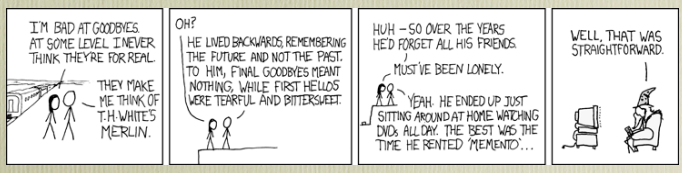
"All You Zombies ....": Good literature and Bad Science

Peter Watson



xkcd.com.

- 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

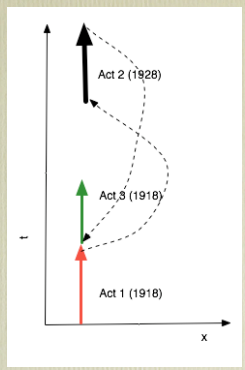
- impossible: forbidden by increase of entropy
- impossible: forbidden by requirement that universe must have positive energy everywhere.
- impossible: time must flow and we have no control over it
- impossible: forbidden by logical paradoxes
- impossible: forbidden by cosmic censorship (Steven Hawking)

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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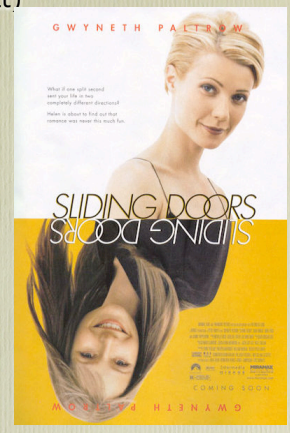
.....

Gordon *(who has been fiddling with the wireless)* Wait a minute, listen to this

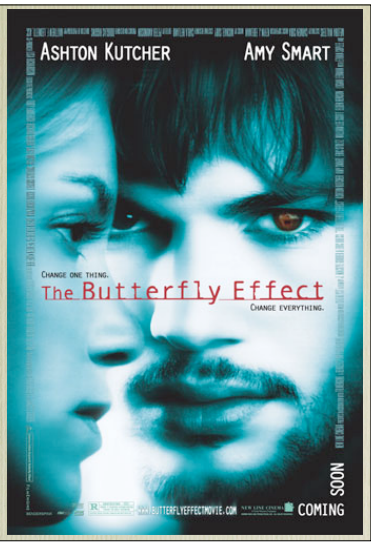
Curtain falls as they dance to "Can't we talk it over"

Sliding Doors (Peter Howitt)

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



The same theme

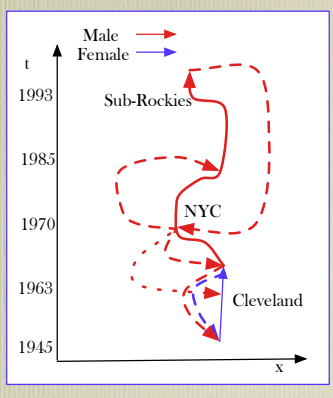


An Inspector Calls: Synopsis:

- 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!)
- Also (refrigerator example) we can decrease entropy localy as long as it increases overall

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

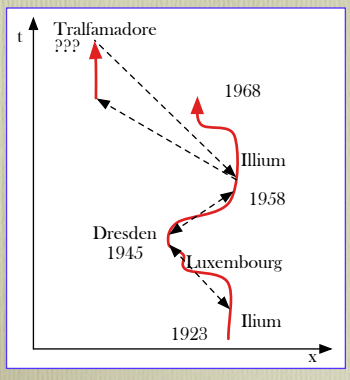
- Time, like an ever rolling stream,
  Bears all its sons away;
  They fly, forgotten, as a dream
  Dies at the opening day.
- **Isaac Watts**

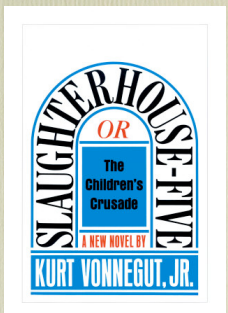
- e.g. Music
- "From me flows that which you call time" (Takemitsu)
- "Of time and rivers flowing
  The seasons make a song."
  Peter Seeger
- River of Time (Jorma Kaukonen)

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?

Slaughterhouse-Five
So it goes





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?

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."

Queensway

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

Unknown physical principle?

- Not an argument

What does a clock measure?
- What does "prediction" mean?
- When did time measurement start?
- Do we experience time in the same way?
- Why does time pass more quickly as we get old?
- What defines the direction of time?
- Physiological Time: what is a biological clock?
- How short a time can we perceive?
- What exactly is causality?
- Is time travel possible?
- If so, why can't we do it?
- If not, what forbids it?
- How do we know that two clocks measure the same time?
- How are time and space linked?
- Is time "smooth"?
- Did time begin?
- Will it end?

- What does a clock measure?
- Interval between events.
- What does "prediction" mean?
- Starting from now, saying what will happen (and in general we cannot do it)
- When did time measurement start?
- Humans: probably ~ 10000 BC.
- Do we experience time in the same way?
- NO; time dilation and twin paradox.
- Why does time pass more quickly as we get old?
- Probably decrease in number of novel experiences.
- What defines the direction of time?
- Increase of entropy, maybe (ultimately) behaviour of particles with handedness.
- Physiological Time: what is a biological clock?
- Almost all are linked biochemical reactions.

How short a time can we perceive?

- Directly ~ 20 ms, indirectly (via sound) ~ 50μs.
- What exactly is causality?
- One event that causes a second: defined via light cone.
- Is time travel possible?
- Don't know.
- If so, why can't we do it?
- See above.
- If not, what forbids it?
- See above.
- How do we know that two clocks measure the same time?
- They don't, in general.

How are time and space linked?

- Manifestations of 4-D space-time.
- Is time "smooth"?
- Maybe.
- Did time begin?
- Maybe.
- Will it end?
- Maybe.

•What is Time?

•I wish I knew