidson is talking (only) about *particular events*. Says we don't need event-types to explain recurrence. (Doing 'the same thing' again just means doing something similar.)
- Argument for the existence of events: The following inference is valid:
  1. John ran quickly.
  2. Therefore, John ran.

  What is the form of this inference?
  1. (Ex)(Rx & jBx & Qx) (There was a running, by John, that was quick.)
  2. (Ex)(Rx & jBx) (There was a running, by John.)

  Not:
  1. Qj
  2. Rj

  Notice that the form of the inference is the same as that of:
  1. There was a grey cat on the mat.
  2. Therefore, there was a cat on the mat.
- Ordinary language makes many apparent references to events. "There were many wars in the 20^{th} century." Etc.
- How to individuate events:
  x is the same event as *y* iff: *x* and *y* have all the same causes and effects.

Events according to Kim:

- Kim uses "event" broadly: Includes both *changes* and *states* (or 'unchanges').
- Events are property-exemplifications. Each event has three things:
  - A constitutive object. (Roughly, the object that is doing something, or being some way.)
  - A constitutive property. (What the object is doing or being.)
  - A time of occurrence.
- Two conditions for defining the concept of an event:
  Existence condition: The event [x,P,t] exists (occurs) iff x has P at t.
  Identity condition: [x,P,t] = [y,Q,t'] iff: (x=y, P=Q, and t=t').

  That explains what an 'event' is. There can also be more complex events with ordered n-tuples for constitutive objects, and relational constitutive properties [and time intervals of occurrence?].
- Misc. issues:
  - What sort of constitutive properties are allowed? (Not just any, for then 2+2 equalling 4 would be an event.)
  - When John ran quickly, is the constitutive property "ran" (with quickness a property of the event), or "ran quickly"? Note: must distinguish the event's *constitutive property* from a property *of* the event.
  - Kim's account of events is compatible with Davidson's analysis of event-sentences--Kim events may be just what are quantified over in the example sentences (1) and (2) above.

• Suppose Mary kissed two admirers at once. How many kissings occurred? Answer: at least 4 (Kim says 3, but this is a mistake), 1 monadic kissing, 2 dyadic kissings, and 1 triadic kissing, namely:

1. [Mary, ① kisses an admirer, t]
2. [<Mary, Steve>, ① kisses ②, t]
3. [<Mary, Larry>, ① kisses ②, t]
4. [<Mary, Steve, Larry>, ① kisses ② and ③, t]

• The role of causation: Some events include other events plus their effects: ex.: Brutus' killing of Caesar includes Brutus' stabbing of Caesar and the effect, Caesar's death.

The Individuation of Events (Kim vs. Davidson):

- Famous example: Brutus stabbed Caesar. Let's say he stabbed Caesar at 12:00 noon, and Caesar died of the knife wounds 1 hour later. Q: Was Brutus' stabbing of Caesar = Brutus' killing of Caesar? (Is this one event, or two?)
  - Davidson: Yes. (One.)
  - Kim: No. (Two.)
  - Q: When did the killing of Caesar occur? (12:00? 1:00? Throughout the interval? Did it have a scattered time of occurrence?)
- How many stabbings occurred?
  - A: infinitely many (on Kim's account): a stabbing, a stabbing-with-a-knife, a stabbing-quickly, etc. (These descriptions all provide different *constitutive properties*: "stabs", "stabs with a knife", "stabs quickly", etc.)
  - But this is not so strange. Similarly, how many tables are here? Many billions. Illustration: let A be an electron on the edge of the table. Consider two objects:

    Table 1 = the table, including A.

    Table 2 = the object consisting of all of table 1 *except* electron A. This is also a table, and it is not identical with Table 1. So it is a second table.

    Similarly, there are billions more tables in the offing.

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Notes #16: Parthood & Identity across Time

Review from last time: Davidson's argument for events; Kim's identity & existence conditions for events; Davidson vs. Kim on individuation of events, the stabbing vs. the killing, &c.
Review from earlier: Lewis on causation.

Questions: What are material objects; under what conditions is a material object *x* identical with object *y*? Special case: When does a material object *persist* over time, and when does it cease to exist?

I. Important concepts:

x is part of y : you all know what this means. Note that everything is a 'part' of itself.
x overlaps y : x and y have a part in common.
x is discrete from y : x and y have no part in common (do not overlap).
the fusion of the S's (where S is some set of objects) : The thing that has as parts the members of S and nothing else (no parts that are discrete from the members of S).

The fusion principle: Given any set of physical objects, there is a unique thing that fuses them, called "the fusion" of the set. (Also called the 'mereological sum'.)

II. About the tinkertoy house:

Thomson has a tinkertoy house on a shelf at 1:15. Let

H = The tinkertoy house that is on the shelf at 1:15.
W = The fusion of the tinkertoys that are on the shelf at 1:15.
W' = The wood that is on the shelf at 1:15.

Plausible claim: H = W = W'

III. Problem:

I remove one stick (alpha) from the house at 1:30 and throw it on the floor, and replace it with another stick (beta). At 1:45 there is a tinkertoy house on the shelf. Is it H?

If Yes: Then there is a contradiction:

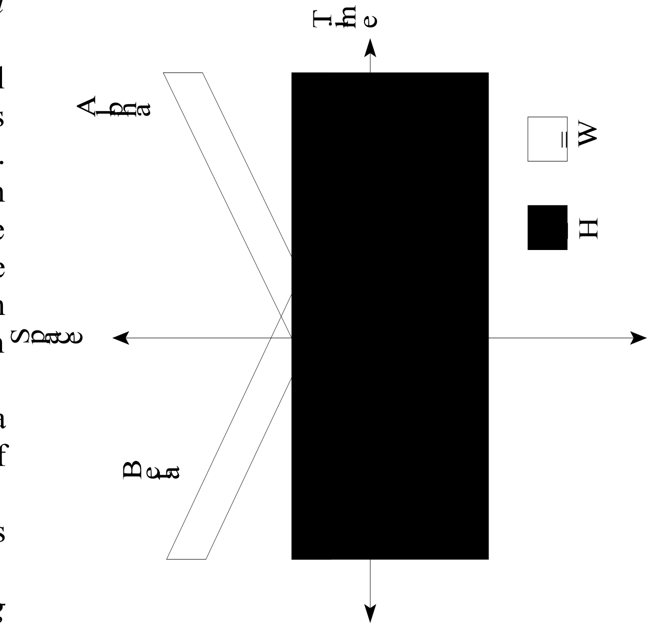
1. H = W. (and W')
2. H is on the shelf at 1:45.
3. W is not on the shelf at 1:45. (nor is W')

Which of these should we reject?

- #1? But H is made only of tinkertoys; therefore, H fuses the tinkertoys, so H is the fusion of the tinkertoys. Likewise, it is the fusion of the wood.
- #2? Then even removing a single particle from H gives you a new house.
- #3? No. The fusion of the S's can't be on the shelf when one of the S's is on the floor.

IV. The 4-dimensionalist solution

- Physical objects are *four-dimensional space-time worms*.
- *The idea of temporal parts:* The 'spatial parts' of a physical object are the parts that occupy different parts of space. Each spatial part exists only in its own region of space. Similarly, the *temporal* parts of an object are the parts occupying different times. Each temporal part exists only in its own *duration* of time.
  - Compare Alfred (the right half of a piece of chalk) with Bert (the later half of a piece of chalk).
- A physical object is the fusion of its temporal parts.
- 'Identity' across time is just *being stages of the same spacetime worm*.



- Solution: H and W are not identical, but they overlap (temporally) from 1:15 to 1:30. (See diagram.)

- Surprising consequence: The chair's seat is not a part of the chair.
  Why: the chair is a certain space-time worm. The seat existed prior to the chair, i.e., the seat-space-time-worm extends prior to the beginning of the chair. So the seat *overlaps* with the chair but is not *part of* the chair, since (a temporal) part of the seat is outside the chair.

V. Objections

a. It implies that change is impossible.
Reply: No, change occurs when an object has some feature at one time that it lacks at another time. Nothing about the theory implies that this doesn't happen.

b. It implies that two physical objects can be in the same place at the same time.
Reply: Yes, but they are *overlapping* objects. This is not so surprising.

c. The problem of temporal chalk extrusion.

- Suppose I hold a piece of chalk in my hand from 12:00 to 1:00. Let Bert = the temporal part of the piece of chalk that exists from 12:30 to 1:00. Then
- Bert is some chalk. Bert also is white, cylindrical, weighs about 3 ounces, etc.
- Bert didn't exist before 12:30. I.e., Bert came into existence at 12:30.
- So a new quantity of chalk popped into existence (while another one, of course, simultaneously went out of existence at the same place) at 12:30.
- The same applies to every other time. Thus:

> "As I hold the bit of chalk in my hand, new stuff, new chalk keeps constantly coming into existence *ex nihilo*. That strikes me as obviously false." (p. 213)

VI. A Better Solution

• A thing can have parts at a time, and different parts at another time. I.e., the part-whole relation is actually a 3-place relation:

x is a part of y at t

not simply:

x is a part of y.

• Alpha is part of H at 1:15, and is not part of H at 1:45.
• Alpha is also part of W' at 1:15, and is still part of W' at 1:45.
• So H ≠ W'. ((1) above is false.) Because

$x = y$ iff $(z)(t)$(z is a part of x at t iff z is a part of y at t).

I.e., x=y iff x and y have exactly the same parts at all times when they exist.

• W doesn't exist, because there are at least *two* fusions-at-1:15 of the tinkertoys that are on the shelf at 1:15.
[• Alternate view: Identity is also relative to a time. H=W' at 1:15, but H≠W' at 1:30.]
• *Objection:*

Suppose H and W' came into existence together (*ex nihilo*), and then went out of existence at the same time. Then, according to the above, H=W'. But H≠W' since they have different modal properties: W' *could have* existed in the shape of a ship, but H could not have.

• *Reply:*

Modify the above principle to:
$x = y$ iff x and y *necessarily* have exactly the same parts at all times that they exist.

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Notes #17: Review

Know what these things are:

Infinity:
- ω (omega)
- c (the continuum)

problem of transworld identity
counterparts
essential/accidental properties
rigid/nonrigid designators
bare particulars
bundle theory
Causation:
- regularity theory of
- counter-factual analysis of

Counter-factual conditional
Events:
- Diff. between Davidson & Kim events
- Kim events: Existence & Identity conditions

Fusions
- & doctrine of arbitrary fusions

4-dimensionalism
- & temporal parts

Know what these people thought of these things:

Aristotle & Galileo: infinity, infinite objects
Cantor & modern mathematicians: infinity
Lewis: possible worlds
- transworld 'identity'
- Meaning of:
  - "possible", "necessary", "impossible"
  - "actual"
- what is causation
- analysis of counter-factuals

Kripke: transworld identity, counterparts
- notion of essential properties
- bare particulars, bundle theory

Davidson: individuation of events
Kim: the constituents of events
- the individuation of events

Thomson: temporal parts
- identity conditions of physical objects
- the parthood relation
- the house & the fusion of tinkertoys (are they identical)

4-dimensionalists: ship-of-theseus type problems

Understand these important arguments:

Galileo's argument for: why infinity isn't a number
The Diagonalization Argument
Lewis: why you should believe in possible worlds
Kim: why there are many tables here
- why there are many events

Thomson's tinkertoy paradox (know what the paradox is)
Thomson's main argument against 4-dimensionalism