

atoms to quanta

from the Greeks to quantum mechanics

from science to metaphysics to ordinary life

david kolb, 2018

Nothing but
atoms and the void...

νόμωι (γάρ φησι) γλυκὺ καὶ νόμωι πικρόν,
νόμωι θερμόν, νόμωι ψυχρόν,
νόμωι χροιή,
ἔτεήι δὲ ἄτομα καὶ κενόν

By convention sweet and bitter,
By convention hot and cold,
By convention color,
but in reality atoms and the void.

(Democritus, quoted in the Tetralogies of Thrasyllus, 9. sext. adv. math. VII 135)

νόμωι

nomoi

do social norms come from

nomos or *physis*

by convention, law, decree

(i.e., as a result of some human act)

vs

by/in nature, in reality,

(i.e., as born, on its own)

...nothing but...

In truth, in reality, finally...

red / Apple

are you saying the *apple* isn't real?

But is not a fake, not made out of papier-mâché

are you saying the *red* isn't real

But what would a fake red be?

Maybe it all depends

on what you mean by "real"

Maybe: it's all "real"
but some is realer than others?

i.e. to *explain* what's happening
you only need to invoke the entities
mentioned on the lower level.

The other level is "made out of" the lower level.

what's on the upper levels is derivative
constructed out of, but not unreal

Explanatory primacy

ATOMS

a-tomon, plural a-toma, non-cut, non-division
uncuttable, indivisible, full, complete,

what they have:

shape, simple location

what they **don't** have:

weight, color, sight,
tendencies, goals,
potentialities. regularities,
laws, forces

ἄτομα

THE VOID

Kenos, Kenon, empty
(latin *vacuus, vacuum*)

to kenon, the empty thing, the void,

just that, no structure no limits

ΚΕΝΌΝ

the everyday world has
weight, color, sight,
regularities, cycles, patterns,
tendencies, goals, potentialities

perceptions, consciousness

how get from one to the other?

for the Greek atomists

mechanical explanations...

everything by contact and touch

no forces

details in the poem by Lucretius

PS: one additional motivation:

get rid of our fear

of the gods

and the afterlife

The major other option:
(Aristotle)

matter is continuous
and infinitely divisible

no void

then, natural motion,
and built-in potentialities

natural motion,
and built in potentialities

development over time:
apple trees and puppies

motion:

why does the stone fall when I let it go?

what Aristotle would say
what the Atomists would say

A third option: Plato

form and pattern are primary

no void, but a “receptacle” or “mother”
a shifting undefined basis
that is formed by mathematical pattern
into basic particles for the different elements

the Platonic solids,
constructed from
regular triangles

Theory stated
by Timaeus
not Plato or Socrates

Pythagorean ideas

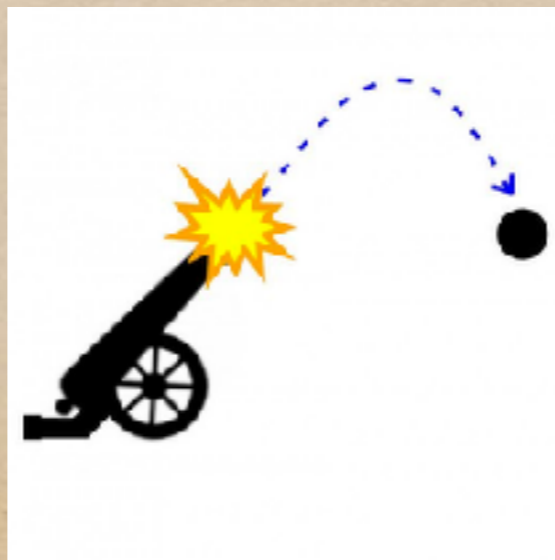
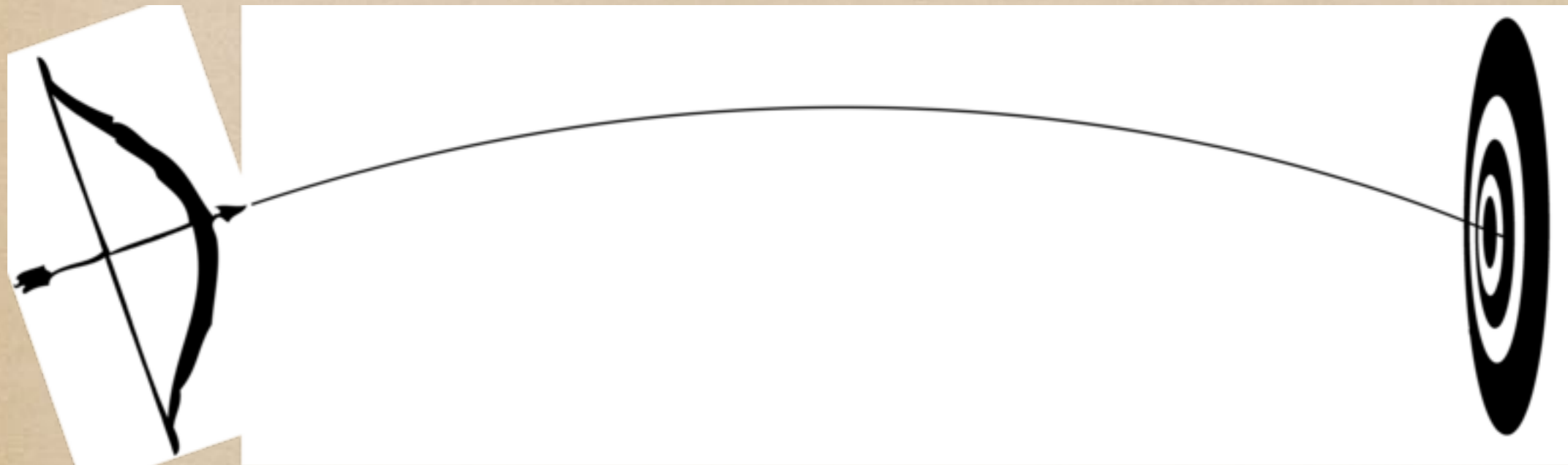
Greek Atomist matter
doesn't have
enough properties
or kinds of connections...
but the atoms
gradually
acquired ...

more intrinsic properties:
shape mass charge etc.

more ways of connecting
and influencing:
fields and forces

Way Station 1

projectile motion - a problem for everyone



Problems:

the ball keeps going up after I stop pushing it up,
—this contradicts Aristotle's idea of natural motion

but then it stops rising
then it curves down

—this contradicts the Atomist theory of motion

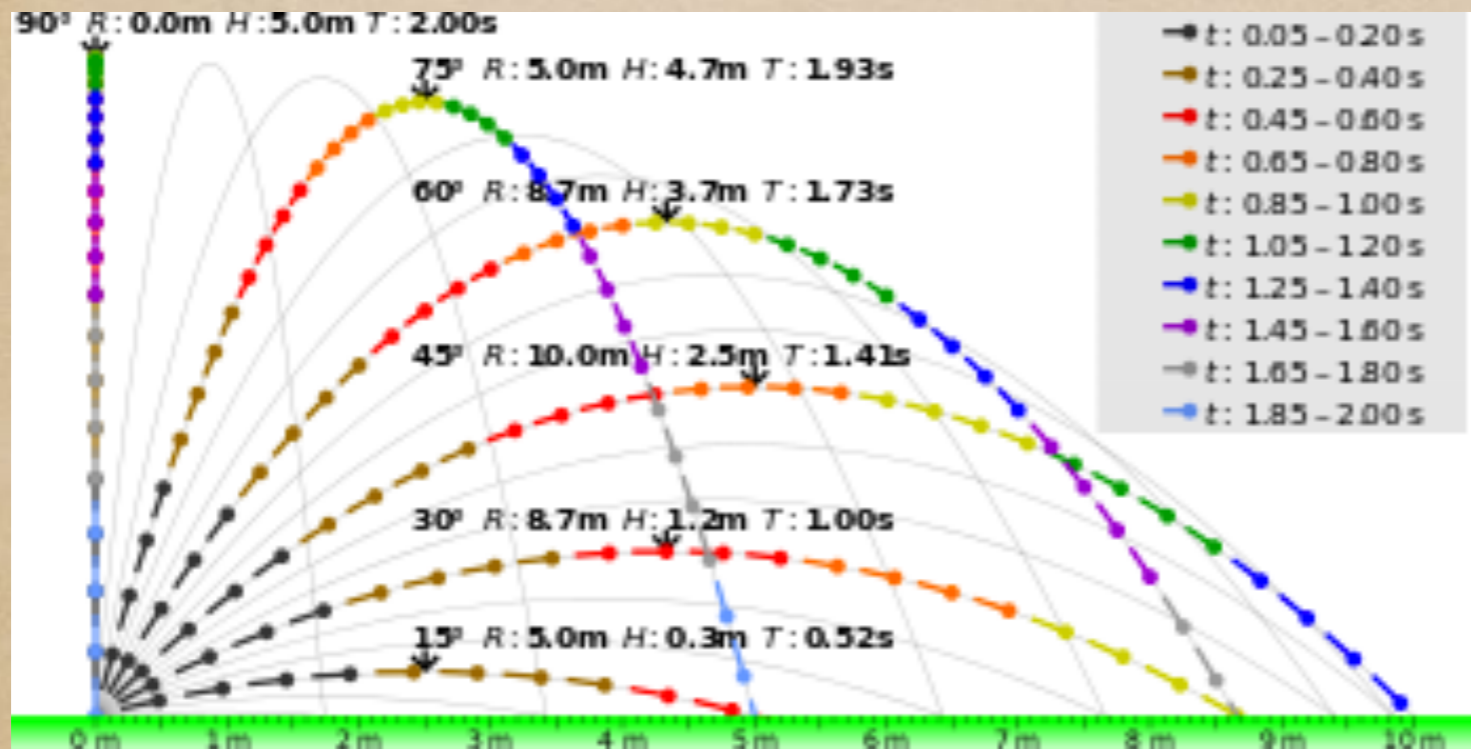
on a calculable path

—this suggests something is right about Plato's ideas

Problems:

the stone keeps going up,
but then it stops

something
appears
to have been
added
to the stone



then worn away

“impetus”

“impetus” handles
the first two problems

but not the third

the ball keeps going up,
but then it stops rising

it curves down,
following calculable paths

Galileo consulted at the
venetian Arsenale...

Way Station 2 the Newtonian model

Atoms,
plus a **force**, gravity,
with a law

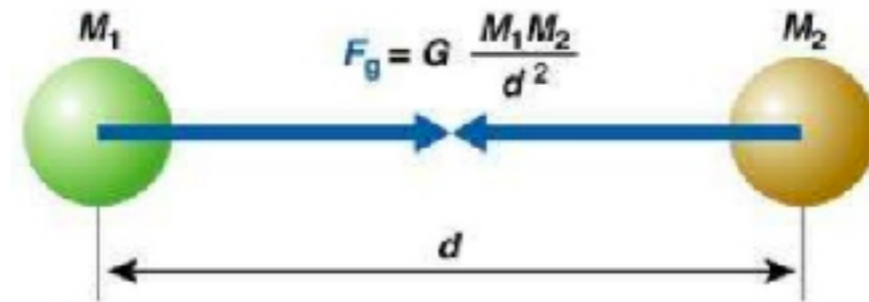
also **mass** (and so **inertia**)
as a new intrinsic quality of the atoms

Dependence on mass

Newton proposed that force of gravity also depended of mass, because his second law states that $F=ma$

- * He therefore had proved that the force of gravity between two objects was directly proportional to its masses.

$$\sum F = ma \quad F_{gravity} \propto \frac{m_1 m_2}{d^2}$$

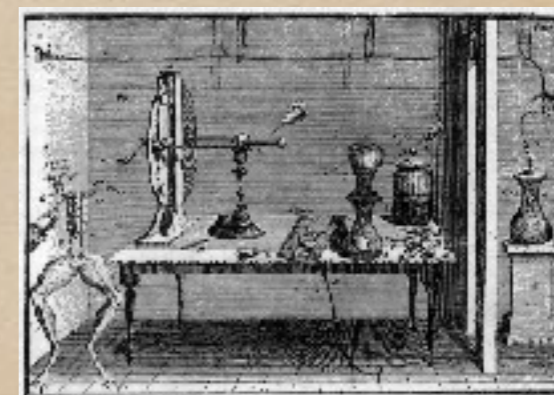
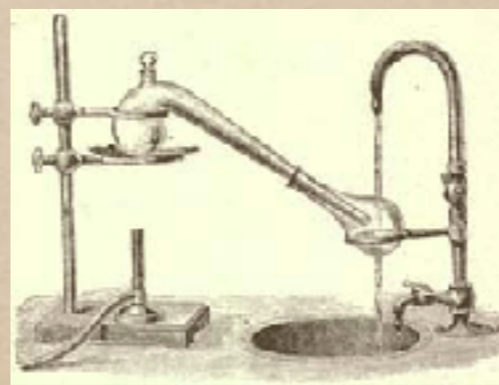


How does gravity work across empty space??

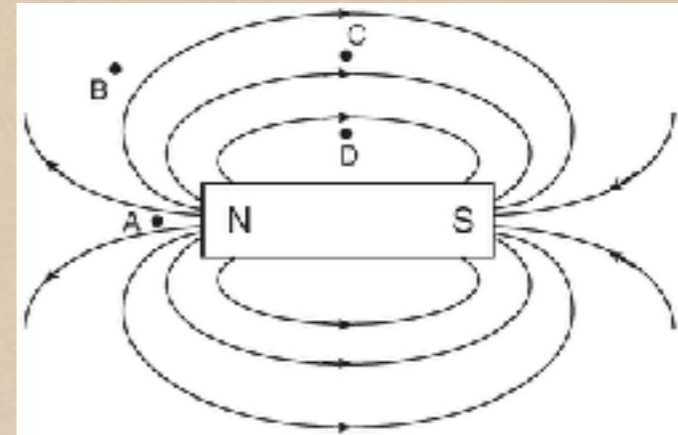
Hypotheses non fingo

Way Station 3
chemistry magnetism electricity
More forces...

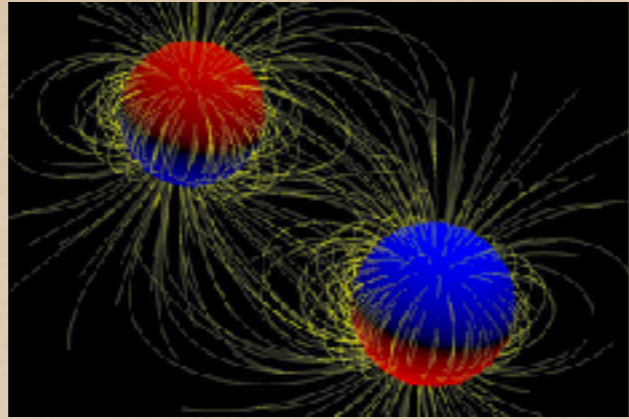
more intrinsic qualities for the atoms
and **more forces** acting on them



1788 Lagrangians
1833 Hamiltonians



1861 Maxwell's equations
fields and waves



A field has a value at every point in space
it fills space

OH, Now we see
how LIGHT is accounted for

So: particles forces, fields
it's all wrapped up...?

but what is a field?

what carries it (if that is a legitimate question)

WHOOOPS...

things inside atoms

they're the real uncuttable?

electrons

protons

neutrons

and light waves in a EM field

we're done?

whoops!

“split” protons and neutrons

aha!? A more basic level?

the new basic list:

electrons
u quark
d quark
neutrino
photons

ah, not quite...

The current Standard Model

			Quarks
			Leptons
			Anti-Quarks
			Anti-Leptons
		Bosons	

many particles

18 quarks
18 anti-quarks
9 leptons
9 anti-leptons
13 gluons

in three generations
with masses
that vary
in no obvious way

4 forces

gravitational
electromagnetic
weak nuclear
strong nuclear

with varying strengths
and distances of operation

The theory of everything (so far)

Gravity Electromagnetism Strong force Weak force

$$Z = \int \mathcal{D}(\text{Fields}) \exp \left(i \int d^4x \sqrt{-g} (R - F_{\mu\nu} F^{\mu\nu} - G_{\mu\nu} G^{\mu\nu} - W_{\mu\nu} W^{\mu\nu} + \sum_i \bar{\psi}_i \not{D} \psi_i + \mathcal{D}_\mu H^\dagger \mathcal{D}^\mu H - V(H) - \lambda_{ij} \bar{\psi}_i H \psi_j) \right)$$

Matter Higgs boson

Atoms and the Void?

**But our basic particles
don't behave like Greek or Newtonian atoms**

Quanta

quantum effects

probabilities

and waves

quantum entanglement...

non-locality...

vs our image of
full particles
simply located

Heisenberg talk

Atoms and the Void?

current best guess, QCD, the void is not so empty

particles as (more or less) localized
bumps in a field

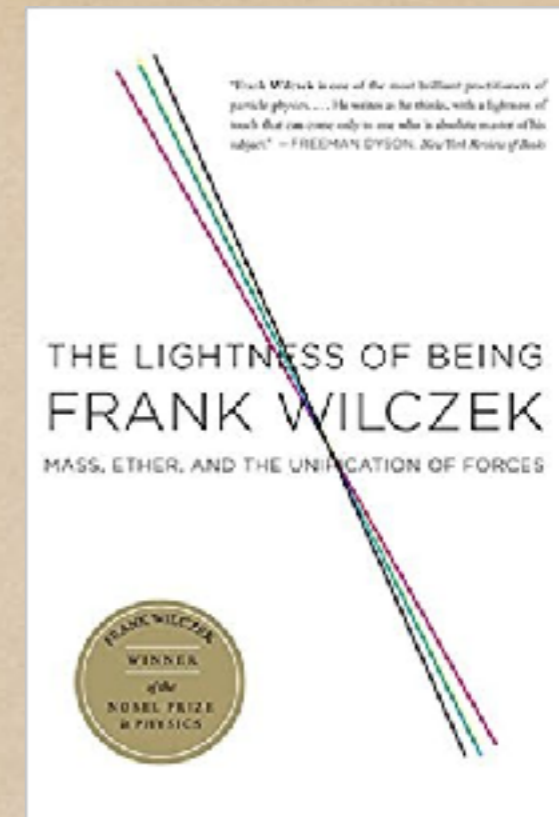
with many (17?) fields filling space
and interacting with one another

and with solidity and mass
as secondary effects

Atoms and the Void?

Sounds more like fluids filling space.

Are we back to Aristotle? Plato?



See the references at

<http://dkolb.org/atoms.web.page.html>

Our images and intuitions
still offer us Greek or Newtonian atoms
zipping around in empty space...

why?

the Math is hard?

Things just different down there?

Yes, but...

there is

a philosophical reason for our prejudice
in favor of solid, simply located atoms

Parmenides "revelation"

There are the gates of the ways of Night and Day, ...Straight through them,
on the broad way, did the maidens guide the horses and the car,
and the goddess greeted me kindly, and took
my right hand in hers, and spake to me these words:

Welcome, O youth, that comest to my abode on the car
that bears thee tended by immortal charioteers!

It is no ill chance, but right and justice that has sent thee forth to travel on this way.

Far, indeed, does it lie from the beaten track of men!

Meet it is that thou shouldst learn all things,
as well the unshaken heart of well-rounded truth,
as the opinions of mortals in which is no true belief at all.

Yet none the less shalt thou learn these things also,—

how passing right through all things one should judge the things that seem to be

the decision about these matters lies in this:
is or is not

the decision about these matter lies in this: is or is not;

and if there is no non-being in what-is

what is is
uncreated
complete
immovable
without end

Nor was it ever, nor will it be;
for now it is, all at once,
a continuous one

Come now, I shall tell...

just which ways of inquiry alone there are for understanding:

the one, **that [it] is** and that [it] is not not to be,

is the path of conviction, for it attends upon true reality,

but the other, **that [it] is not** and that [it] must not be,

this, I tell you, is a path wholly without report:

for **neither could you apprehend what is not,**

for it is not to be accomplished, nor could you indicate it. (Fr. 2)

the one, **that [it] is** (*ESTI*) and that [it] is not not to be,
is the path of conviction, for it attends upon truth

but the other, **that [it] is not** (*OUK ESTI*) and that [it] must not be,

this, I tell you, is a path wholly without report:

for **neither could you apprehend** (GNOIHS) **what is not,**

...nor could you indicate (PHRASAIS) **it.**

but not ever was it, nor yet will it be, since it is now together entire, single, continuous; for what birth will you seek of it?

How, whence increased? From not being I shall not allow **you to say or to think: for not to be said and not to be thought is it that it is not.**

And indeed what need could have aroused it **later rather than before,** beginning from nothing, to grow?

Nor ever from not being will the force of conviction allow something to come to be...

And how could What Is be hereafter? And how might it have been? For if it was, it is not, nor if ever it is going to be: thus generation is extinguished and destruction unheard of.

Nor is it divided, since it is all alike;

and it is not any more there, which would keep it from holding together,
nor any worse,

but it is **all replete with What Is**.

Therefore it is **all continuous**: for What Is draws to What Is.

And **remaining the same, in the same place, and on its own it rests,**
and thus steadfast right there it remains;

for **powerful Necessity (KRATERH ANANGKH)**

holds it in the bonds of a limit, which encloses it all around,

wherefore it is right that What Is be **not unfinished (A-TELEU-THTON);**

for it is not lacking (EPIDEES):

if it were, it would lack everything (PANTOS EDEITO).

But since there is a **furthest limit, it is perfected**

from every side, like the bulk of a well-rounded globe,

from the middle equal every way: for that it be neither any greater
nor any smaller in this place or in that is necessary;

for **neither is there non-being, which would stop it reaching**

to its like, nor is What Is such that it might be **more than What Is**

here and less there. Since it is all inviolate,

for it is equal to itself from every side, it extends uniformly in limits

what is this “what-is”, physical spatial or what?

what about our busy multicolored world?

an underlying issue:

is it correct so say there is no non-being in what is?

Notice that each atomist atom
is a perfect little example
of P's what-is

but there are many of them

the “old” interpretation of Parmenides

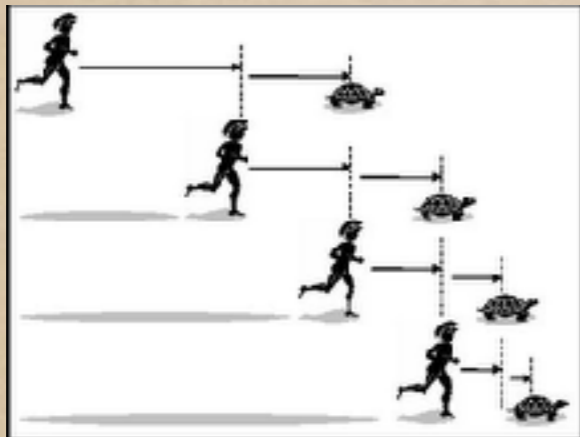
monism

There is only One Being

And there is not, and never shall be,
anything besides what is,
since fate has chained it
so as to be whole and immovable.

Wherefore **all these things are but names**
which mortals have given, believing them to be true—
coming into being and passing away,
being and not being,
change of place
and alteration of bright colour.

Zeno's Paradoxes seem to support a monistic reading



If everything when it occupies an equal space is at rest,
and if that which is in locomotion is always occupying such a space at any moment,
the flying arrow is therefore motionless

When the recitation was completed, Socrates ... said: What is your meaning, Zeno? Do you maintain that **if being is many, it must be both like and unlike, and that this is impossible**, for neither can the like be unlike, nor the unlike like-is that your position?

I see, Parmenides, said Socrates, that **Zeno** would like to be not only one with you in friendship but your second self in his writings too; he **puts what you say in another way**, and would fain make believe that he is telling us something which is new. For **you, in your poems, say The All is one**, and of this you adduce excellent proofs; and **he on the other hand says There is no many**; and on behalf of this he offers overwhelming evidence. You affirm unity, he denies plurality.

Yes, Socrates, said Zeno. **The truth is, that these writings of mine were meant to protect the arguments of Parmenides against those who make fun of him and seek to show the many ridiculous and contradictory results which they suppose to follow from the affirmation of the one.** My answer is addressed to the partisans of the many, whose attack I return with interest by retorting upon them **that their hypothesis of the being of many, if carried out, appears to be still more ridiculous than the hypothesis of the being of the one.**

BUT...

what about the second part
of Parmenides' poem?

P warns us to avoid a path

along which mortals who know nothing

wander two-headed: for haplessness in their
breasts directs wandering understanding.

They are borne along deaf and blind at once,
bedazzled, indiscriminating hordes,

who have supposed that it is and is not the same and not the same;
but the path of all these turns back on itself.

Is P's second part that path
or is it another?

Mortals have made up their minds to name **two forms**,
one of which they should not name, and that is where they go astray from the truth.
They have distinguished them as opposite in form,
and have assigned to them marks distinct from one another.
To the one they allot the **fire of heaven**,
gentle, very light, in every direction the same as itself,
but not the same as the other.

The other is just the opposite to it, **dark night, a compact and heavy body**.
Of these I tell thee the whole arrangement **as it seems likely**;
for so no thought of mortals will ever outstrip thee.

And thou shalt know the substance of the sky, and all the signs in the sky,
and the resplendent works of the glowing sun's pure
torch, **and whence they arose**.

And thou shalt learn likewise of the wandering deeds of the round-faced moon,
and of her substance.

Thou shalt know, too, the heavens that surround us, whence they arose,
and how Necessity took them and bound them to keep the limits of the stars
how the earth, and the sun, and the moon,
and the sky that is common to all, and the Milky Way,
and the outermost Olympos, and the burning might of the stars **arose**.

The narrower bands were filled with unmixed fire,
and those next them with night, and in the midst of these rushes their portion of fire.
In the midst of these is the divinity that directs the course of all things;
for she is the beginner of all painful birth and all begetting,
driving the female to the embrace of the male,
and the male to that of the female.

a “newer” interpretation of Parmenides

primary and secondary
modes of being?

a level of fundamental permanent being
and a level of changing beings

Plato

Aristotle

NB:

keep your eye on

: TIME

vs total positive presence

recall that Greek atoms are unaffected by time

Objections to Parmenides

Objection #1

...is it true that

¿ there is no non-being in what is ?

The puppy is not yet full grown.

Potential

The puppy is not all at once all that it is

Objection #2

modern distinction: two uses of "IS"

"John is, John exists"

"John doesn't exist"

"John is at home"

"John is not at school"

The second case doesn't seem as problematic.

Plato's Eleatic Stranger in *the Sophist*

"commits parricide"
by making a distinction

John is flying.
John is sitting.

combining two existing items

SO

not referring to non-existing items

so we can use negative language

Objection #3

anyhow, we do refer to nonexistent things

though it is puzzling
how we do it

Santa Claus is coming to town.
The present King of France is bald.

All unicorns are white.

The luminiferous ether carries light waves.

A square circle is impossible.

The dog I might have brought with me today would be bored.

more going on in language than P imagines

BUT

but does any of that invalidate P's fundamental point?

...which is...?

fullness, positive being

why is P. relevant to our discussion? #1

P offers an elucidation
of our feeling that the bottom basic level of reality
has to be totally positive

P provides a challenge:
what other alternative could there be?

why is P. relevant to our discussion? #2

P puts it starkly:
how do you relate
basic reality
to our everyday experiences ?

his "old" answer: you don't

"his" "new" answer: levels or modes of reality

maybe a third, daring answer ??

deny his basic claims
about fullness, positivity

could we refuse his basic point ?

Heraclitus

“process philosophy”

basic reality without full positivity
or at least without static positivity

are the scientific “facts”
of QM etc relevant here?

TIME as a problem

stay tuned ...

HEY!

can't we just let the facts decide ?

ah, facts.....

back to: what kind of argument is P making?

what kind of argument is P making ?

where's the evidence ?

...what evidence could possibly count
for or against his claim ?

what kind of argument is P making?

consider the tone of the Prologue

revelation, special thinking, not ordinary,
initiation into the higher mysteries

is P arguing
a posteriori **OR** a priori

a posteriori "from after"
a priori "from before"

before/after what?

experience

empereia

a posteriori

“empirical”

resulting from experience

a priori

“???”

prior to experience

is this possible?

how? (various answers)

are there concepts or categories
prior to some experiences ?

prior to this or that area

is teaching an animal to discriminate stimuli
the same as
“having the animal learn a concept of xx’s” ??

**does learning the concept
make it possible** to have organized experience of xx’s
instead of a confused series of perceptions ?

but do some categories/concepts
need to be a priori in a stronger sense ?

prior to ANY and ALL areas of experience ?

making it possible to have any organized experience at all ?

maybe **molding or forming** organized experience of anything ?

Two ways to claim that

You might say:

some categories are needed, to experience,
make judgments, and know objects,
but there's not any particular categories
that are necessary,
those change over time

Or You might say:

certain very basic categories
are necessary in all cases

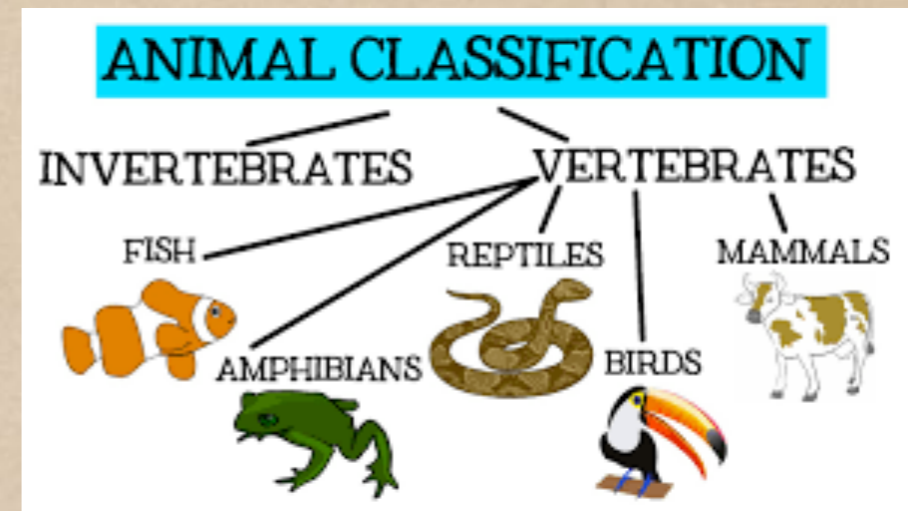
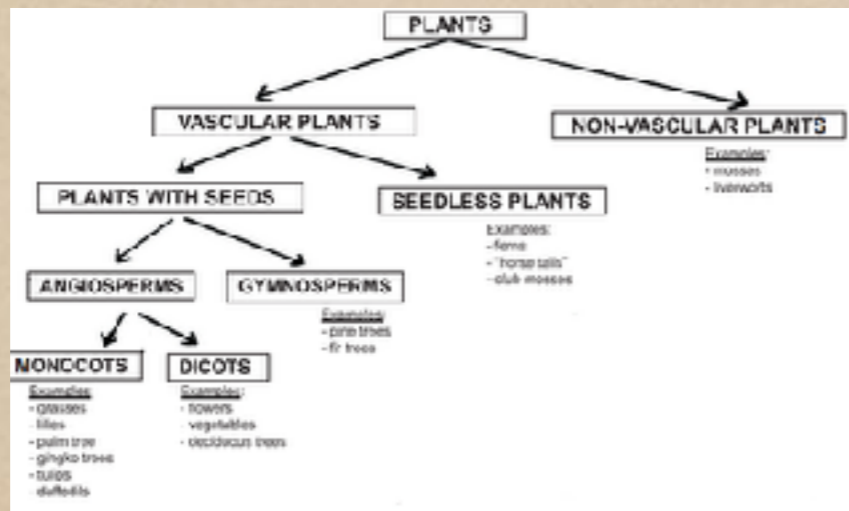
logic, math, grammar... more ??

total empiricism vs synthetic a priori judgments

Think about two kinds of categories:

1) categories that **segregate objects** into groups (sets, classes)

often arranged in a tree structure



These could change.

2) categories that apply to every object in any group

maybe...these don't change ?

Plato's list

BEING

UNITY (one/many)

same/different

(motion / rest)

**these don't create divisions and groups
they do something else**

A medieval list: ens unum verum bonum res

Kant's list of categories

Quantity

Unity

Plurality

Totality

Relation

Inherence and Subsistence (substance and accident)

Causality and Dependence (cause and effect)

Community (reciprocity)

Quality

Reality

Negation

Limitation

Modality

Possibility

Existence

Necessity

Kant argues that these provide the necessary framework on which you build your empirical knowledge

The Deep Question:

Can you do science without some such framework of basic categories ?

Can science replace those basic categories or only specify them differently ?

e.g. Greek atoms vs Quantum objects...

does QM change what it means to "be" ?

Deep stuff
categories vs grammar

categories enabling/molding/limiting thought ?

“the Whorff hypothesis”
eg for colors

for “being”?
and logic ?

Where we are at:

relating levels of language and
the everyday world
versus the scientific world

“scientific realism” and the “nothing but atoms and the void”

everyday empirical language/activities

VS

theoretical concepts/explanations/elaborations

Agáin:

νόμωι (γάρ φησι) γλυκὺ καὶ νόμωι πικρόν,
νόμωι θερμόν, νόμωι ψυχρόν,
νόμωι χροιή,
ἔτεῃι δὲ ἄτομα καὶ κενόν

By convention sweet and bitter,
By convention hot and cold,
By convention color,
but in reality atoms and the void.

(Democritus, quoted in the Tetralogies of Thrasyllus, 9. sext. adv. math. VII 135)

ATOMS

a-tomon, plural a-toma, non-cut, non-division
uncuttable, indivisible, full, complete,

what they have:

shape, simple location

what they **don't** have:

weight, color, sight,
tendencies, goals,
potentialities. regularities,
laws, forces

ἄτομα

atoms have:

shape
simple location
motion

the everyday world has:

weight, color, sight,
regularities, cycles, patterns,
entities with careers
tendencies, goals, potentialities
in systems and ecologies
with perceptions, consciousness

HOW DOES

atoms have:

shape

simple location

motion

THIS

the everyday world has:

weight, color, sight,

regularities, cycles, patterns,

Produce THIS

entities with careers

tendencies, goals, potentialities

in systems and ecologies

with perceptions, consciousness

Both are “real”

The Eleatic Stranger says:

“My notion would be, that anything which possesses any sort of power

to affect another,

or to be affected by another,

if only for a single moment,

however trifling the cause and however slight the effect,

has real existence;

and I hold that the definition of being is simply power.”

(Plato, *The Sophist*)

but does this come in levels...?

Explanatory Primacy

The Greek Atomists
made the crucial move:

many small entities
moving and combining
by chance
into larger structures
with new properties

Greek Atomist matter
doesn't have
enough properties
or kinds of connections...
but we've seen
how the atoms
gradually
acquired ...

more intrinsic properties:
shape mass charge etc.

more ways of connecting
and influencing:
fields and forces

atoms clumping ...
new items with new properties...
unexpected behaviors...
many selection processes...
reuse what's developed in new ways...
systems get formed...
crystals...minerals...organic molecules...
self-duplicating...reproducing...
living...being selected/adapted...
unexpected behaviors...
many selection processes...
reuse what's developed in new ways...

...you've got
Evolution

NB: There is no such Thing as Evolution

Evolution is a result,
not a single unified cause or process.

Evolution results from the coming together
of many independent processes.

There is no overall unity or goal.

Variation

plus

Differential Rates of

survival

**and
reproduction**

However

these
are
caused

whatever
the units are

molecules
cells
traits
systems
organisms
memes
groups
cultures

...

Variation

plus

Differential Rates of

survival

and
reproduction

**different
processes
crisscrossing
competing
on
many
different
scales
and rhythms**

no overall
unity
or
goal

variation, reproduction, selection
=> new forms and systems

powerful idea...

applied in biology, anthropology, sociology,
psychology, ecology, economics...
maybe even cosmology, art, science...

A BIG CHANGE

no prior repertory of The Forms

objections to evolution are not silly
because evolution
demands more changes
than might at first appear

Objections to Evolution:

fears

loss of overall pattern, unity, purpose

loss of our difference, our primacy

loss of moral compass (?)

Objections to Evolution:

religious objections:

literal reading of scripture

can be overcome with less literal reading

but then there are

the problems
of “natural evil”
and bad design

Objections to Evolution:

philosophical objection:

Aristotle and (mostly) Plato:
matter is passive and receptive
with no activity or definition
until it receives
a form
from some entity
already actual

so no
new forms
can arise
on their own

Atomist matter
is not merely passive, receptive,

it has its own
activity
and builds
new forms

this is a deep shift

from:

the basic patterns for types of beings
and some activity applies them

to:

basic types of interactions
and new patterns result

then we analyze and systematize them

That's the first and biggest answer

but it leads to the next problem

one that the Greeks did not really appreciate

HOW DOES

atoms have:

shape

simple location

motion

THIS

the everyday world has:

weight, color, sight,

regularities, cycles, patterns,

entities with careers

tendencies, goals, potentialities

in systems and ecologies

with perceptions, consciousness

Produce THIS

...you've got
the Mind-Body Problem

identity theory

brain states

dualism

something more

A lot of debate these days about consciousness
in relation to atoms and matter.

Surprisingly little of this with the Greeks.

Consciousness was not a big problem for the Greeks because
given the notion of matter as receptive of form from outside
the act of receiving form could be an act of becoming aware.

Their problem was almost the opposite of ours.

For them it was sensation that was easy
and intellectual understanding that was hard.

For us it's *in a way* the reverse.

In the Greeks

Sensations were accounted for roughly on the image of a stamp shaping passive matter.

Like the atomistic theory of vision.

There was something passive in the body which received from the active source outside a pattern or shape or smell or whatever.

So that reception, that being molded, could be envisioned as becoming aware.

The hard part for them was to understand how we could be aware of *universal qualities*, not this particular blue shade but blue in general, not this particular person but humanity in general, not this particular imperfect circle but the geometrically perfect circle.

Our senses are never stamped by such perfect items any perceptible stamp must be singular and not universal

But we do know universals
(we do geometry, argue in syllogisms, etc.)

so it was necessary to posit
some special faculty
that could *receive* universal forms
or could pull them out (*ab-tract*) them
from particular perceptions

Aristotle even seems to conclude that
this *active intellect* cannot be part of the body

Then...

replace 'seeing' universals
with constructing them
in a kind of language use

This leads to an analysis of universals
in terms of language
and information processing.

and matter, no longer passive but active
can get arranged into systems
that record and process information

Then we develop machines
that can identify humans, circles, etc.

...but now there may be a problem about
the sensory perception of a particular shade of blue
or of a particular imperfect circle.

So here is the program:

brain resembles a computer

receives input data,

processes it,

loads the result into the cortex

the resulting brain/body state

just IS

a perception, thought, etc.

we'll work out the details as we learn more

HOW DOES

atoms have:

shape
simple location
motion

THIS

the everyday world has:

weight, color, sight,
regularities, cycles, patterns,
entities with careers
tendencies, goals, potentialities
in systems and ecologies

Produce THIS
with perceptions, consciousness

DONE!

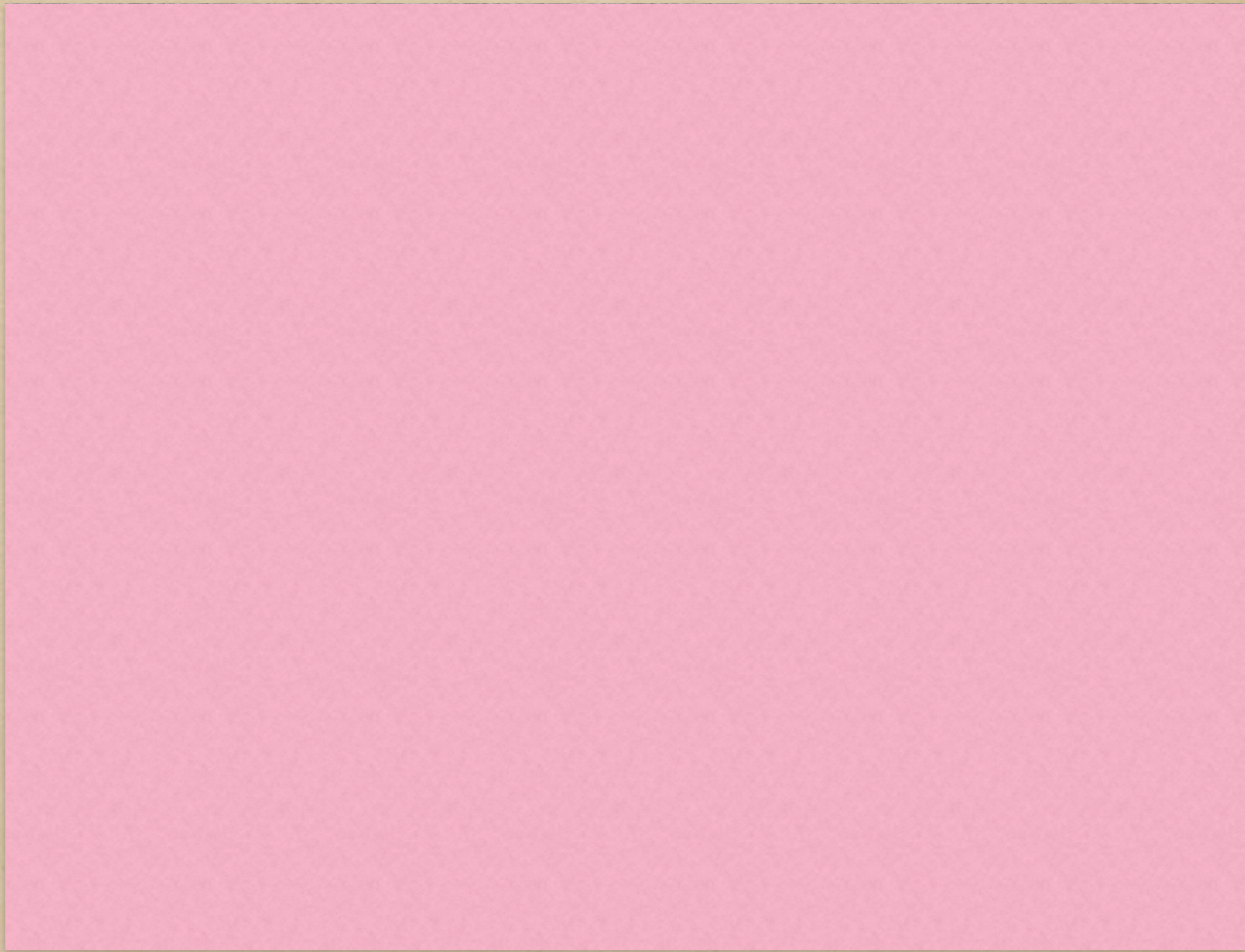
DONE ???

DONE ???

HOW DOES

atoms have:	the everyday world has:
shape	weight, color, sight,
simple location	regularities, cycles, patterns,
motion	entities with careers
THIS	tendencies, goals, potentialities
	in systems and ecologies
	Produce THIS
	with perceptions, consciousness

ok so far
but is there more to explain ??



The experience of seeing this pinkish rectangle



identity theory

brain states

denial, witches

but qualia

dualism

something more

but interaction problem

...you (may) have
the Hard Problem of Consciousness

fundamentally an organism has conscious mental states if and only if there is something that it is to *be* that organism—something it is like *for* the organism.

appearing, seeming correlations not enough

There's no problem here ?

Our research programs are adequate

There's a real problem here ?

Something needs to be added
to the research programs.

[W]e must confess that perception,
and what depends upon it,
is inexplicable in terms of mechanical reasons,
that is through shapes, size, and motions.

If we imagine a machine
whose structure makes it think, sense, and have perceptions,
we could conceive it enlarged, keeping the same proportions,
so that we could enter into it, as one enters a mill.

Assuming that, when inspecting its interior,
we will find only parts that push one another,
and we will never find anything to explain a perception.
And so, one should seek perception in the simple substance
and not in the composite or in the machine.

Leibniz

[S]upposing whatever traces, machines, or motions you like in the brain,
one will never find the source of perception
or of the reflection on oneself,
which is a truly internal action,
any more than one could find it in a watch or in a mill.
For crude or subtle machines differ only in degree. (LTS: 259)

Leibniz

In the same way, it is obvious that perception cannot be deduced from bare matter since it consists in some action. . . .

Hence we can easily conclude that in any mill or clock taken by itself no perceiving principle is found that is produced in itself; and it does not matter whether solids, fluids, or a compound of both are considered in the machine.

Moreover, we know that there is no essential difference between coarse and fine bodies except that of size. From this it follows that it cannot be conceived how perception arises in a crude machine, however constituted from fluids or solids, it also cannot be conceived how perception arises from a subtler machine, for if our sense were also more subtle it would be the same as if we were perceiving a crude machine, as we do now. And so it must be considered as certain that from mechanism alone, i.e., bare matter and its modifications, perception cannot be explained (GP: VII, 328–329/SLT: 64)

...you might have
another alternative

panpsychism

take some basic
experience/consciousness/feeling
as primitive

panpsychism

small units of “experience” or “awareness”

aggregating and connecting

leibniz

whitehead

Considerations against panpyschism

“you’ve got to be kidding, right?”

the combination problem

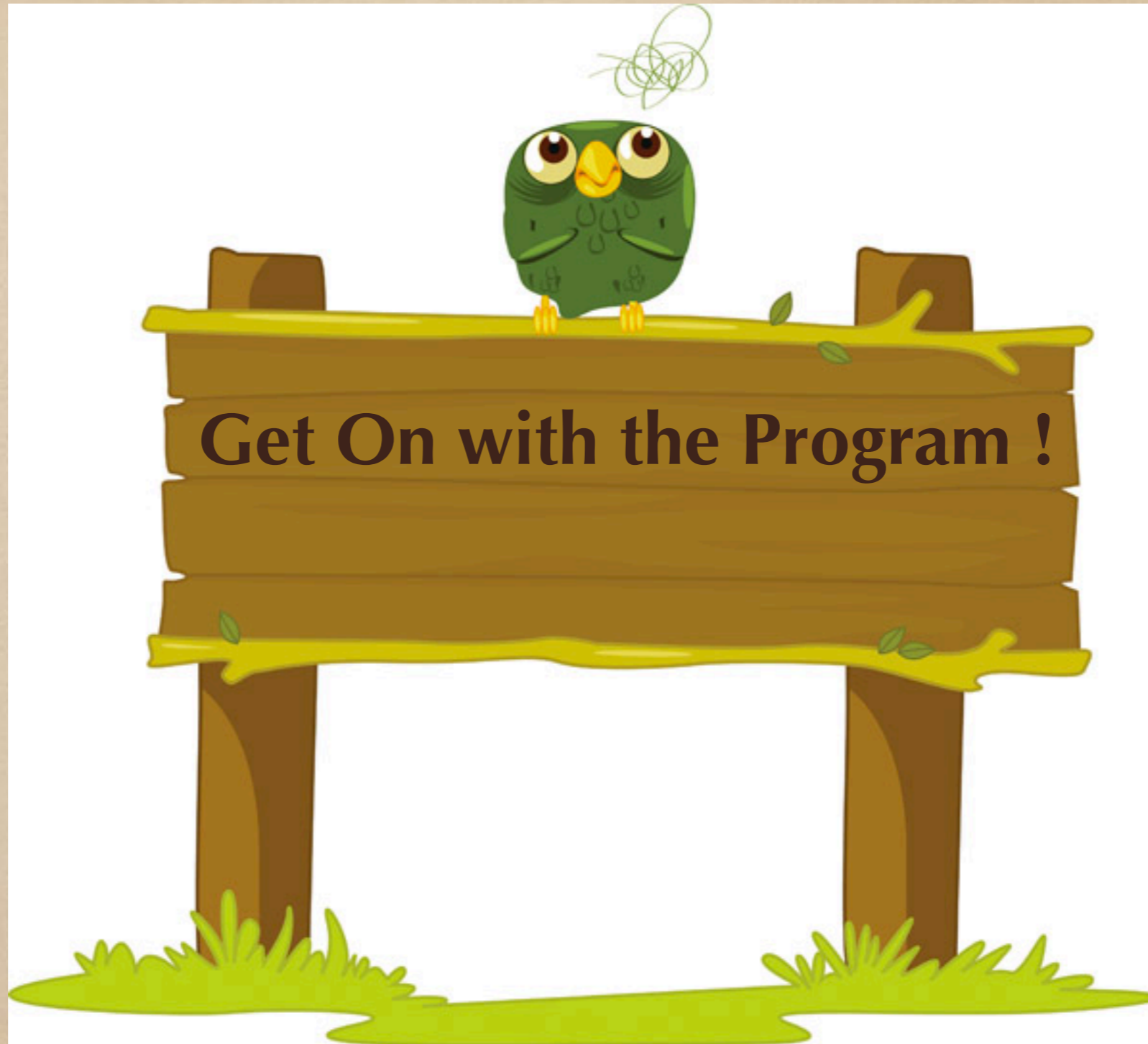
Considerations favoring panpyschism

accounting for experience and consciousness

intrinsic nature argument

sorites problems and mental causation

so where are we?



Get On with the Program !

research in physics and other sciences
study the brain, etc.
find explanations for how
animals like us
can have the powers
and experiences that we we have

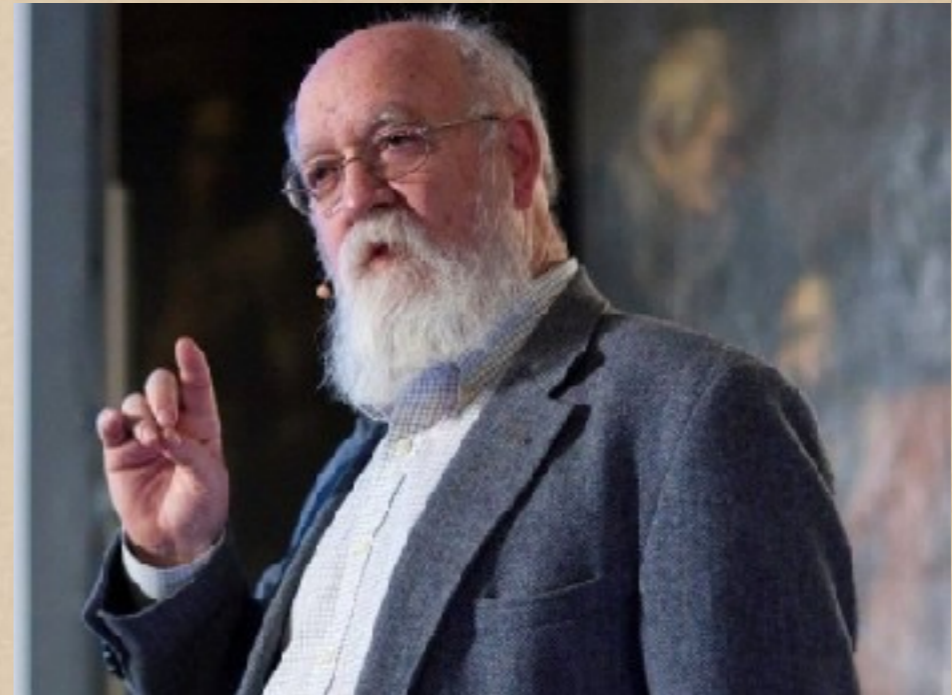
if it turns out you need to invoke
panpsychism
or to make changes in physics
then do that

Yes



David Chalmers

No



Daniel Dennett



<https://www.youtube.com/watch?v=JoZsAsgOSes>

David Chalmers

‘One central problem,’ Chalmers tells us, ‘is that consciousness seems to be a further fact about conscious systems’ over and above all the facts about their structure, internal processes and hence behavioral competences and weaknesses.

Daniel Dennett

He is right, so long as we put the emphasis on ‘seems’. There does seem to be a further fact to be determined, one way or another, about whether or not anybody is actually conscious or a perfect (philosopher’s) zombie.

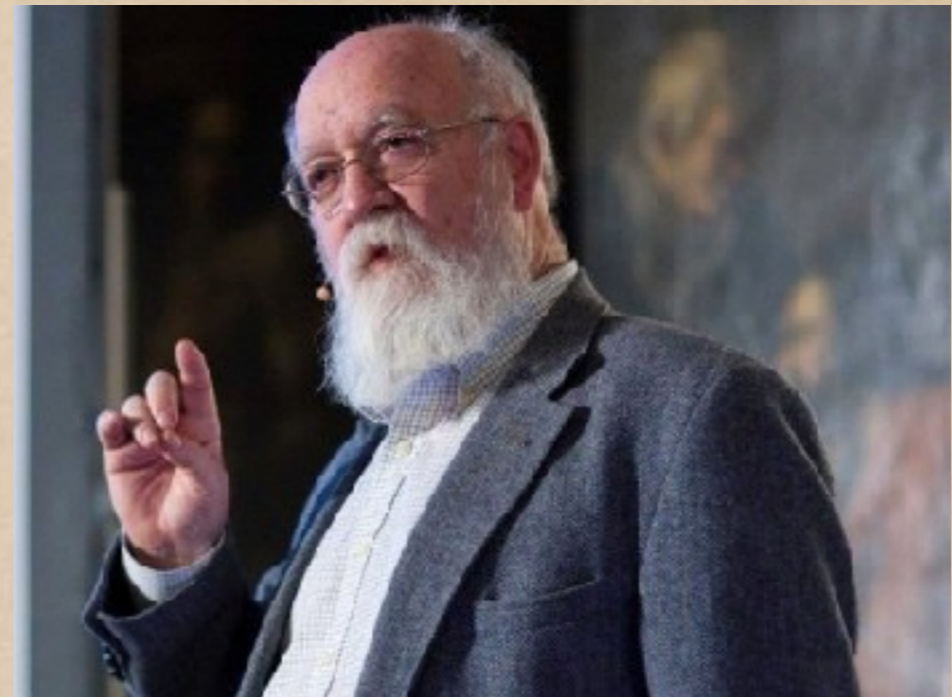
I can feel it just as vividly as anybody; I just don’t credit it, any more than I credit the sometimes well-nigh irresistible hunch that the sun goes around the earth;

No

Just because the existence of consciousness as Chalmers describes it seems to be a brute fact, does not mean that it is a brute fact.

If I can come up with an alternative explanation why it seems to Chalmers and others that consciousness forces itself upon us as a brute fact that evades all causal explanation, I do not have to take their claims at face value.

And if that alternative explanation is simpler and more coherent than Chalmers', he will no longer have the epistemic right to describe his feelings on this subject as an unquestionable "bedrock of intuitions".



Daniel Dennett

Yes



Experience is the most central and manifest aspect of our mental lives, and indeed is perhaps the key thing to be explained in the science of the mind.

Experience cannot be discarded like the vital spirit when a new theory comes along.

At this point we're out on the edge, exploring.



one idea:

Whitehead and Deleuze
about the primacy of feeling and desire/urges
over clear intellection

and about moving from vague to satisfied experience

are very useful, even if you don't buy into
a panpsychic metaphysics
for electrons

So, we're done!

the scientific image of the world
is now linked
to our ordinary richer everyday
“manifest” image of the world

...erh... not quite...

There's one little problem.

TIME

“going with the program”
and experience and progress
happens in TIME

BUT physics has no place for
our “manifest image” of time

Father Parmenides has his Revenge

physics vs time

the decision about these matter lies in this: is or is not;

and if there is no non-being in what-is

what is is
uncreated
complete
immovable
without end

Nor was it ever, nor will it be;
for now it is, all at once,
a continuous one

When Besso died in the spring of 1955, Einstein — knowing that his own time was also running out — wrote a now-famous letter to Besso's family.

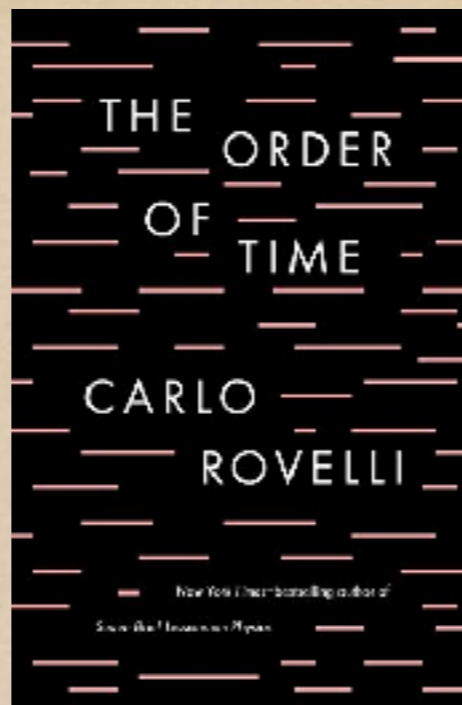
“Now he has departed this strange world a little ahead of me,” Einstein wrote of his friend's passing. “That signifies nothing.

For us believing physicists, **the distinction between past, present and future is only a stubbornly persistent illusion.”**

The concept of time, Rovelli says, “has lost layers one after another, piece by piece”.

We are left with “an empty windswept landscape almost devoid of all trace of temporality ... a world stripped to its essence, glittering with an arid and troubling beauty”.

good background



Carlo Rovelli

<https://www.youtube.com/watch?v=1RJ4t7Ji55k>

two watches

change does not advance together

<https://www.youtube.com/watch?v=ekKNjtckby0>

newton to to now

survey

Inconvenient Truth #1

Newton's equations
can be run backwards

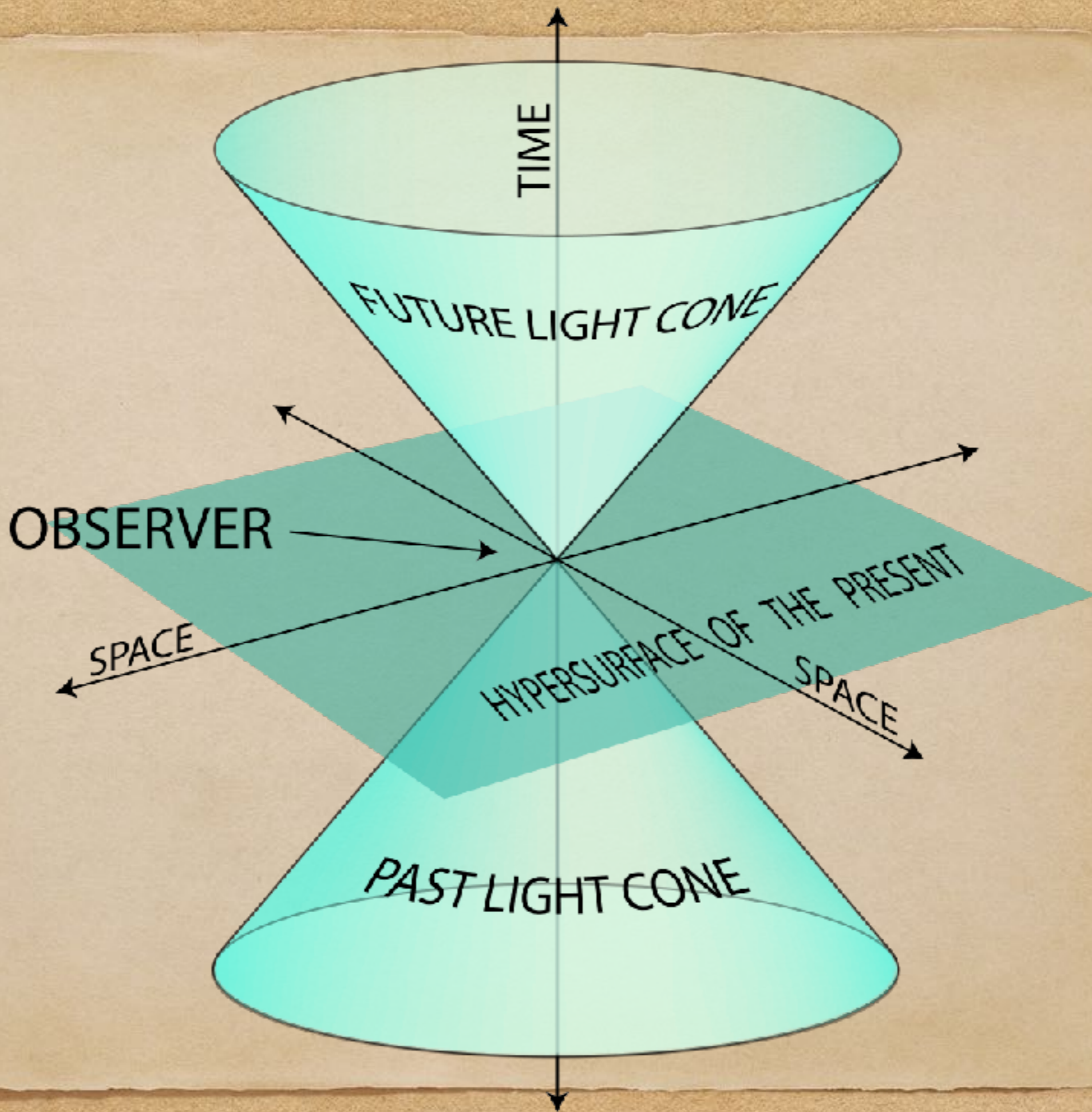
NB: the problem of "the arrow of time"

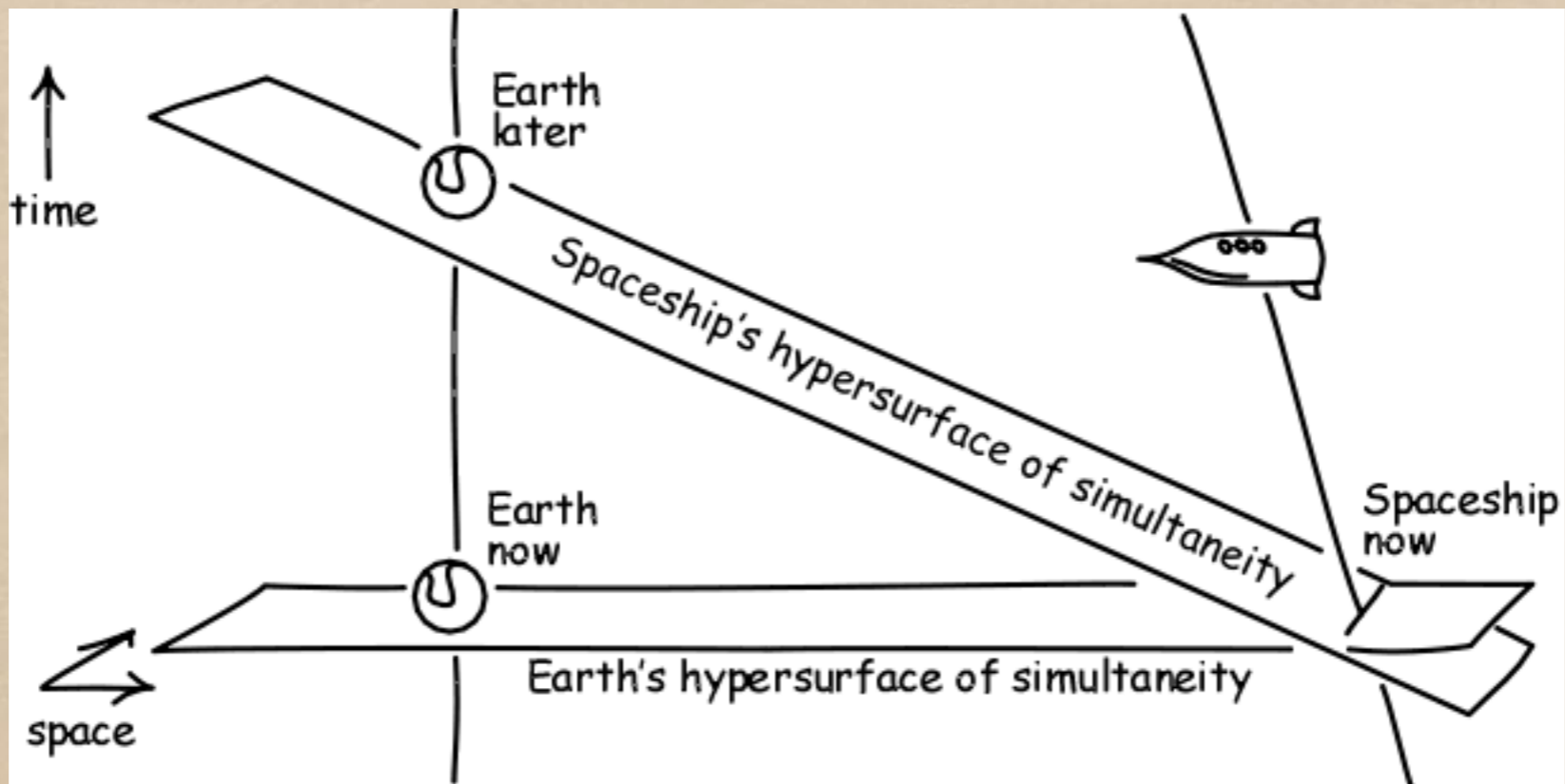
see Sean Carroll

"improbable" is not "impossible"

Inconvenient Truth #2

Einstein's Special Relativity has no place
for a common shared "now"

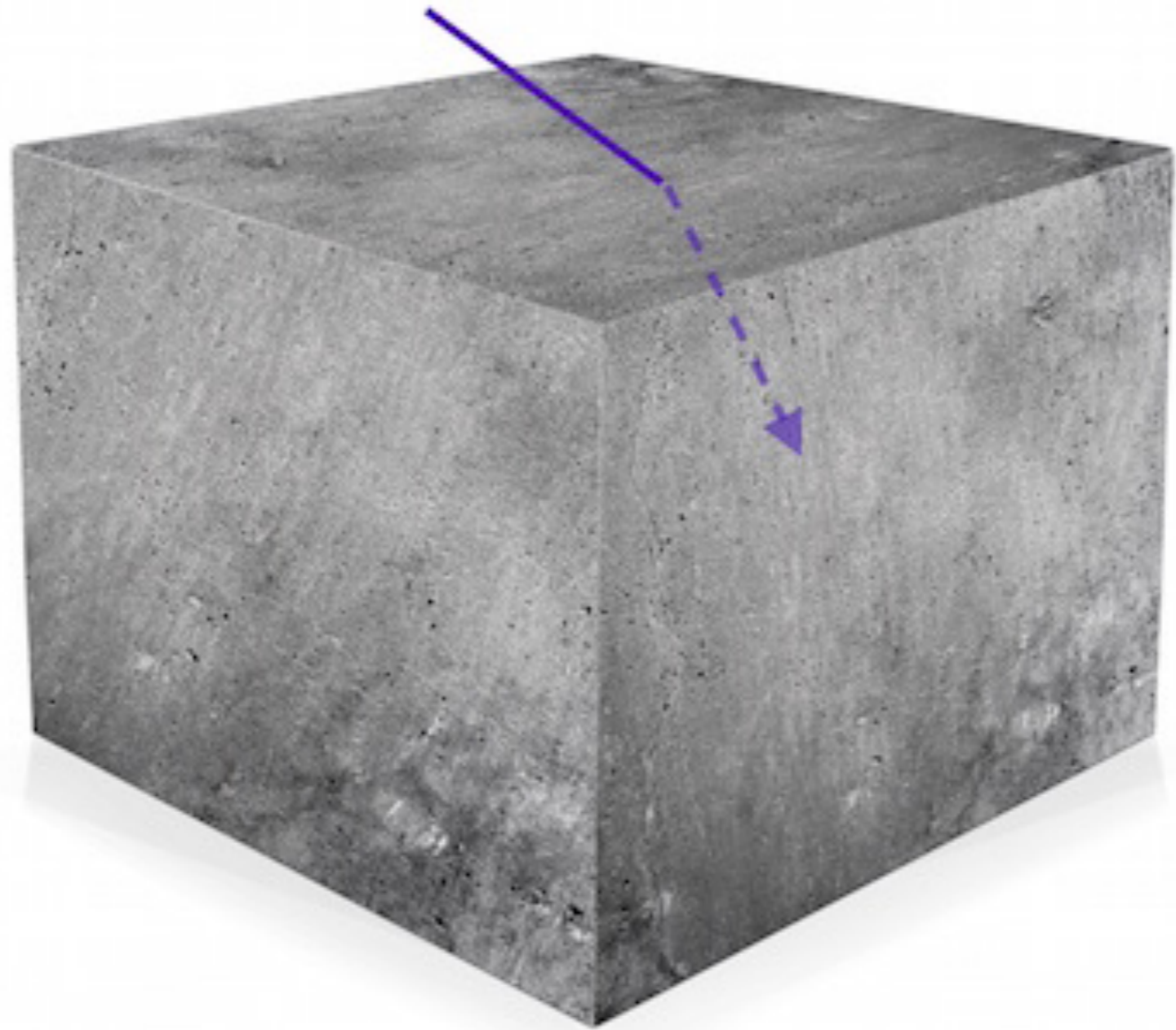




Inconvenient Truth #3

Einstein's General Relativity
brings a "block universe" of space-time

You are here



The universe **just is**:

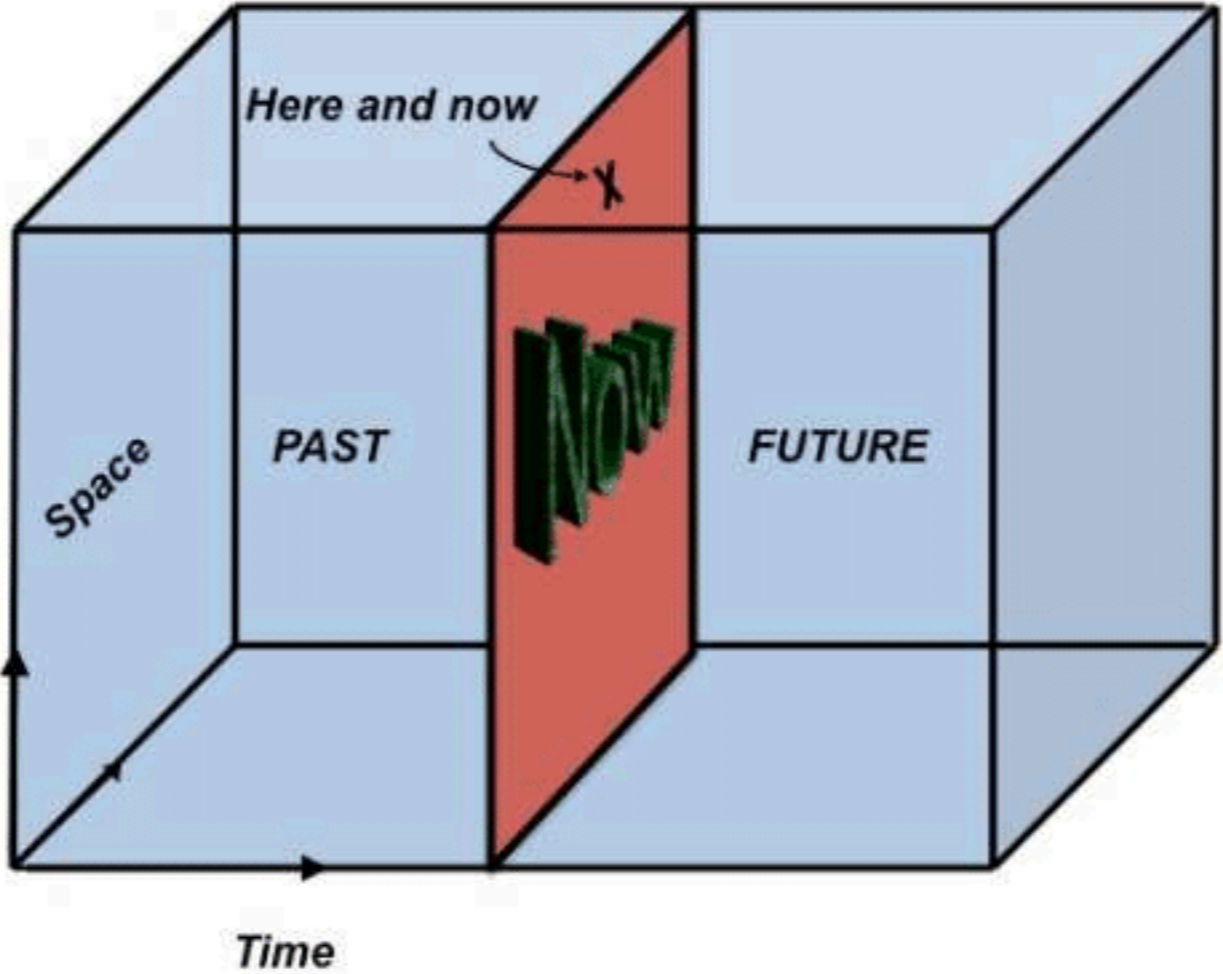
a fixed 4- dimensional spacetime block,
representing all events that have happened and
that ever will happen.

Past, present and future are equal to each other,
for there is no surface which can uniquely be
called the present.

This implicitly embodies the idea that time is an
illusion: time does not “roll on”.

Parmenides is smiling

Einstein's Block Universe



an example:

Time is a lot like space. Just like Boston and San Diego both exist, so do these different times always exist, things we call the past the present and the future. So there's no one that's happening. They're all happening with respect to themselves.

SDM: So the past isn't over and the future isn't yet to come?

CC: Right. It all exists **now**. Just like Boston and San Diego both exist.

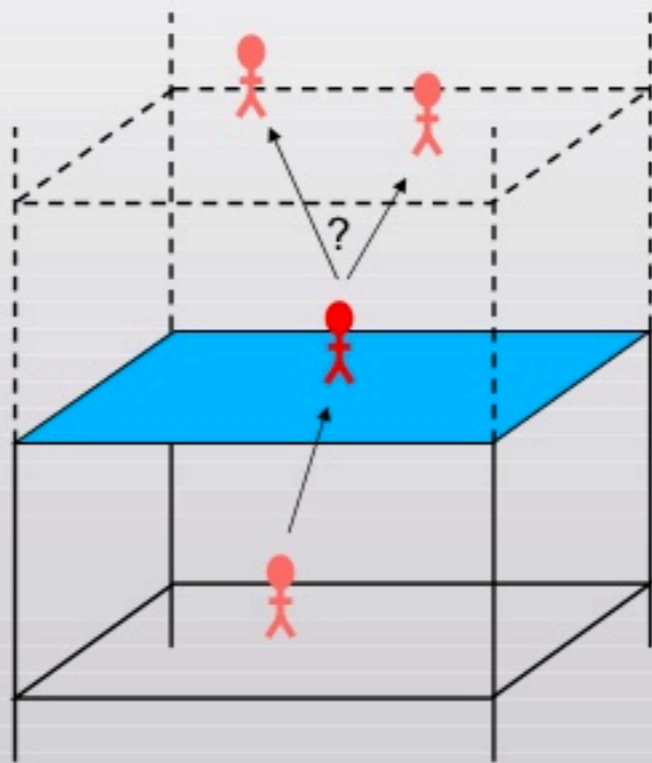
CC: It's still a little weird to think there's some event there on the universe that is my death. It's there already. That's hard to get your head around that. I mean, you can understand it, but it's hard to appreciate.

SDM: Um, yeah.

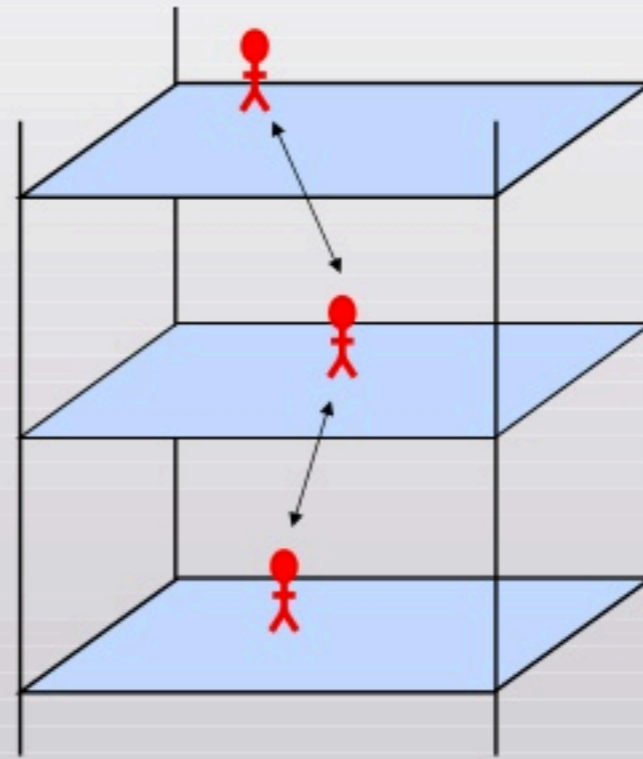
CC: If you think about time like space. There's already a place like Boston, where things are happening. They're not happening here, but they're there. Boston's there, and so are those future events. It can lead to deep philosophical questions, like in what sense do you have free will?

[http://
www.sandiegomagazine
.com/Blogs/Cityfiles/
Spring-2015/Can-
Time-Go-Backwards-
Local-prof-goes-
Through-the-
Wormhole/](http://www.sandiegomagazine.com/Blogs/Cityfiles/Spring-2015/Can-Time-Go-Backwards-Local-prof-goes-Through-the-Wormhole/)

How do we reconcile the block universe with our intuitive understanding of time?



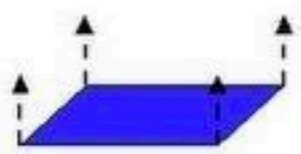
vs.



1

**4th Dimension
is Time Only
Only Present Exists**

Presentism
"Nowism"

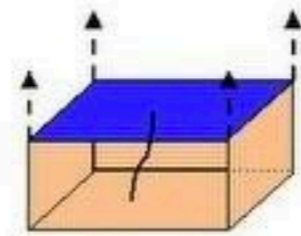


The Present

2

**Future 4th Dimension
is Time Only
Present and Past Exist**

Possibilism
"The Tree Model"

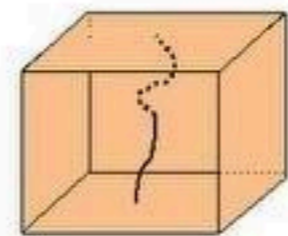


Past & Present

3

**4th Dimension
is Time Only
Future-Present-Past
All Exist**

Eternalism
"The Block Time Universe"

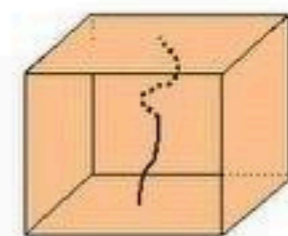


Past, Present, & Future

4

**4th Dimension
is Spatial with Time
Future-Present-Past
All Exist**

Spatial Eternalism
"The Block Spatial Universe"



Past, Present, & Future

Inconvenient Truth #4

Quantum Mechanics ??

Alas, it does complicate the picture
but doesn't really provide
an escape from the problem.

...a long story....

...and problems connecting with GR...

Inconvenient Truth
SUMMARY

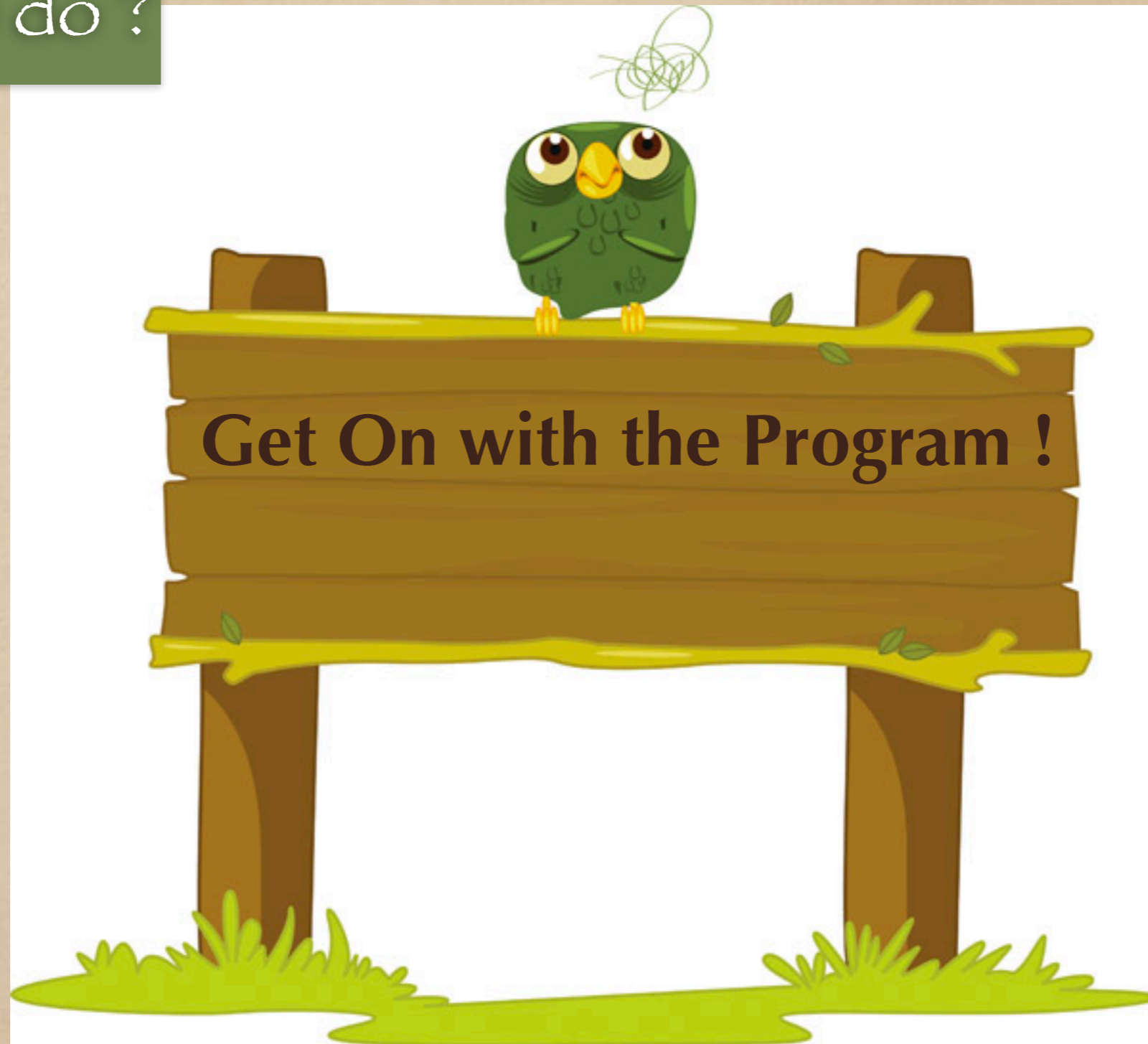
space-time "just is"

It's all settled, finished
"like a well-rounded sphere"

Parmenides is laughing

No room for
freedom,
choice,
open possibilities ?

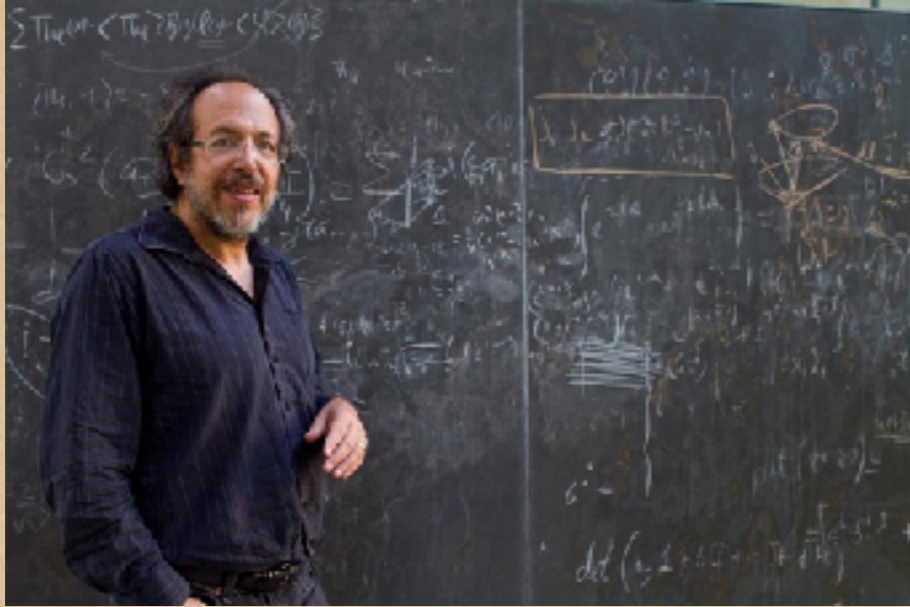
what to do ?



research in physics and other sciences
study the brain, etc.
find explanations for how
animals like us
can have the experience of time
that we we have

if it turns out you need to invoke
make changes in physics
then do that

Yes



Lee Smolin



No



Craig Callender



Explaining why critters like us come up with the model of time that we do, even if it's wrong.

The challenge ... is to frame this first-person experience within the static block offered by physics — to examine “how the world looks from the evolving frame of reference of an embedded perceiver” whose history is represented by a curve within the space-time of the block universe



Craig Callender



<https://www.youtube.com/watch?v=TuIMcce0j6k>

→ INTRODUCING

TIME

A GRAPHIC GUIDE



CRAIG CALLENDER & RALPH EDNEY

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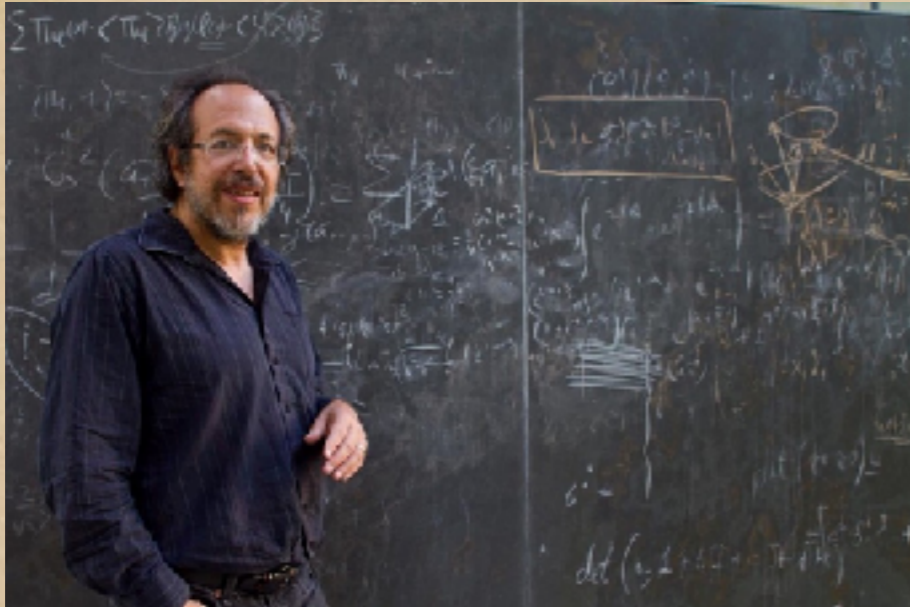


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BUT
explaining why we feel

freedom,
choice,
open possibilities

still doesn't say they
are illusions



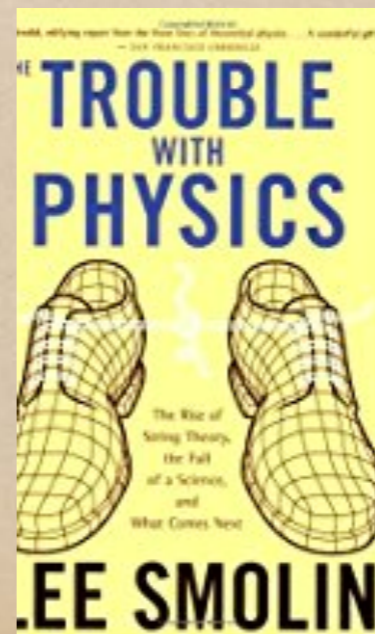
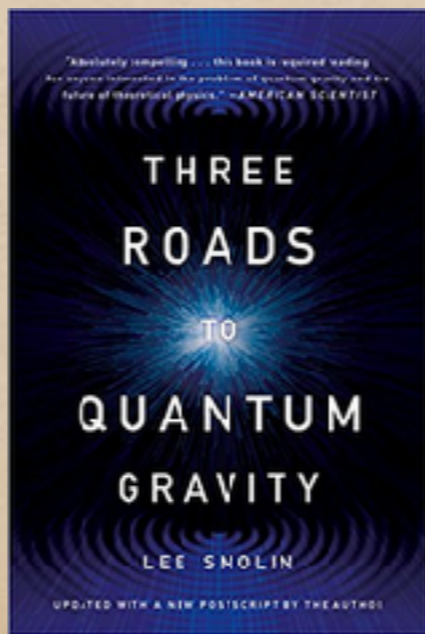
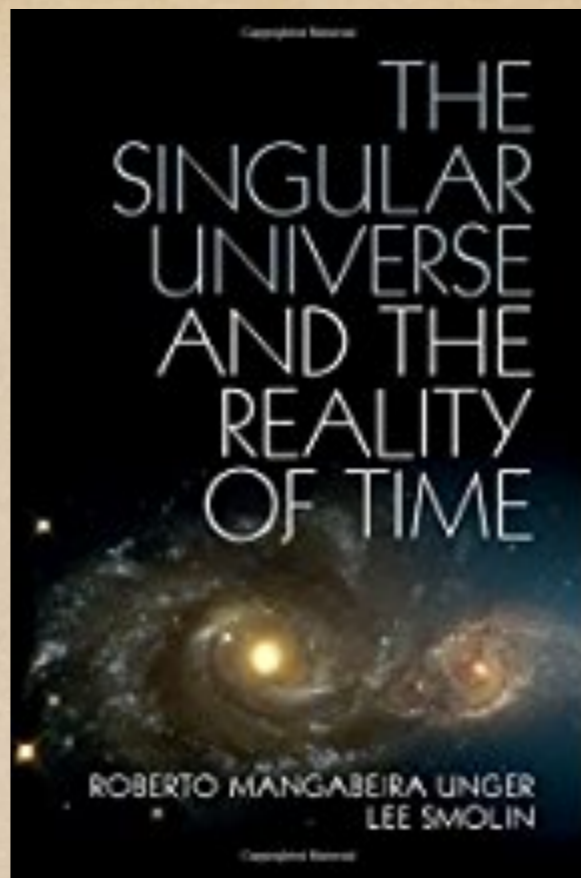
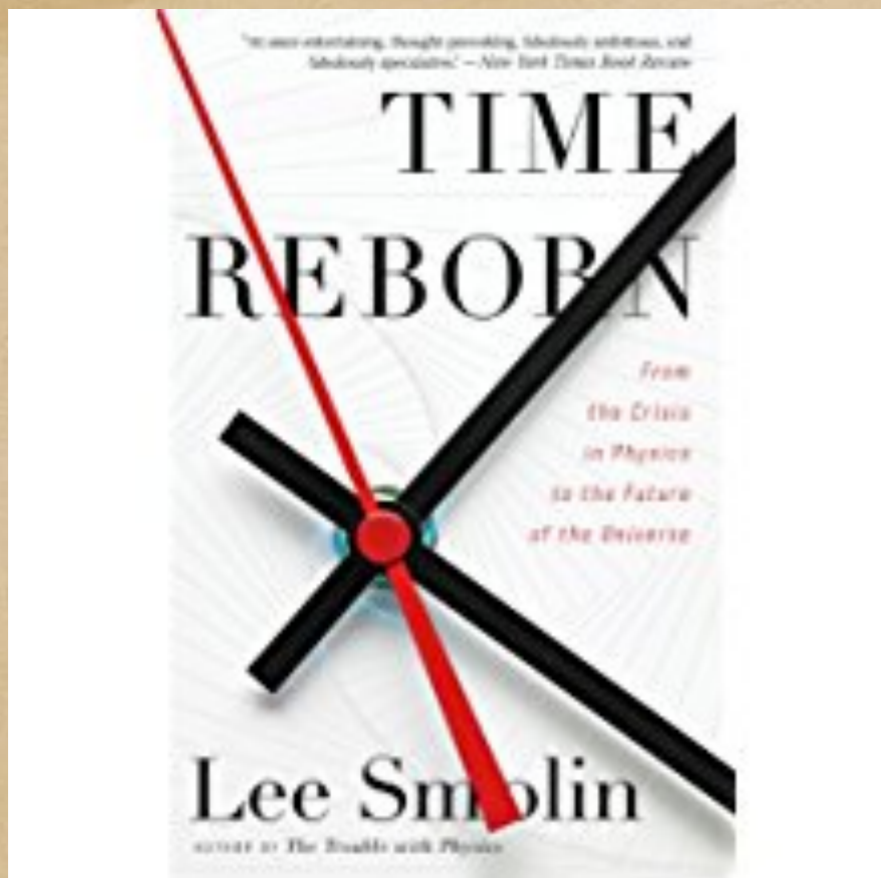
Lee Smolin



“The future is not now real and there can be no definite facts of the matter about the future.” What is real is “the process by which future events are generated out of present events,” he said at the conference.

“I’m sick and tired of this block universe,” said Avshalom Elitzur, a physicist and philosopher formerly of Bar-Ilan University. “I don’t think that next Thursday has the same footing as this Thursday. The future does not exist. It does not! Ontologically, it’s not there.”

https://www.youtube.com/watch?v=ATxi0_-7HqQ



As Roberto Mangabeira Unger and I
argue in our new book *The Singular
Universe*,

the most important discovery
cosmologists have made is that the
universe has a history.

We argue this has to be extended to the
laws themselves.

At this point we're out on the edge, exploring.



But HEY, what about...

daily life

freedom,
choice,
open possibilities ?



An Experiment

Imagine you are deliberating
about some important decision...

SUDDENLY



An Investigator appears beside you
and says:

“We (scientists, martians, god) have studied you
and we KNOW
what you will decide.”

then she...vanishes without saying
anything more.

Now what do you do ?

This is parallel to
accepting the block universe
but still having to live and make decisions

you have to act as if you have free will

**“a will that cannot exercise itself
except under the idea of its freedom
IS FREE, from a practical point of view.”**

Immanuel Kant

Immanuel Kant

Kant is saying that **in engaging in practical endeavors — trying to decide what to do, what to hold oneself and others responsible for, and so on** — one is justified in holding oneself to all of the principles to which one would be justified in holding wills that are autonomous free wills.

And **one is justified in this because rational actors can only operate by seeking to be the first causes of their actions.**

so in daily life

you make decisions
and act
presupposing

that possibilities are multiple
in an open future

We are always out on the edge, exploring.



..You mean the science can't be trusted ?

Trusted for what?

for learning how to deal with the material world **sure**

for giving us an overall view of what might be
probably possible

for trimming unrealistic expectations and goals?

but...remember Clarke's laws

for telling us what our choices,
values and goals should be ?

not such a good idea...

Arthur C. Clarke's Three laws

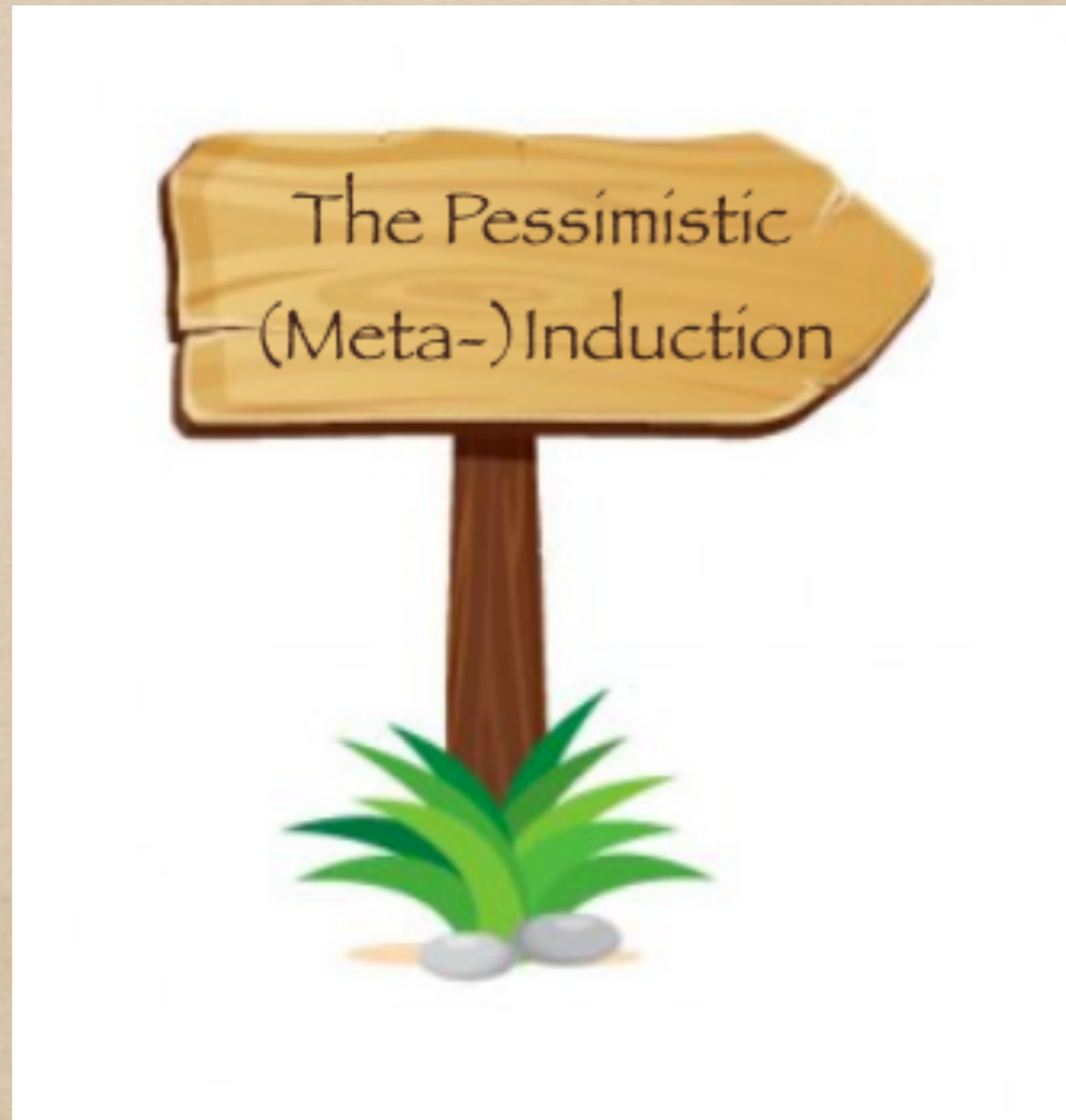
When a distinguished but elderly scientist states that something is possible, he is almost certainly right.

When he states that something is impossible, he is very probably wrong.

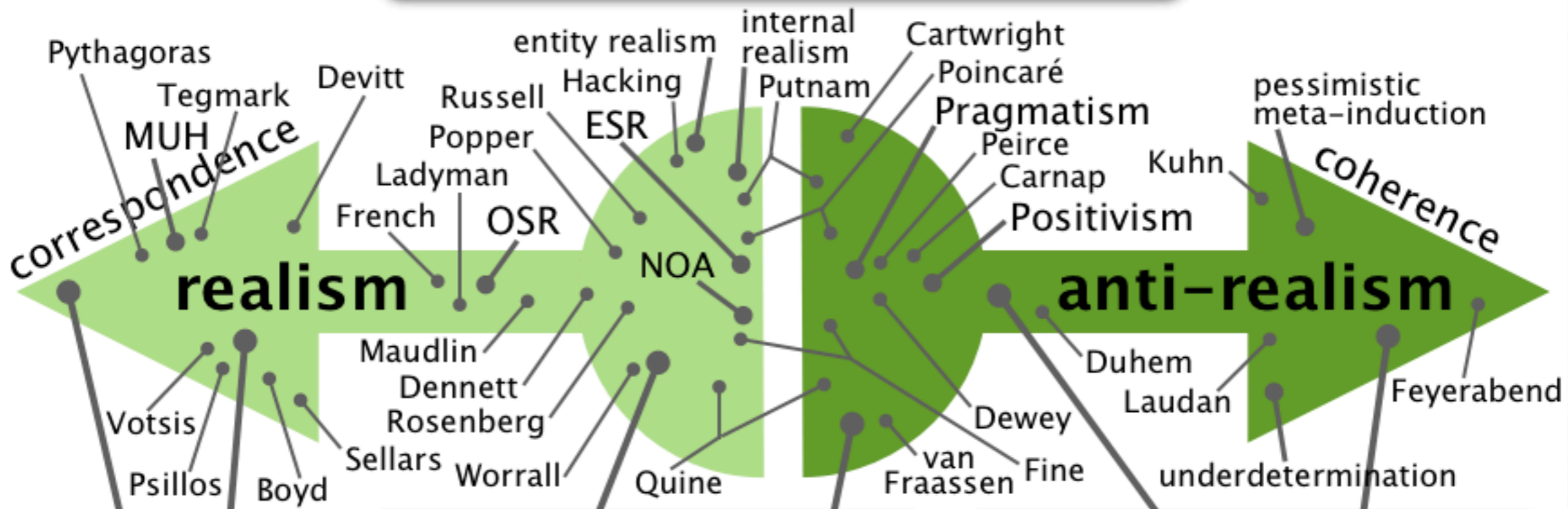
The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

Any sufficiently advanced technology is indistinguishable from magic.

BUT.....Science...



philosophy of science



Naive Realism
 The world I see is real. What are you all arguing about?

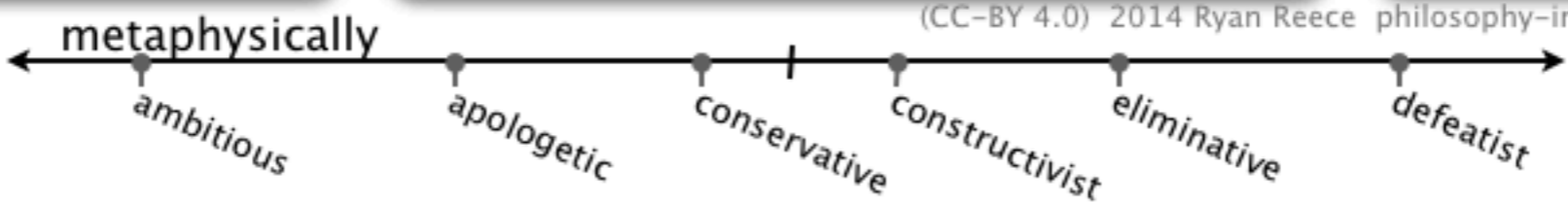
Structural Realism
 Science has identified real patterns, relationships, and structures (at least within a regime) in nature.

Instrumentalism
 Theoretical concepts may have use in predicting observations, but we have no ontological commitments to them.

Scientific Realism
 Science makes real progress in describing real features of the world.

Constructive Empiricism
 Science aims to give us theories which are empirically adequate, but does not justify metaphysical claims about reality.

Relativism
 Social constructivism. Epistemological anarchism.



(CC-BY 4.0) 2014 Ryan Reece philosophy-in-figures.tumblr.com

John Dewey, in the course of a spirited rejection of what we call **the "pessimistic meta-induction"** :

But the very putting of the question... induces modification of existing intellectual habits, standpoints, and aims.

Wrestling with the problem, there is evolution of the new technique to control inquiry, there is search for new facts, institution of new types of experimentation; there is gain in the methodical control of experience. And all this is progress.

It is only the worn-out cynic, the devitalized sensualist, and the fanatical dogmatist who interpret the continuous change of science as proving that, since each successive statement is wrong, the whole record is error and folly; and that the present truth is only the error not yet found out.

John Dewey, *Essays in Experimental Logic* (1916) p.101

BUT, don't take the too easy road:

“Well, it's all just Belief?
Faith in...whatever?
You choose.”

NO!

belief and faith are not the same

beliefs are testable, adjustable

not *finally* a matter of choice

belief can and will evolve and self-question

rely on what
currently seems
most reliable

BUT hold beliefs **lightly,**
self-critically.

what counts most is the process,
not today's content

and there's still plenty beyond...

To quote a famous Thinker

There are always the **Unknown Unknowns**.

We are an example of what hydrogen atoms can do, given fifteen billion years of cosmic evolution.

And we resonate to these questions. We start with the origin of every human being, and then the origin of our community, our nation, the human species, who our ancestors were and then the riddle of the origin of life. And the questions: where did the Earth and Solar System come from? Where did the galaxies come from?

Every one of those questions is deep and significant. They are the subject of folklore, myth, superstition, and religion in every human culture.

But for the first time [?] we are on the verge of answering many of them.

I don't mean to suggest that we have the final answers; we are bathing in mystery and confusion on many subjects, and I think that will always be our destiny. The universe will always be much richer than our ability to understand it.

Carl Sagan

%%%