

“All You Zombies”: Good literature and Bad Science

Peter Watson



Is Time Travel Possible

- The assertion: prior to 1900 the space-time diagram for any work satisfied the standard conditions: Aristotle's three unities become "space-time causality is preserved" or "special relativity is satisfied".
- Principle is violated in (e.g.)
 - Oedipus Rex
 - Macbeth
 - A Christmas Carol
 - A Connecticut Yankee at the Court of King Arthur
 - The Time Machine

but these tend to be "trivial" violations.

After about 1900, a variety of works violate this in a non-trivial way

So we should think about how we can avoid the paradoxes

TIME TRAVEL INTO THE PAST

There is no debate, even among science fiction writers, that this is completely impossible. It not only involves violations of the laws of physics, particularly the Second Law of Thermodynamics, but literally and actually involves gross logical contradictions. The idea is that mad Dr. Soandso gets into his time machine (not clearly described) and somehow goes back to ancient Rome, where he gives a translated handbook of physics and chemistry to a Roman scholar, and thus utterly changes the course of human history the atomic bomb, for instance, is then invented by Claudius Festus Arpinna in 350 AD.

Despite the fact that even the writers agree time trips into the past are an impossibility, they love to play with them, because of the plot complications that can be generated by the logical contradictions that arise. My favorite books of this type are Dinosaur Beach by Keith Laumer and The End of Eternity by Isaac Asimov. The time-travel short story to end all time-travel short stories is All You Zombies! By Robert A. Heinlein. Wells' 19th Century The Time Machine is the genre's daddy.

If we could construct a time machine, can we evade the paradoxes?

Time travel is

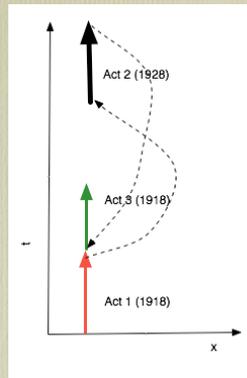
- impossible: forbidden by increase of entropy
- impossible: forbidden by relativity
- impossible: forbidden by requirement that universe must have positive energy everywhere.
- impossible: time must flow and we have no control over it
- impossible: forbidden by logical paradoxes
- impossible: forbidden by cosmic censorship (Steven Hawking)

Time travel is

- possible in theory, but in practice impossible (e.g. costs too much energy)
- possible: paradoxes avoided by many-worlds model
- possible: past can be seen as movie, but not altered
- possible: free-will is an illusion, so it is irrelevant!
- irrelevant: time is an illusion

e.g. Three Time Plays by J. B Priestley:
"Time and the Conways"

Spoiler Alert!
Plots will be revealed



Dangerous Corner

Darkness, a shot, lights

Freda, Olwen, Miss Maud and Betty are listening to the radio

....Stanton, Gordon (Betty) & Robert (Freda) enter

Gordon (*Beginning to fiddle with the radio*): What's on the ether tonight?

Freda: Oh Gordon, don't start it again. We've only just turned it off

Gordon: What did you hear?

Freda: The last half of a play.

Olwen: It was called "the Sleeping Dog"

Stanton: Why?

Miss M: We're not sure- something to do with lies

Olwen: You know, I believe I understand that play now. The sleeping dog was the truth, and ..the husband insisted on disturbing it.

.....

Betty: Oh but one has to. I'm always fibbing. I do it all day long

Gordon (*still fiddling with the wireless*): You do, darling, you do

Robert runs out to commit suicide

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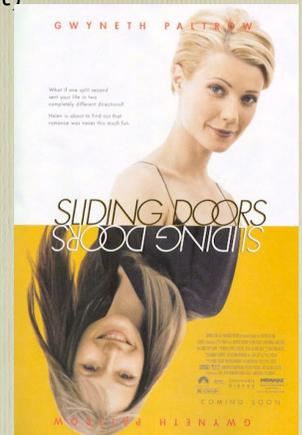
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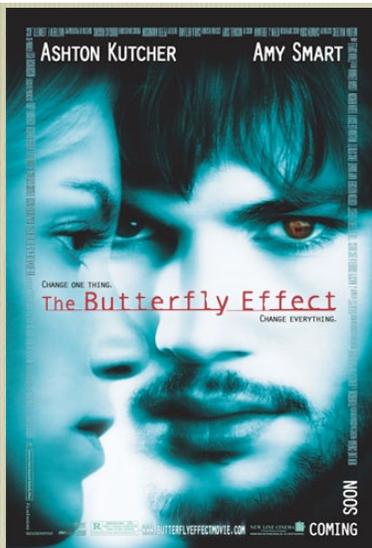
Gordon (*who has been fiddling with the wireless*) Wait a minute, listen to this
Curtain falls as they dance to "Can't we talk it over"

Sliding Doors (Peter Howitt)

Note both these have common theme of two sets of world-lines, separated by the butterfly effect.



The same theme

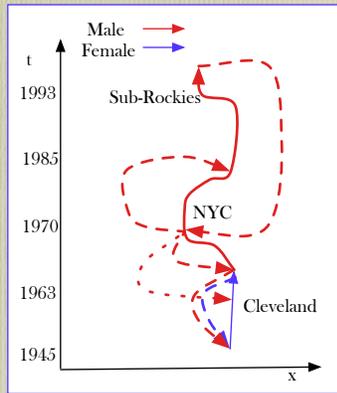


An Inspector Calls: Synopsis:

- A wealthy family (the Birlings) are celebrating the engagement of their daughter to Gerald Croft.
- Inspector Goole calls, investigating the horrifying suicide (by drinking disinfectant) of one Eva Smith.
- Reveals that ALL the family (unknowingly) had a hand in her death.
- The inspector leaves and Gerald phones the hospital: no girl has committed suicide.
- They celebrate the hoax, the phone rings: a girl has been found dead and an inspector is on his way round....

“All You Zombies”

- Well, you do better!



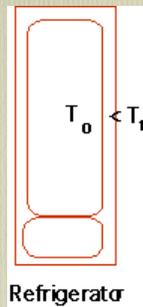
Increase of Entropy?

- Unsatisfactory for forbidding time travel since it doesn't forbid travel into the future
- (let's skip tomorrow and move on to Saturday!)

Note we can decrease entropy locally as long as it increases overall

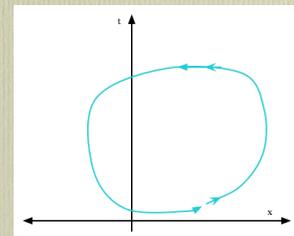
Initially room and fridge at same temp., afterwards $T_0 < T_1$

So we would need a “time-refrigerator” to travel into the past



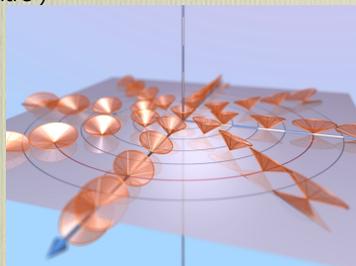
So can we build a time-machine?

- Now we know the question to ask;
- Can we arrange for world-lines to be closed?



Note relativity does **not** forbid time-travel

- Godel invented a model universe consistent with GR with closed time-lines. Not like ours:
- it has a centre (ours has no centre)
- it is not homogenous (ours is)
- It rotates (ours doesn't).



Maybe time simply "flows"

- You could not step twice into the same river; for other waters are ever flowing on to you. Heraclitus

River analogy is not uncommon: e.g

Time is a sort of river of passing events, and strong is its current; no sooner is a thing brought to sight than it is swept by and another takes its place, and this too will be swept away. Marcus Aurelius

e. g. Books:

"Randall and the River of Time" (C. S. Forester)

"Riverworld" (Philip Jose Farmer)

Oh god, our help in Ages Past

- Time, like an ever rolling stream,
Bears all its sons away;
They fly, forgotten, as a dream
Dies at the opening day.
- **Isaac Watts**

e.g. Music

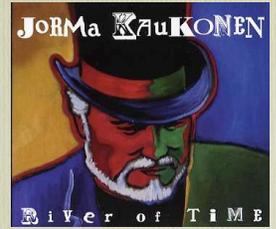
"From me flows that which you call time"

(Takemitsu)

- "Of time and rivers flowing
The seasons make a song."

Peter Seeger

- River of Time (Jorma Kaukonen)



But in reality the analogy of time flowing is not very useful:

flow of something is "rate of change"

e.g. flow of a river is amount of water that passes you in a given time.

If time is to flow, it is the amount of time that passes you in a given time at the rate of 1 second per second?

Seems to require "meta-time"

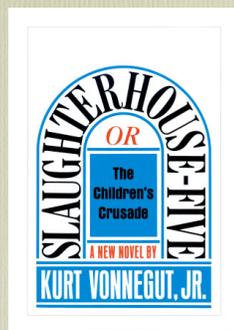
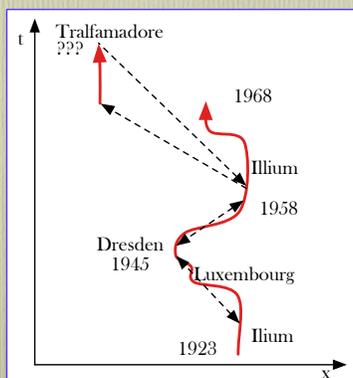
Does "meta-time" flow?

Unknown physical principle?

- "Cosmic Censorship"
- Not an argument

Slaughterhouse-Five: *So it goes*

Billy Pilgrim has become unstuck in time



Free will doesn't exist

"Out of 31 inhabited planets I have visited, only on Earth is there any talk of free will."

Vonnegut, Slaughterhouse Five

- Which of our time-stories actually imply free will?
- Can we prove free-will?
- Could we have a story in which a murder is committed in one frame but not another?

There was a young man who said "Damn
It is suddenly borne on me that I am
An engine that moves
In predestinate grooves
I'm not even a bus, I'm a tram."

Let's try to summarize the mess we are in

- We have lost the idea of universal time and with it
 - The concept of simultaneity
 - The concept of a universal "now"
 - The idea that Euclid was right!

Let's try to summarise the mess we are in

- We have gained
 - The linking of time and space into space-time
 - Black holes
 - Curved Spaces
 - Multiple time-lines connecting events
 - Time-travel ??????????????????????
 - The concept of space without time

Why is the speed of light so special?

- It isn't: it's just the maximum speed that anything can move at.
- Anything massless always moves at c (photons, neutrinos almost)
- Anything massive (protons, electrons, spaceships) can approach c but not get there
- It is really a number that relates distance to time

Finally

- A somewhat subtle point
- Originally we had "universal time"
- Not crazy to think that time can change, but then it should be tied to measurement (e.g. clock, photon, biology
- It is now connected to a "frame of reference", disconnected from any measurement

Where does this leave prediction?

- Predictions (especially of the future) are hard!
- We can PROVE some very simple systems with exact equations are unpredictable
- We (more-or-less) understand what systems are predictable
- Some very complex systems ARE partly predictable
- Quantum systems allow very accurate average predictions but no individual predictions
- And seem to forbid retrodictions!

Time as an Illusion

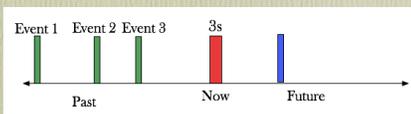
- The “easiest” way out of all the paradoxes is that time does not exist in the way we talked about it in lecture 1.
- Suppose the universe exists in the “Slaughter-House Five” sense
- Tralfamadorians have access to all of it
- Maybe our consciousness is such that we have access to “now” ONLY
- "Among the things Billy Pilgrim could not change were the past, the present, and the future."

Time as an illusion: Is the Queensway ordered in time?

- St Laurent
- Railway Station
- Rideau River
- Ottawa U
- Rideau Canal
- Museum of Nature

The Biggest Problem: why is there a “Now”?

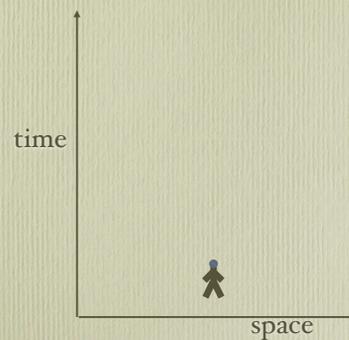
We tie down past and future with events.



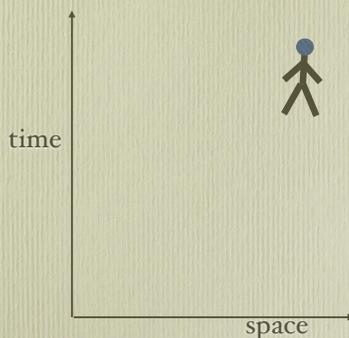
We'll call this the linear model

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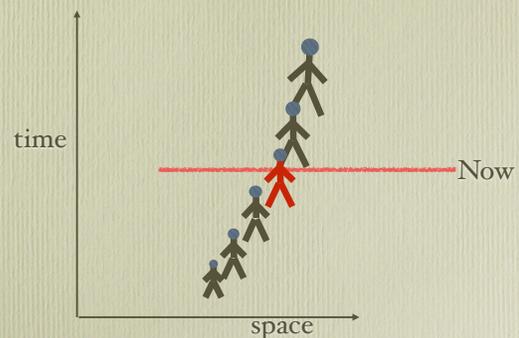
Note that **we** see a sequence of events



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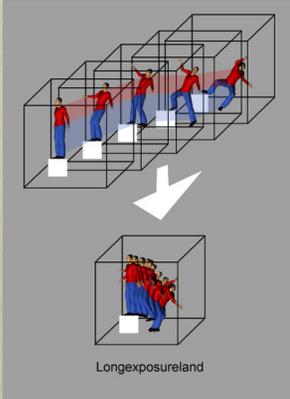


Physics is quite happy with a trajectory



i.e. “**now**” seems to be a construct of life

Note artists tend to be locked into the moment



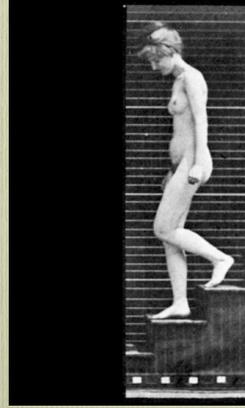
Longexposureland

Tim Pickup



David: Napoleon Crossing the Alps

Nude descending a staircase



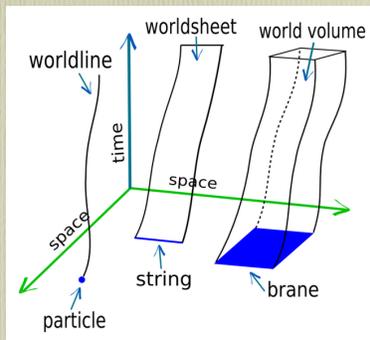
Edward Muybridge (1887)



Maurice Duchamp (1912)

Block Universe

- Assumes we can stand “outside” space-time
- Obviously no flow of time (any more than flow of space!)



Wikipedia

Quantum universe must be more complicated since it is not predictable



Growing block-universe

- Distant past is fixed
- present is fixed as we make measurements
- future is indeterminate
- Allows for a “now”

If time is an illusion, why

a) do we care about it so much?!

b) can we measure it to such fantastic accuracy!?

What is Time?

I wish I knew