

About Time

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Introduction

In Western-inspired cultures, our single word “time” has about as many meanings as the many *different* words that the Arctic Inuit are said to have for snow. So, even from the viewpoint of literature, time is a complex idea to categorise. But when it comes to the physics, philosophy and psychology of time, the task is even more slippery – roughly in that order of difficulty.

Perhaps the main overriding idea about all the sorts of time we can envisage is that

*Time sets the stage for our exploration of **relationship** and **transformation**.*

Our aim in these notes is to look mainly at the physical understanding of time, for three reasons:

1. it is closer to the nitty-gritty reality of daily business, since we are concerned with “clock time”.
2. Physical time – whatever it is – puts certain logical limits on what non-physical ideas of time (personal, mythical, theological, etc.) can mean to us.
3. Dealing with concepts of time (and space) acts as a sort of release on the imagination, which can help us to navigate the more elusive sorts of time.

Different Times

The table below gives a rough idea of the three domains of thought about time: what they are, how they compare; what to look for in thinking about them. Note an important feature: *each category interacts with its neighbouring one*.

Physical time	Cognitive time	Mythical/theological time
← <i>chronos</i> → “my appointment is at 9:40 ”	→←	<i>kairos</i> → “my time is not yet come”
measured [clocks]	experienced [life events]	ritualised [gives meaning]
causality	layering (like lasagna)	time-lessness; eternity
irreversibility	life-changing	immanent purpose
history	memory	<i>anamnesis</i> ; re-presentation

Time: object or invention?

Following Wittgenstein, we might argue that the meaning of “time” depends on the *use* we make of that word, in communicating with one another.

In physics we use “time” to denote a *sequence* of states *recorded* from a measuring device; the sun (sundial), a pendulum or spring (classical clock), or atomic transitions (quantum clock). This involves an understanding of three concepts:

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|---------------------|--|
| simultaneity | - what clock reading coincided with the event? |
| memory | - what did we record the previous time? |
| prediction | - what will happen the next time? |

Although all these elements engage us in well-understood procedures that anyone can reproduce, notice that they make sense only in a complex network of *linguistic* and therefore *social* conventions.

Question. Why is communicating the truth the central ethical principle in science?

- Because lying about results undercuts the faith that we need in the regularity and reproducibility of scientific knowledge. And this is clearly bound up with our understanding of passing on knowledge through our communities *and* through time.

A brief history of time (& space) in Western physics

“My own suspicion is that the universe is not only queerer than we suppose, but queerer than we *can* suppose” — J. B. S. Haldane

1. Pre-Galileo—Newton:

space and time are absolute. Perfect space and time are manifest in the Heavenly order (Music of the Spheres, etc.). Earth is the immobile centre of all space. Time is divinely ordained to be the same everywhere.

Motion is absolute. Perfect motion is seen in the progress of the Crystal Sphere containing the stars. But some “stars” (the Planets) have proper motions (i.e. they are carried by other heavenly spheres moving separately).

The laws of heavenly motion are pure; the laws of earthly motion are not.

2. Galileo—Newton:

Motion is defined relative to the observer. There is no preferred point or favoured centre in space. But time remains absolute.

Forces are of two kinds: contact forces (such as a cue striking a billiard ball) and action-at-a-distance forces (gravitational attraction between any two bodies).

3. Faraday—Maxwell:

The finite speed of light means electric and magnetic forces *propagate* (*spread out*) *in space and in time* (“fields” of force). Finite propagation means that space and time are always connected; we must deal with them *together*.

There are no instantaneous forces or action-at-a-distance forces. [But: does there exist some medium to transmit the would-be action-at-a-distance forces by contact – the *aether*???

4. Einstein (special relativity):

Space and time are both measured relative to a uniformly moving observer.

There is no aether. There are no contact forces, only extended fields.

The *speed of light*, the *form of the force laws*, and the *causal ordering* of physical processes are the same for (uniform) observers.

Space and time must be considered as a whole. But “space-time” does not have a history of its own; it is still the permanent stage on which all physical events act themselves out.

Simultaneity is relative. That is: there are pairs of events such that that one may be seen to happen before the other to some observers, and vice versa to other observers (so these cannot be causally linked, or lie “inside the light cone”).

5. Einstein (general relativity):

All observers are equivalent *whether or not* they move uniformly.

There are no forces; only the geometry of space and time, which may be *curved*. (Natural motion may not be on straight lines.)

Only the *speed of light*, the *form of the laws of motion*, and the *causal ordering* of physical events are the same for all observers.

The laws of motion also describe the evolution of *space-time*;

time and space are transformable and evolving physical entities. But they keep their meaning as the *absolute framework* within which everything happens.

The universe cannot be static. Einstein's equations *require it* to evolve.

Some formally valid solutions to the equations contain time paths that *loop back on themselves*. So “cause” and “effect” may not have absolute meaning [Goedel].

6. Quantum mechanics:

Events cannot be located at some infinitely precise space-time point.

At least looking forward into the future, *there are no unique causal sequences*. Each belongs to a family of possible futures.

When and how an event is measured will affect not only its future but the history that links it with its past.

The observed history of an event is a “quantum sum” over all possible sequences - including some that are non-causal (i.e. lying *outside* the light cone).

7. Quantum cosmology:

General relativity and quantum theory are mutually exclusive in their current forms. Indications are that, to bring them together, a more fundamental conception has to be found. In this hypothesised future theory,

space and time may no longer play the role of an absolute framework within which everything happens.

It may turn out that space-time will emerge from a more primitive set of entities [just as the co-operative motion that we perceive of water waves emerges out of the underlying, collective interactions of the basic water molecules]. An older way of saying this is that space-time may be an *epiphenomenon* of some more basic reality.

If time and space are not basic, will a window open onto other space-times, beyond our weirdest dreams? We cannot know. There is little if any inkling of what that deeper conceptual level may be. All we know for sure is that someone will keep on challenging this ignorance as long as quantum and gravity theories are in conflict.

Lessons & Exercises

Space and time not “unmoved movers” in physical history: they are
subject to physical laws.

Whether physical space and time have a beginning and/or end, or whether they last indefinitely, is a question of *observation*. Myth and theology have nothing to tell us about physical time.

Try to visualise the history of the universe as a salami. It is an organic whole, but what we perceive is only a set of separated slices. Their ordering is our perception of time flow. But this is a *perception*; it is not the underlying reality of the whole.

Consider the outside-of-time quality of fairy tales (“Once upon a time, in a galaxy far far away...”) and of dreams. They run within our awareness as stories or dramas, but we never have a sense that they are located in history. They do not belong in physical time. The same might be said of the Aboriginal Creation dreamings, and perhaps of the Adam and Eve story.

Dom Gregory Dix once described the Holy Spirit as the mediator of a “mutual repercussion of the eternal with the temporal”. In other words, *kronos* (physical time) and *kairos* (divinely ordained “time”) are somehow interdependent. We see this played out at length in both Testaments. Whatever it is that governs time (and thus space), according to Dix's theology there must be a corresponding dynamic behind God's time (and space). But we cannot, need not, and properly should not attempt to, translate this into physics. It is inherently of myth.

The Eucharist and Time

Dix sheds light on one of the implications of the Eucharist: it is a corporate action whose “shewing”, or culminating purpose, is already accomplished — only not yet overtly so. Like its original, the annual Seder (Passover meal) in Judaism, for us the Eucharist takes place in physical time. But the intent of each remembrance is, in its own way, to incarnate the permanent covenant between God and humanity — and to *weld God and humanity into a whole*. (This makes a link to eschatology: the theology of God's ultimate provision for His creatures.)

Think back to the whole space-time salami (or pastrami, if you keep Kosher...). In Communion we fulfil Jesus' legacy by “recalling” into temporal, social and personal presence the real, once-and-future, presence of God. That presence is held by believers to run — harmoniously and undividedly — right through world history. It is God's universal *kairos*.

The permanent sign and guarantee of this once-and-future Eucharistic presence is the “once-for-all” redemptive action of Cross and Resurrection (and, of course, vice versa; to Christian sensibility they are indivisible). This is, by deliberate intent, the *precise* parallel of the once-for-all Passover liberation of the Hebrews from Egypt, whose establishment is yearly affirmed in the ritual Seder meal.

Peter Burrows puts it as follows. At the Seder, the Haggadah is ritually read: it is the foundational Exodus story of God's liberation of Israel from slavery. Do I hear in it

the story of my forebears? Yes, and much more: it is *my and your* story, witnessed Now. Who is redeemed within the moment? *I* am, with my impermanence, standing in continuity with the whole community: past, present, future.

At the Eucharistic rite, the Words of Institution are ritually read over the gifts: it is the foundational Last Supper story opening up the Passion and its power to free us from our own alienation. Do I hear my forebears' story? Yes, and much more: it is *my and your* story, in the Now. Who is redeemed within the moment? *I* am, with all my impermanence, standing in continuity with all humanity: past, present, future.

In their respective traditions each of these instituting events of religious history has been subsumed, *qua* divine covenant, into the Godhead's mythic timelessness. Yet, to this day, each is actualised within its community, *within physical time*, as a simple shared meal (where, at least in Judaism, the stranger is ever welcome). The meal becomes the *anamnesis* — a recollection that is an actual calling down — of the eternal presence of God, incarnated in the present Moment and liberating it from its bondage within time (read: coming to live in us and so free us from the inconstant wilfulness of our ego).

In one sense there is no Eucharistic anamnesis in God's timekeeping. For, each such commemoration *is* the Last (I.e. Fulfilled) Supper: "It is finished!" (John 19:30).

Does the anamnesis transform the physical world? No.

Does it transform the world's *meaning*, and that of time?

Definitely, for those who assent to, and freely enter, both its symbolism and its relational intent.

Does it transform our world's *future*?

This depends on whether we allow the mystical and timeless reality of God to transform our daily time-bound realities - and our relationships with them.

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