OXFORD PHILOSOPHICAL SOCIETY

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Trier, Saturday 17th November 2018

In this Universe of Existence, Motion and Causality, Motion is the most Important

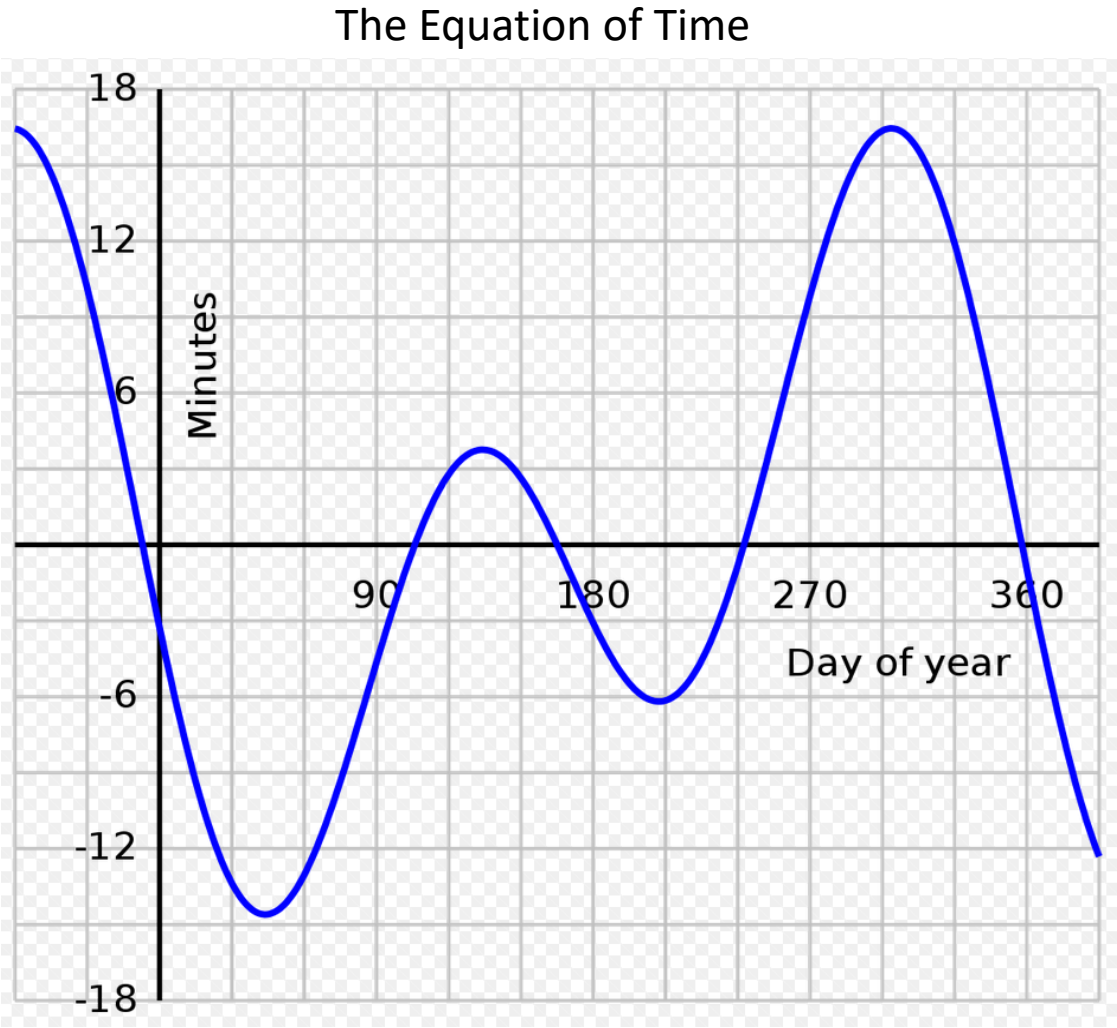
By Seán Coughlan

Ligeti - Symphonic Poem for 100 Metronomes

The metronome is a conventional symbol of time and timing. When Ligeti wrote his *Poeme Symphonique* for 100 metronomes, it was as a joke and the planned transmission of his (then) new work was cancelled and a football match broadcast in its stead. Nevertheless, we will take time as real, as persistent and as sequential as the ticking of a metronome...

Standard time is the synchronization of clocks within a geographical area or region to a single time standard, rather than using solar time or a locally chosen meridian (longitude) to establish local mean time standard. Historically, the concept was established during the 19th century to aid train travel, first used by British railways on December 1, 1847, when they switched from local mean time, which varied from place to place, to Greenwich Mean Time (GMT).

In a mean time system, the time interval between noon (when the Sun is highest) and 12:00 is called the equation of time, where “equation” is used to mean a correction.



Not Quite 95 Theses and Nobody need eat Worms

- Nothing *is*; things *happen*
- The world is made up of events, not permanent in time
- We understand the world by studying change
- The granularity of quantum mechanics implies that almost all values of time do not exist. *Corollary*: A minimum interval of time does exist
- Time is a human creation for the purpose of measurement; or is an actual physical property of the universe; or is something else
- Our science is still founded on the concept and reality of the *second* as a time interval
- Eternity (infinity) and transient time make for interesting bedfellows

So I offer a pot pourri of facts and (perhaps) fictions that should illustrate what a multifaceted thing time appears to be.

The Contestants

Philosophers debate the paradoxes, or engage in meditations, dialogues and reflections on the existence, content and nature of space and time.

Physicists, too, have been trying to mould space and time to fit their notions concerning micro- and macro-worlds.

Mathematicians focus on the abstract aspects of space, time and their measurement.

Cognitive scientists ponder over the perceptual and experiential facets of our consciousness of space and time,

Computer scientists theoretically and practically try to optimize the space-time complexities in storing and retrieving data/information.

Linguists, logicians, artists, evolutionary biologists, geographers etc, all are trying to weave a web of understanding around the time and space.

Theologians loved infinities; declared infinitesimals heresy; and insist on a beginning and an end to/of time.

An Interesting Thing

- The Chinese referred to the cosmos as " Yǔzhòu", meaning, quite literally, 'Space-Time'. ***Yǔ*** refers to three-dimensional spaces, while ***zhòu*** is a fourth dimension indicating a series of successive changes 宇宙 (宇 yǔ = space + 宙 zhòu = time).*
- It becomes apparent that by Yǔzhòu**, ancient Chinese philosophers came remarkably close to the modern concept of Unified Field.
- That is not to say, of course, that the ancient Chinese had an actual scientific grasp of relativity. But in philosophical terms, it remains a momentous conceptual achievement, to be able to express reality as a (fluid) combination of space and time, neither of which are absolute.

*The Notion of Time in Chinese Philosophy: Part 1 by Chris Angelis https://gbtimes.com 14 Sep 2011

**Attrib. Zhuang Zhou, circa 4th century BCE, credited with a work known by his name, the ZHuangZi

The Dimension of Time

We will **not** start with Dr Who, abstract T-symmetry considerations or determinism, etc but with a rather more physical approach

- What are the fundamental dimensions that govern our ability to manage the physical world?
- What are the standards we use to ensure a common understanding of everyday matters of distance, speed, weight, heating and lighting and more?

Well, there are only seven essential (fundamental) dimensions, one of which is, of course, TIME; and any SI Unit of measurement may be represented by a product of these seven dimensions and a constant.

The Seven Fundamental Dimensions

	name	*abbrev*	*standard-defined by*
• [M]	Mass	kg*	In Nov 2018 the kg will be defined by using Planck's constant ($6.62607004 \times 10^{-34}$ m^2 kg /second)
• [T]	Time	second*	9 192 631 770 cycles of a Caesium atomic clock
• [L]	Length	metre*	1579800.76204233 wavelengths of helium–neon laser light; the distance travelled by light in a vacuum in 1/299,792,458 of a second
• [K]	Temperature	kelvin*	1/273.16 of the thermodynamic temperature of the triple point of pure water at 611.2Pa – expected to be redefined in Nov 2018
• [I]	Current	ampere	6.2415093×10^{18} elementary charges moving past a boundary in one second - expected to be redefined in Nov 2018
• [N]	Amount of substance	mole/mol	a mole is expected to be redefined in Nov 2018 to have exactly $6.02214076 \times 10^{23}$ elementary entities (Avogadro's Number) using Boltzmann's constant
• [J]	Luminous intensity	candela	a candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt/steradian

- * => base unit

$$\text{unit} = \text{constant} \times M^a.T^b.L^c.I^d.K^e.J^f.N^g$$

Fundamental Constants, and Friends

	Dimensions
Planck	M.L2.T-1
Boltzmann	M.L2.T-2.K-1
Gravitational	M-1.L3.T-2
Speed of light in vacuo	L.T-1
Gas Constant	M.L2.T-2.K-1.Mo-1
Entropy	M.L2.T-2.K-1

Time for Change

- On November 16, in Versailles, representatives from 57 countries will vote to dramatically transform the international system that underpins global science and trade. This single action will finally realize scientists' 150-year dream of a measurement system based entirely on unchanging fundamental properties of nature.
- The International System of Units (SI), informally known as the metric system — the way in which the world measures everything from cat food to the cosmos — will change the definitions of the fundamental dimensions of measurement

……..and that includes the second – the dimension of time!

A Second Interesting Thing (in 3 parts)

1. In the year 1000 CE, the Persian Muslim scholar al-Biruni first used the term *second* in Arabic (ثانية*thaniyah*) and defined it as1⁄86,400 of a mean solar day. He also defined *thirds* and *fourths.*
2. In the 13th century, scientists, including Bacon, and later Kepler and Brahe, used the Latin term *parte minutae* to mean a unit of time which represented the *second* small part of an hour.
3. 1 second is presently defined as:

9 192 631 770 cycles of a Caesium atomic clock

Maths for Starters

We understand the world by studying change, not by studying things. Anaximander (c. 610 - 546 BCE)

We recall Newton and the classical equations of motion:

$$S=ut+(1/2)at^2; \quad v=u+at; \quad v^2=u^2+2as$$

We seem stuck with this manifestation of time whether we hit a cricket ball or drive a car.

Differentiation and its sibling, Integration, are maths terms which cover the everyday descriptions of change, particularly rate of change of one variable with respect to another variable.

The expression ds/dt is: "the rate of change of distance wrt time (mph)". *differentiation*

The expression $s = \int v\,dt$ is: "the distance travelled in time t at velocity v". *integration*

In both expressions, time and motion are simply locked.

The Heart of the Matter?

- Classical mechanics gives “time” a special role and implies it is a “thing” that exists
- Mechanics can be formulated to treat time as a variable like any other
- The temporal variable(s) may be defined in terms of other parameters
- Velocities etc may be compared with no “time” or “direction of time”
- Analyses may only ever compare the motion of the object to the motion of another thing, eg: a clock, calling the reading “time”
- There may be no reason at all to think this extra ‘time’ thing needs to be accounted for, or may have a direction that needs to be explained or accommodated.

More Motion

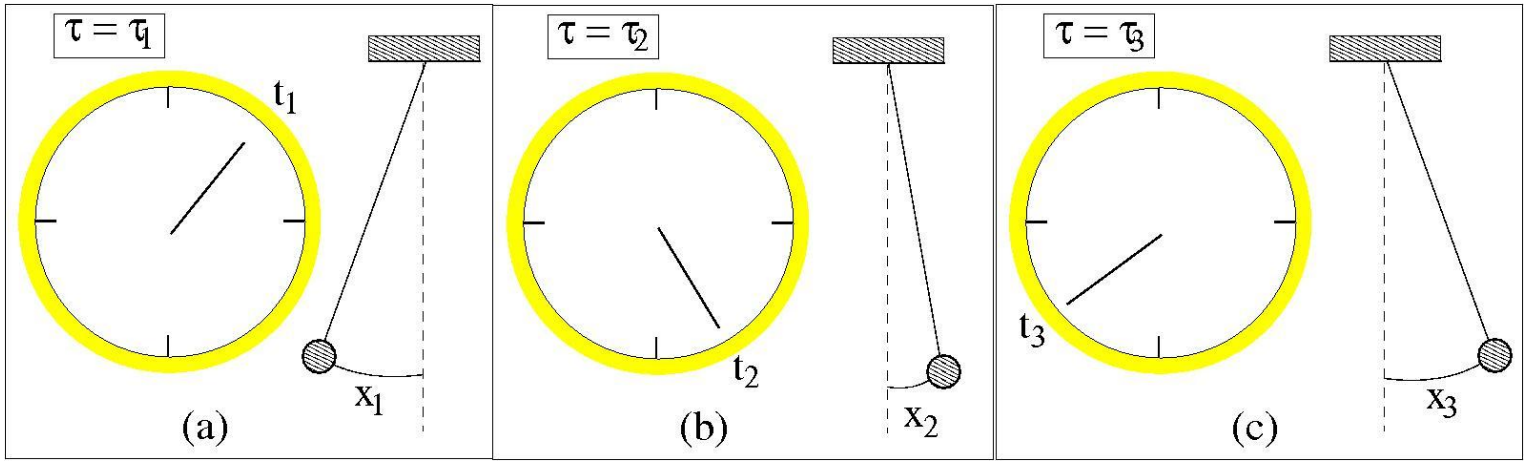
To describe the world, the time variable is not required.

- How does one describe the world in which everything occurs but there is no time variable? What is required are variables that actually describe it: the height of this, the length of that, the weight of something else. These are properties that we see continuously changing.
- In 1965 the Wheeler-DeWitt equation* was published, an equation for quantum gravity that was written without any time variable.
- *But I have shown you that fundamental constants all contain the dimension of Time, How can this be?*

**Reportedly* disavowed by one its fathers, ill defined, never empirically tested, it attempts to combine mathematically the ideas of quantum mechanics and general relativity

The Wheeler-DeWitt Conundrum

Hands on dials can be made to rotate (in any direction), and can be in various locations, and pendulums can be at any point in a swing, and moving in either direction, and these variables can be compared. Mechanics can be formulated to treat the time variable on the same footing as the other variables, by introducing **τ**, an unphysical parameter, identifying different correlations between $\tau = \tau_n$, $x = x_n$ and $t = t_n$



Hello, Quantum Mechanics

- ***Planck Time***: In quantum mechanics, the Planck time is the unit of time in the system of natural units known as Planck units. A Planck unit is the time required for light to travel in a vacuum a distance of 1 Planck length, which is approximately 5.39 × 10^−44 s. Theoretically, this is the smallest time measurement that will ever be possible.
- *In comparison*: a **Time Unit** (TU) is defined as 1024 µs for use in engineering.
- ***Planck length***: is 1.6 x 10^{-35} metres = 0.00000000000000000000000000000016 meters. (An atom size is about 0.0000000001 meters).

Time Dilation

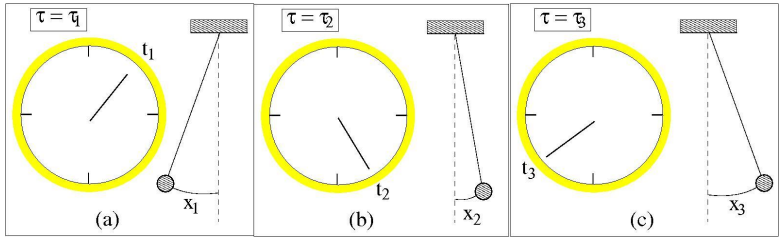
- According to the theory of relativity, **time dilation** is a difference in the elapsed **time** measured by two observers, either due to a velocity difference relative to each other, or by being differently situated relative to a gravitational field. (*Motion, or rate of change of position is necessary for the effect to take hold*)

- (Hendrik) Lorenz and (George Francis) Fitzgerald in 1897/1905/1907

$$t_v = t_0 / \sqrt{(1 - v^2/c^2)}$$

A clock in a moving frame will be seem to be running "slow". As **v** increases towards **c**, the clock slows further.

Worlds Collide!



To describe the world, we do not need the time variable: what we need is a theory of **variables that change** with respect to each other and actually describe it and provide a continuous definition of "WHEN". Like the hands of a clock.

But the idea that there is some other universal thing with a flow and direction to which all things can be compared, or which should be included in equations may just be nothing other than an unfounded idea

Thus the 'problem of time' i.e. the problem of linking apparently directional classical time with apparently bi-directional Quantum Time, may not be a genuine problem but a false problem that arises only with the insistence of the (possibly) incorrect idea that 'time', with or without a direction may exist.

Thus the worlds of "hard" mechanics and "soft" philosophy might coexist, even if not yet happily.

A Third and Fourth Curious Thing

3. A *leap-second* is applied to Co-ordinated Universal Time to keep it close to Mean Solar Time. Since 1972, 27 leap-seconds have been inserted, including one on 1 January 1980.
4. Dimensionally, the period of a pendulum T = 2. π.SQRT(L/L/T^2), which reduces to T= constant.T

Thus, and incidentally, a pendulum with period of precisely 1 second cannot be made.

$$T = 2\pi \sqrt{\frac{L}{g}}$$

Getting Ahead of Ourselves

There is a long history of trying to see the future and of trying to manage it to advantage:

- Forecasting/Fortune telling (eg: Delphic and other oracles; Tarot cards)
- Prophecy (eg: many in the OT; Nostradamus; The Brahan Seer)
- Dreams (eg: JW Dunne – An Experiment with Time)
- Gambling/Betting (eg: the Racing Post; Probability maths)
- Future proofing (eg: the weather report; (*tech*)not requiring updating as things change)
- Anticipation (eg: Game Theory; Choice Theory; comms theory)
- Forward Planning (P^6) (eg: PERT and MS Project)
- Retro-causality (eg: Wheeler*-Feynman Absorber Theory; Hume's and Kant's dismissal)

*remember him?

Because someone is going to ask…….

Feynman and Wheeler obtained this result in a very simple and elegant way. They considered all the charged particles (emitters) present in our universe and assumed all of them to generate time-reversal symmetric waves. The resulting field is

$$E_{\mathrm{tot}}(\mathbf{x},t) = \sum_n \frac{E_n^{\mathrm{ret}}(\mathbf{x},t) + E_n^{\mathrm{adv}}(\mathbf{x},t)}{2}.$$

Then they observed that if the relation

$$E_{\mathrm{free}}(\mathbf{x},t) = \sum_n \frac{E_n^{\mathrm{ret}}(\mathbf{x},t) - E_n^{\mathrm{adv}}(\mathbf{x},t)}{2} = 0$$

holds, then E_{free} being a solution of the homogeneous Maxwell equation, can be used to obtain the total field

$$E_{\mathrm{tot}}(\mathbf{x},t) = \sum_n \frac{E_n^{\mathrm{ret}}(\mathbf{x},t) + E_n^{\mathrm{adv}}(\mathbf{x},t)}{2} + \sum_n \frac{E_n^{\mathrm{ret}}(\mathbf{x},t) - E_n^{\mathrm{adv}}(\mathbf{x},t)}{2} = \sum_n E_n^{\mathrm{ret}}(\mathbf{x},t).$$

The total field is retarded, and causality is not violated.

In the absorber theory the same concept is used, however, in presence of both retarded and advanced waves. The resulting wave appears to have a preferred time direction, because it respects causality. However, this is only an illusion. Indeed, it is always possible to reverse the time direction by simply exchanging the labels *emitter* and *absorber*. Thus, the apparently preferred time direction results from the arbitrary labelling.

So I do have to mention *Causality*, or One thing leads to another!

We (probably) all agree the distinction between

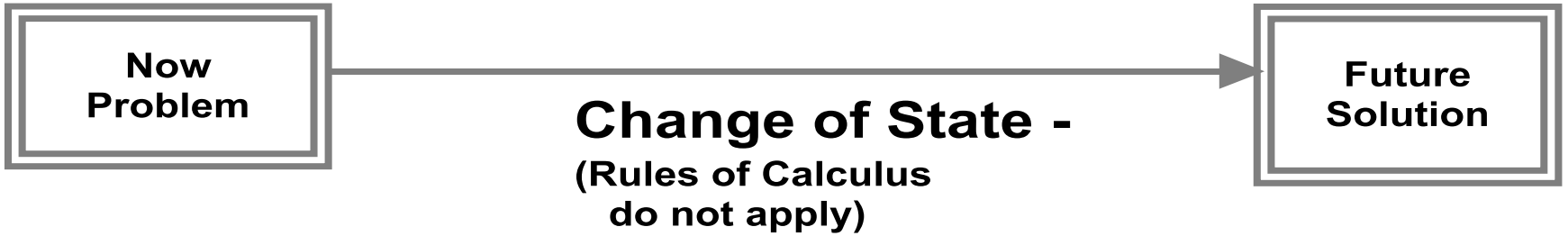
- Correlation: constant conjunction
- Contiguity: cause and effect placed next to each other

Hence one may agree with *temporal priority* and a *causal chain*.

NB: Arguments at the quantum level are based on empirics or theory but with so much unknown there is paradox and incompatibility between theories and discoveries.

But I am a believer in cause and effect(or) no effect without a cause

Explaining a Plan – outcomes in a probabilistic world



Sum of n activities => Plan

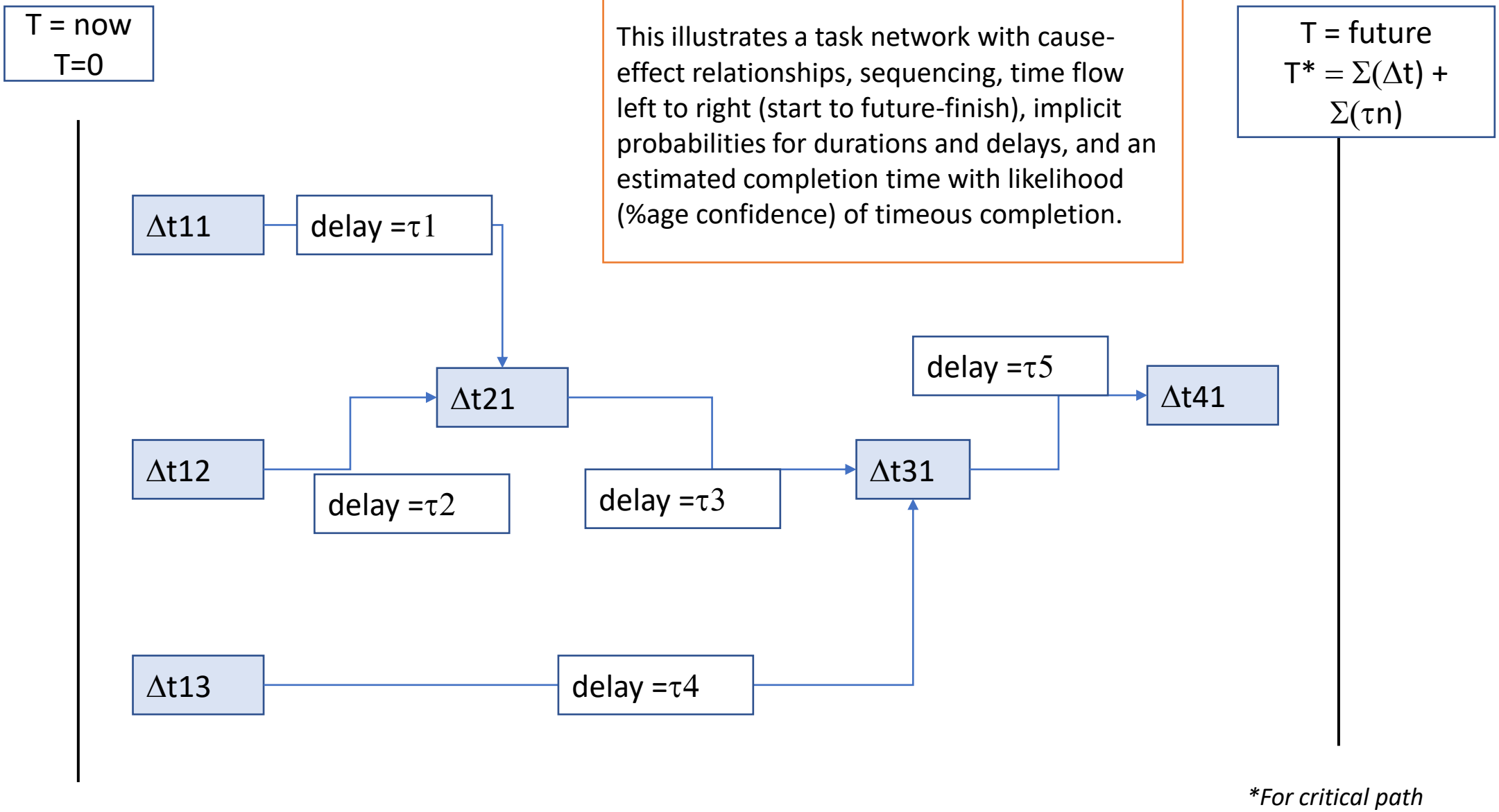
* **duration of content**
* **defined outcome for completion**
* **sequence**
* **estimation of contingency**
* **probability of completion on time**

C requires B requires A

A permits B permits C

Causation may/must be assumed backwards&forwards
Passage of time is very real
Requirement is to deliver the Change of State

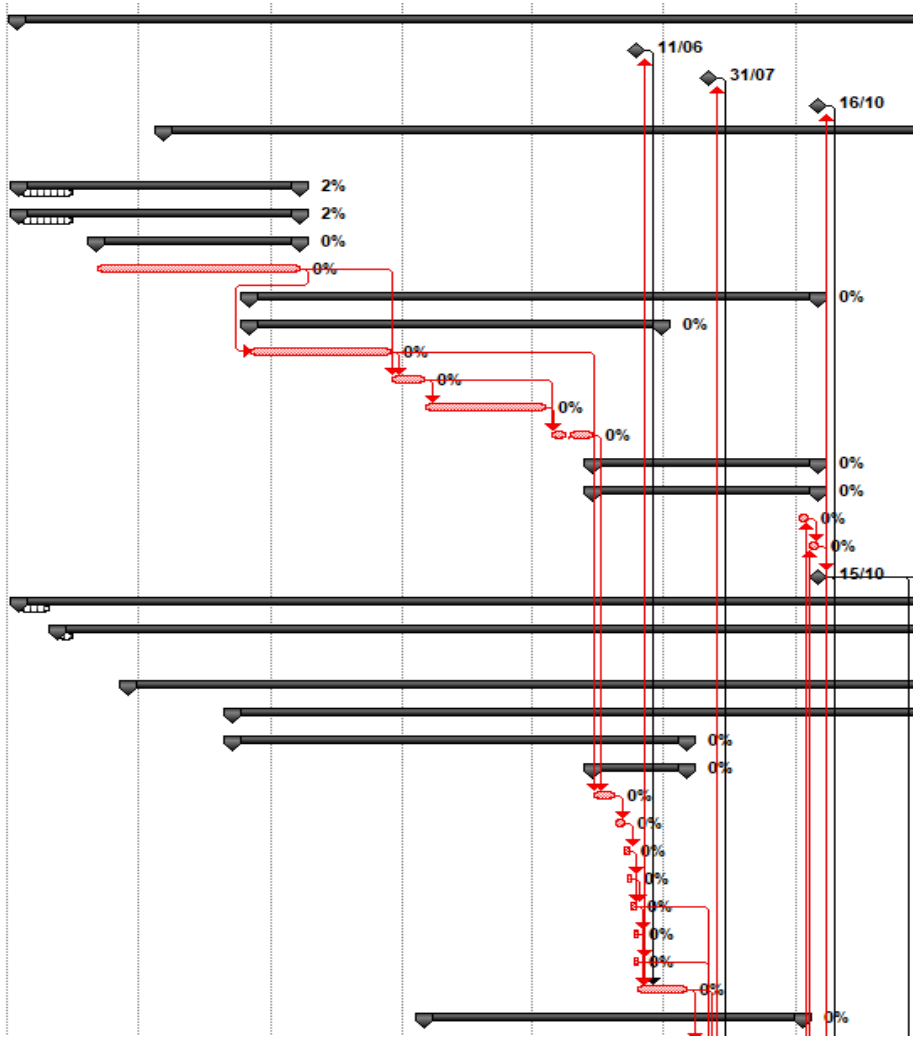
Absorbing the Uncertainty of Duration



*For critical path

Planning in a Probabilistic World

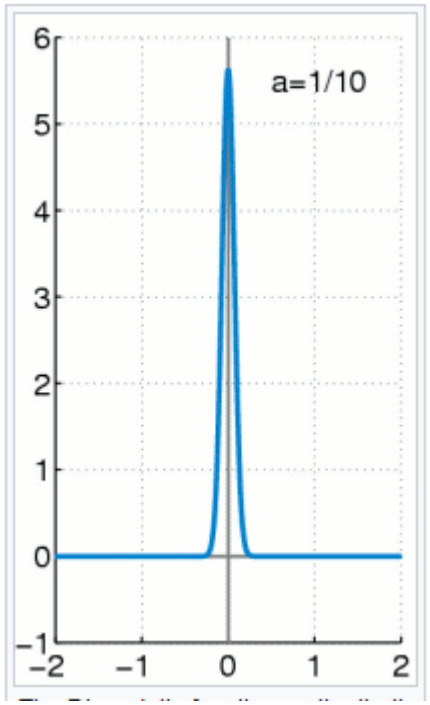
Project Milestones	**619.88 days**	**0%**	**Tue 08/04/08**	**Wed 29/09/10**
OJEU Published	0 days	0%	Thu 11/06/09	Thu 11/06/09
PQQ Issued	0 days	0%	Fri 31/07/09	Fri 31/07/09
ITPD Descriptive Document Issued	0 days	0%	Fri 16/10/09	Fri 16/10/09
Internal Gateway Reviews	**650 days**	**0%**	**Fri 18/07/08**	**Mon 28/02/11**
Internal Gateway 5	0 days	0%	Mon 28/02/11	Mon 28/02/11
contract scope/content	**136.88 days**	**2%**	**Tue 08/04/08**	**Mon 20/10/08**
P21+ framework optioneering	**136.88 days**	**2%**	**Tue 08/04/08**	**Mon 20/10/08**
System (IT/IS)	**100 days**	**0%**	**Mon 02/06/08**	**Mon 20/10/08**
Metrics, KPIs and VfM calculations	100 days	0%	Mon 02/06/08	Mon 20/10/08
Requirements	**270 days**	**0%**	**Tue 16/09/08**	**Thu 15/10/09**
H/L Requirements Spec.	**193 days**	**0%**	**Tue 16/09/08**	**Mon 29/06/09**
Produce H/L Requirements Spec	70 days	0%	Tue 16/09/08	Mon 22/12/08
Review H/L Requirements Spec in Project	10 days	0%	Tue 23/12/08	Thu 15/01/09
Requirements Consultation Period	60 days	0%	Fri 16/01/09	Thu 09/04/09
Update H/L Requirements Spec	20 days	0%	Tue 14/04/09	Tue 12/05/09
Business Requirements Specification	**110 days**	**0%**	**Wed 13/05/09**	**Thu 15/10/09**
Detailed Requirements Spec	**110 days**	**0%**	**Wed 13/05/09**	**Thu 15/10/09**
Gain Assurance for Detailed Requiremen	5 days	0%	Fri 02/10/09	Thu 08/10/09
Sign Off Detailed Requirements Spec	5 days	0%	Fri 09/10/09	Thu 15/10/09
Issue Detailed Requirements Spec	0 days	0%	Thu 15/10/09	Thu 15/10/09
management & control	**721.88 days**	**6%**	**Tue 08/04/08**	**Mon 28/02/11**
QA	**703 days**	**29%**	**Tue 06/05/08**	**Mon 28/02/11**
OGC Gate 5	3 days	0%	Thu 24/02/11	Mon 28/02/11
Procurement Solution	**567 days**	**0%**	**Tue 24/06/08**	**Wed 29/09/10**
Procurement (Competitive Dialogue)	**436 days**	**0%**	**Thu 04/09/08**	**Wed 09/06/10**
Qualification Stage	**214 days**	**0%**	**Thu 04/09/08**	**Thu 16/07/09**
OJEU Notice Phase	**46 days**	**0%**	**Wed 13/05/09**	**Thu 16/07/09**
Produce OJEU Notice	10 days	0%	Wed 13/05/09	Wed 27/05/09
Review OJEU Notice	5 days	0%	Wed 27/05/09	Wed 03/06/09
Update OJEU Notice	2 days	0%	Thu 04/06/09	Fri 05/06/09
Assure OJEU Notice	2 days	0%	Fri 05/06/09	Mon 08/06/09
Sign Off OJEU Notice	2 days	0%	Tue 09/06/09	Wed 10/06/09
Issue OJEU Notice	1 day	0%	Thu 11/06/09	Thu 11/06/09
Publish OJEU Notice	1 day	0%	Thu 11/06/09	Thu 11/06/09
Expressions of Interest Period	25 days	0%	Fri 12/06/09	Thu 16/07/09
PQQ Stage	**182 days**	**0%**	**Fri 16/01/09**	**Mon 05/10/09**

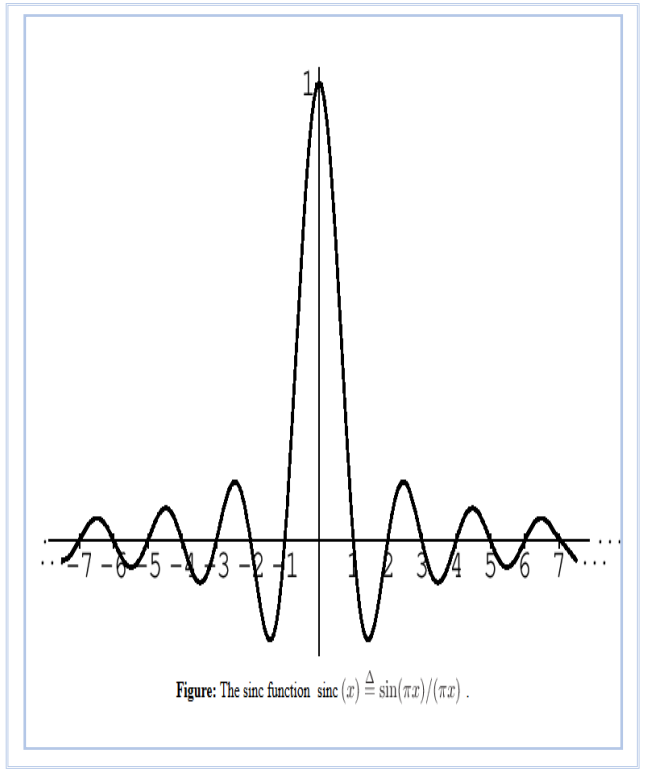


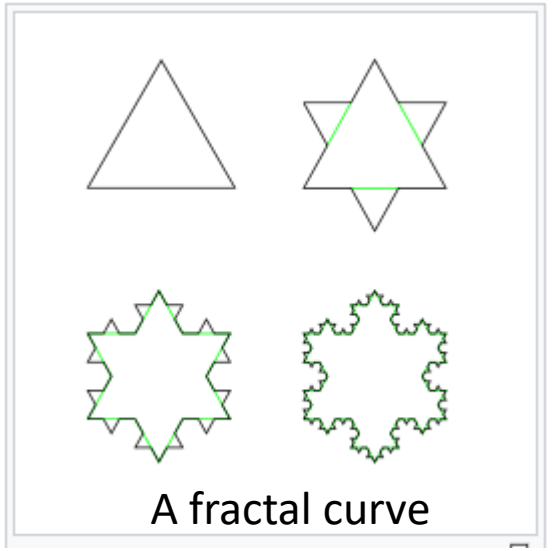
Time in Two Different /Fields

Infinite length in finite area – Koch Snow Flake – infinite time to traverse

Dirac spike: time (t=0) to frequency (f>0 at t<0)







A Fifth Interesting Thing

An **isochronous curve** looks like a catenary, a curve with which we are all familiar as it is the curve of a suspended telephone wire, or a power line. If the isochronous curve is considered as a frictionless track down which marbles may run, then it has the property that if two marbles are released at the same time form arbitrary points on either side of the middle, then they will meet in the middle no matter from where they were each released.

This seems counterintuitive and one might easily wrongly guess that a marble acting simply under gravity would take different lengths of time to travel different distances along the same track.

Information Theory and Signal/Data Analysis

- In **computability theory**, the **halting problem** is the **problem** of determining, from a description of an arbitrary computer program and an input, whether the program will finish running (i.e., **halt**) or continue to run forever. **The halting problem** is perhaps the most well-known problem that has been proven to be undecidable; that is, there is no program that can solve the halting problem for general enough computer programs
- Turing proved that for some kinds of computer program, it would never be possible to predict whether or not the program would ever finish: RUNTIME -> ∞
- In **information theory**, the ability to recover **sense from partial or noisy signals** (*eg: send 3s/4d, we are going to a dance*) employs the concept of entropy (disorder) to recover data.
- Time series **analysis** comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series **forecasting** is the use of a model to predict future values based on previously observed values. Time series data have **a natural temporal ordering**. This makes time series analysis distinct from cross-sectional analysis where the data could be entered in any order, and also from special data analysis where the observations typically relate to geographical locations. Time series models will often make use of the **natural one-way ordering of time**.

Time Reversal Symmetry (at last!)

- *T-symmetry* is the theoretical symmetry of physical laws under the transformation of time reversal. It can be shown to be equivalent to the conservation of entropy. As the second law of thermodynamics does not permit entropy to be conserved in general, it follows that the universe does not in general show symmetry under time reversal: time is said to be non-symmetric, or asymmetric.
- *A mathematical or physical process* is **time-reversible if** the dynamics of the process remain well-defined when the sequence of time-states is reversed.
- *A deterministic process* (no randomness is involved in the development of future states of the system) is **time-reversible** if the time-reversed process satisfies the same dynamic equations as the original process under a change in the *sign* of time.
- *A stochastic process* is **time-reversible if** the statistical properties of the process are the same as the statistical properties for time-reversed data from the same process.
- *Thermodynamic processes* **can be reversible or irreversible**, depending on the change in entropy during the process.
- *Time reversal signal processing* is a process which is used to reverse a received signal. Time-reversal mirrors (TRMS) are made of large transducer arrays, allowing the incident field to be sampled, time-reversed and re-emitted. Time-reversal of fields allows a very efficient approach to focus pulsed waves through inhomogeneous media.

Entropy is the thermodynamic arrow of time

- Entropy suggests (proves?)unidirectionality of time
- Second Law states entropy (in a closed system) tends to increase with time
- A system becomes more disordered with time
- Rate of change of entropy is not determinable
- Entropy cannot be used as a measure of time
- Entropy does not require an observer for it to increase
- *Why do hot things pass heat to cool things and not the other way around.*

- Boltzmann determined that the answer to the last point is: BY PURE CHANCE

So, while entropy seems to be unidirectional, underpinning this apparent fact is a probability which may suggest to you that the direction of time is purely probabilistic in nature and in Nature

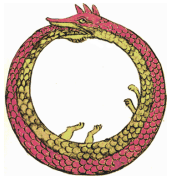
Something Rotting in the State of Ukraine

The second law of thermodynamics states that the total entropy of an isolated system can never decrease over time. In all spontaneous processes, the total entropy always increases, and the process is irreversible. The increase in entropy accounts for the irreversibility of natural processes, and the asymmetry between future and past.

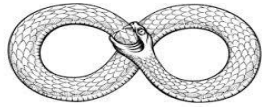
Entropy has often been loosely associated with the amount of order or disorder, or of chaos, in a thermo- dynamic system. The traditional qualitative description of entropy is that it refers to changes in the status quo of the system and is a measure of the amount of wasted energy in a transformation from one state or form to another.

We (are forced to) Recognise Philosophy & Theology……

- Fatalism - a philosophical doctrine that stresses the subjugation of all events or actions to destiny; that we are powerless to do anything other than what we actually do; that humans have no power to influence the future, or indeed, their own actions.[
- Eternalism - a philosophical approach to the ontological nature of time, which takes the view that all existence in time is equally real.
- Aeviternity - In Scholastic philosophy (qv Aquinas), the mode of existence experienced by angels and by the saints in heaven. It is a state that lies between the eternity (timelessness) of God and the temporal experience of material beings.
- Eschatology - a branch of theology concerned with the final events in the history of the world, the end of the world, or the ultimate destiny of humankind. Does the end of the world imply the end of time? *And behold I am with you until the consummation of the world. (Matthew, 18.xx)*



Types of Eternity and Infinity



- Eternity is considered to be outside of time, with no beginning and no end. “Eternity” is often used when what is really meant is “everlasting” or “never ending” or “sempiternal,” that is, having a beginning but lasting indefinitely.

Two types of eternity:

- The everyday experience of time: present receding into past and being replaced by the future = **never-ending succession** extending to infinity
- Eternity outside of time and **non-successive**:
  - God with angels and saved souls who share the Beatific Vision, **Aeviternity**
  - “The **fire of hell** is called eternal only because it never ends.” (Aquinas)

- The Jain mathematical text Surya Prajnapti (c. 4th–3rd century BCE) classifies all numbers into **three** sets: **enumerable, innumerable, and infinite**.
- “Infinity” is an abstract concept of boundlessness. “Infinity” cannot be physical. For example, there is an infinity of mathematical points between two bookends, but there cannot be an infinity of books between them.

Two types of infinity:

- Both the real world and on-paper infinities can all generally be described via functions, sets, and irrational numbers, and all relate back to mathematics. From this perspective, we can say the **two main types of infinities area: countable and uncountable** (infinite sets). There are many other kinds of infinity that can be placed in these two broad categories.

I do not Believe McTaggart is Real

F@!!¬*ng Hell!! Seems like I have wasted my life!

1. Time is real only if real change occurs.
2. Real change occurs only if the A-series exists.
3. The A-series does not exist.
4. Therefore, time is not real.

Time as a Social Construct

- A social construction is something that a group of people create and maintain. Our experiences about time come from clocks: we feel that there is no time without a clock.
- Time is very real, but it's a real social construction. It's not so important that we know what time it really is. It's only important that we know what time everyone around us thinks it is.
- We measure time not simply in terms of minutes and seconds, but in terms of concepts such as "early," "late", "soon".
- Is "half a mo" longer or shorter than "two shakes of a nanny goat's tail" ?
- The Thomas Theorem (1928 WI & DS Thomas): " if men (sic!) define situations as real, they are real in their consequences."

The End of Time

- **Richard Feynman** (1918-88), Bongo player, safe cracker, Nobel Laureate, once quipped that "Time is what happens when nothing else does."
- **Julian Barbour** (b. 1937) physicist and historian of science, opines: "Change merely creates an illusion of time, with each individual moment existing in its own right, complete and whole…if nothing happened, if nothing changed, then time would stop. For time is nothing but change."
- **Sean Michael Carroll** (b. 1966) cosmologist and physics professor: "The problem is not that I disagree with the timelessness crowd, it's that I don't see the point….If anyone could spell out straightforwardly what I might be able to understand by thinking of the world in the language of timelessness, I'd be very happy to re-orient my attitude and take these works seriously."
- **Heywood "Woody" Allen** (b. 1935) American director, writer, actor, and comedian: "Eternity is an awfully long time, especially towards the end."