

Measuring Time

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PHI 171 - Fall 2014



*Time as
Expectation and
Memory*

Our First Course Topic:

Time and Change

Is time real? Is
time an illusion?

Does the world
change? Or is
change just an
appearance?

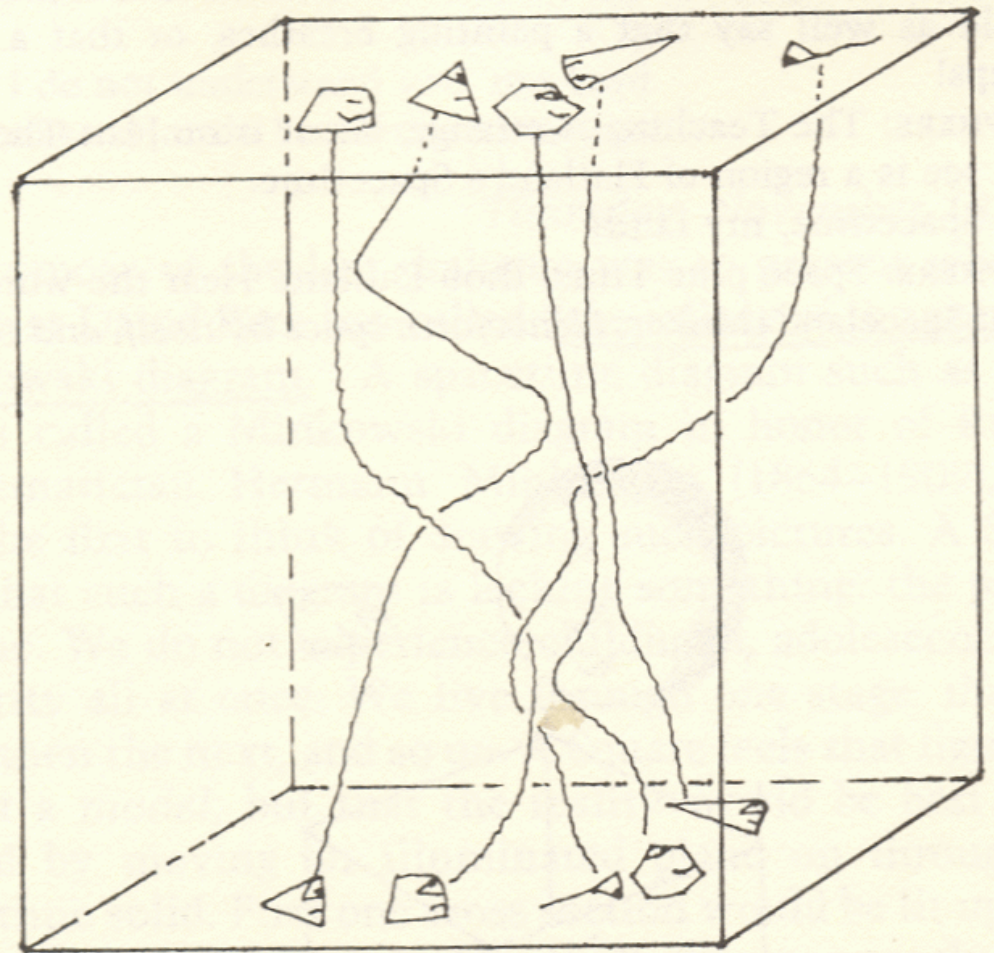
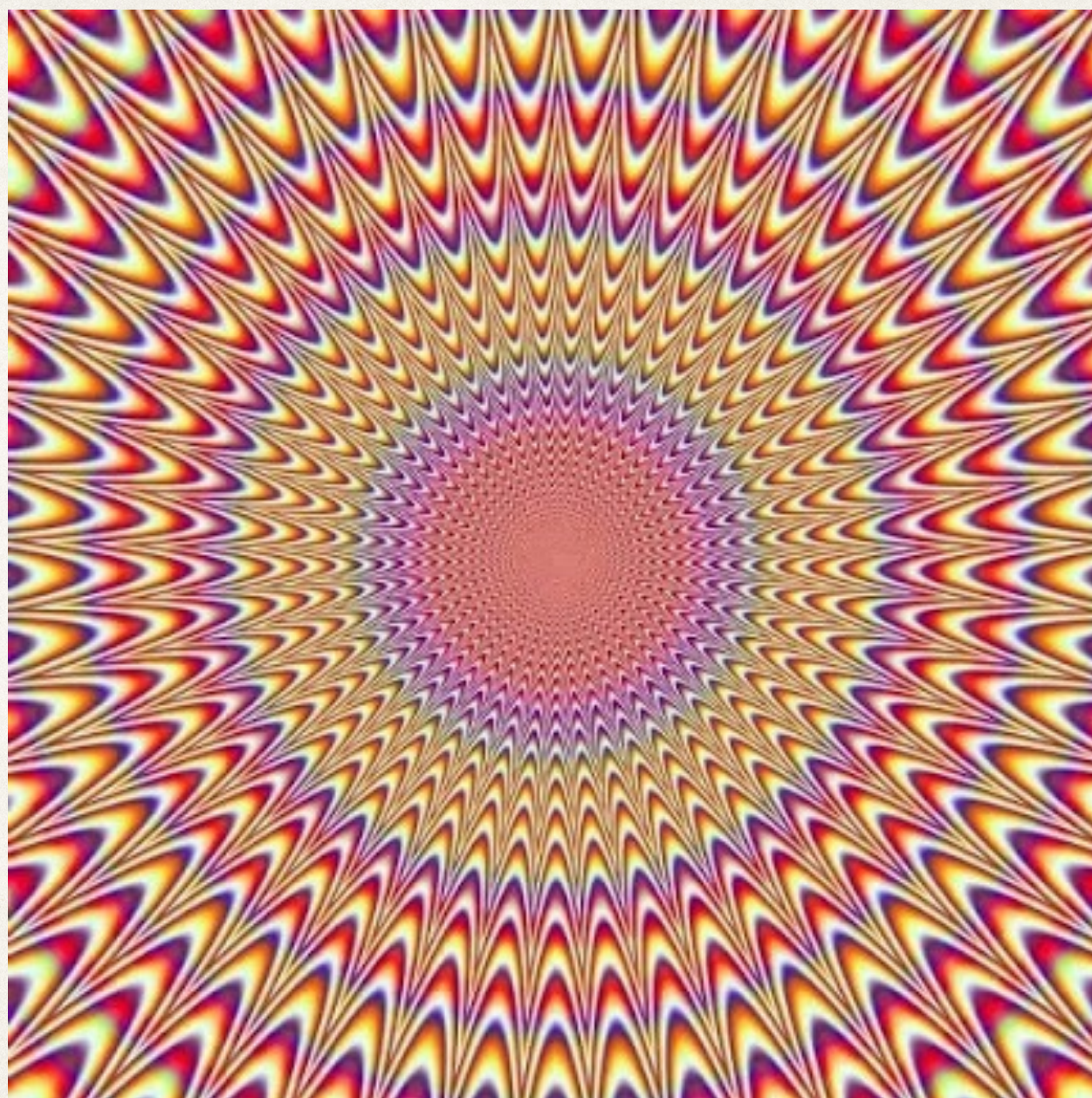


Fig. 140. A tangled tale.



From Monday Class:

Augustine's Puzzle About the Flow of Time

- ❖ The past does not exist: it does not exist anymore
- ❖ The future does not exist: it does not exist yet
- ❖ The present does not exist: it tends to non-existence

*How can we experience the flow of time if
past, present and future do not exist? Of what do we
experience the flow?*

A Further Complication: Measuring Time

How Do We Measure The Past and the Future?

And yet we say, “a long time” and “a short time”; still, only of time past or to come.

A long time past (for example) we call an hundred years since; and a long time to come, an hundred years hence.

*But a short time past, we call (suppose) often days since; and a short time to come, often days hence. **But in what sense is that long or short, which is not? For the past, is not now; and the future, is not yet.***

If We Cannot Measure the Past and the Future, Can We at Least Measure the Present?

Let us see then, thou soul of man, whether present time can be long ...

Are an hundred years, when present, a long time? See first, whether an hundred years can be present. For if the first of these years be now current, it is present, but the other ninety and nine are to come, and therefore are not yet, but if the second year be current, one is now past, another present, the rest to come. ...

But see at least whether that one [year] which is now current, itself is present; for if the current month be its first, the rest are to come; if the second, the first is already past, and the rest are not yet.

Therefore, neither is the year now current present ... neither is that current month present; but one day only; the rest being to come

The Present Cannot Be Measured Either Because it Has No “Space”

*If an instant of time be conceived, which cannot be divided into the smallest particles of moments, that alone is it, which may be called present. Which yet flies with such speed from future to past, as not to be lengthened out with the least stay. For if it be, it is divided into past and future. **The present hath no space.***

Augustine's Puzzle About Measuring Time

- ❖ The past does not exist: it does not exist anymore
- ❖ The future does not exist: it does exist yet
- ❖ The present has no space, no extension

*How can we measure time if past and future
do not exist and the present has not extension? Of what
do we measure that it is longer or shorter?*

Augustine Really Wants to Understand

My soul is on fire to know this most intricate enigma.

A Possible Solution?

*I heard once from a learned
man, that the motions of the sun,
moon, and stars, constituted
time...*

But This Solution is Mistaken

I ask, does the motion alone make the day, or the stay in which that motion is completed ...?

*For if the **first** be the day; then should we have a day, although the sun should finish that course in so small a space of time, as one hour comes to.*

*If the **second**, then should not that make a day, if between one sun-rise and another there were but so short a stay, as one hour comes to; but the sun must go four and twenty times about, to complete one day.*

Let no man then tell me, that the motions of the heavenly bodies constitute times...For that no body is moved, but in time

Let us Pause for a Moment

Augustine says that there cannot be movement but in time. *Therefore, he thinks that it makes no sense to define time in terms of movement.*

But if the world were completely still, immutable and unchanged, would there still be time? Augustine seems to think yes insofar as God created the world and time with it.

Augustine's Proposal — Finally! — Namely, Time as Protraction of the Mind

Whence it seemed to me, that time is nothing else than protraction; but of what, I know not; and I marvel, if it be not of the mind itself?

For what, I beseech Thee, O my God, do I measure, when I say, either indefinitely “this is a longer time than that,” or definitely “this is double that”?

*That I measure time, I know; and yet I measure not time to come, for it is not yet; nor present, because it is not protracted by any space; nor past, because it now is not. **What then do I measure? Times passing, not past? for so I said.***

The Mind is Being Measured, Not Time Itself

It is in thee, my mind, that I measure times.

...In thee I measure times; the impression, which things as they pass by cause in thee, remains even when they are gone; this it is which still present, I measure, not the things which pass by to make this impression.

This I measure, when I measure times. Either then this is time, or I do not measure times.

Time as Expectation and Memory

*Who therefore denieth, that things to come are not as yet? and yet, there is in the mind an **expectation** of things to come.*

*And who denies past things to be now no longer? and yet is there still in the mind a **memory** of things past.*

*And who denieth the present time hath no space, because it passeth away in a moment? and yet our **consideration** continueth, through which that which shall be present proceedeth to become absent.*

*It is not then future time, that is long, for as yet it is not: but a long future, is “**a long expectation of the future,**” nor is it time past, which now is not, that is long; but a long past, is “**a long memory of the past.**”*

Augustine on Measuring Time

...in Brief

QUESTION: When we say that an interval of time is shorter or longer than another, what do we measure as shorter or longer?

PUZZLE: We cannot measure the past because the past no longer exists, and what does not exist cannot be short or long. We cannot measure the future either because the future does not exist yet, and again, what does not exist cannot be measured. Finally, we cannot measure the present because the present has no extension at all. But if we cannot measure the present, the past or the future, what do we measure when we measure time?

ANSWER: Time only exists in the mind. We measure the *expectation* of an event, which can be long or short. We measure the *memory* of an event, which also can be long or short.

Did Augustine Offer a Satisfactory Solution? *Maybe Not...*

- ❖ What is a “long expectation”? What is a “long memory?”
- ❖ The mystery still persists: *If time is in the mind and if we measure time, then how do we measure the length of our mind?*
- ❖ We could measure the *intensity* of our memory, or the *feelings* that our memory triggers. But how do intensity and feelings give us criteria to determine the length of an event in time?

Aspects of our Experience of Time

- ❖ **The flow of time.** *Why cannot we experience the past or the future? Why does time seem to flow?*
- ❖ **Duration.** *How can a time period be longer than another?*

Did Augustine offer a satisfactory account of these two aspects of our experience of time?

Let's Now Turn from the Experience of Time to the Physics of Time

*Time in modern physics and the question of change
will be the topics of next week*