



Truth and Awe

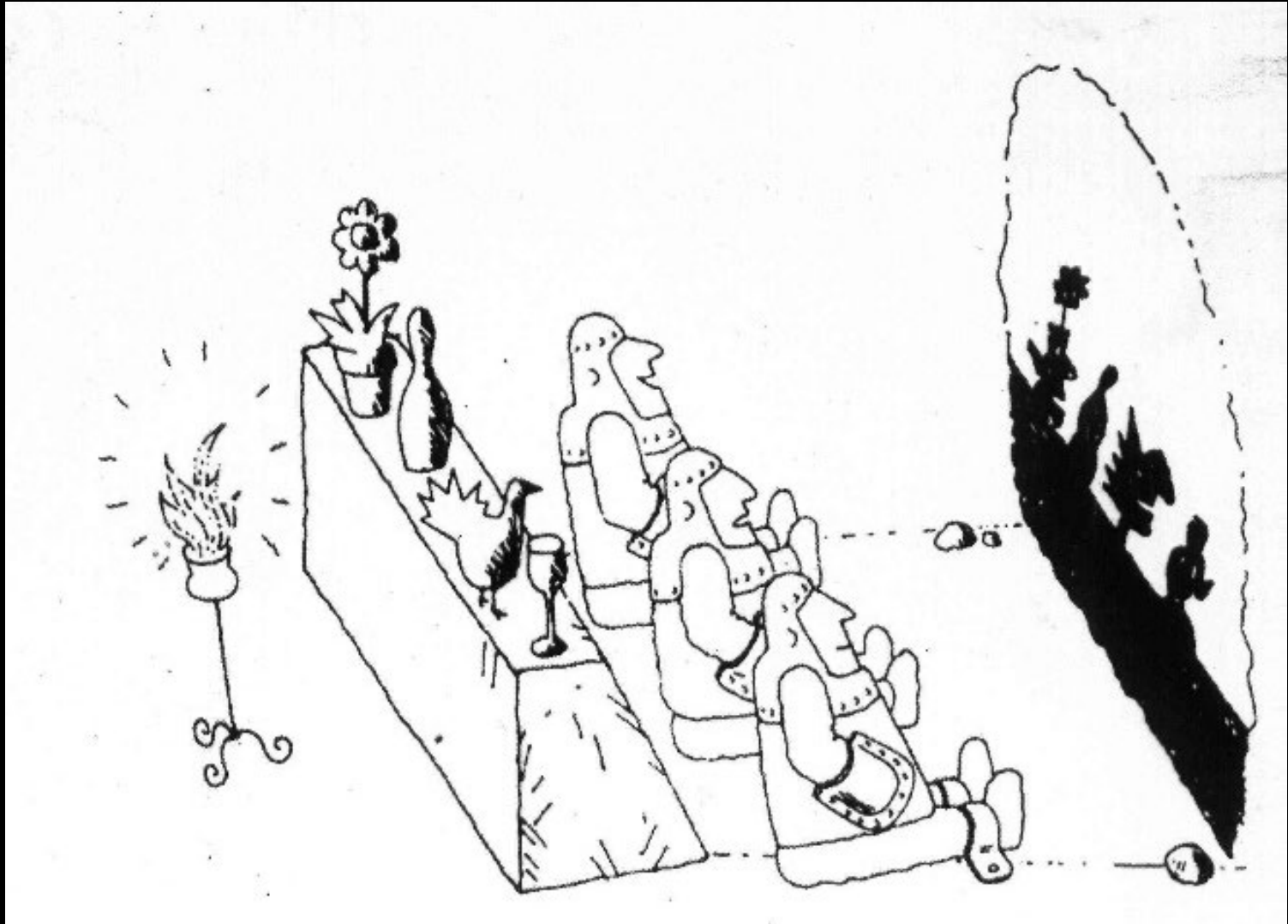
Eclipse of Thales, 585 BCE

as recorded by Herodotus

- interrupted a battle in a long war
- taken as an omen
- stopped the battle & ended the war
- predicted by Thales?
- “birth of science”? (Isaac Asimov)

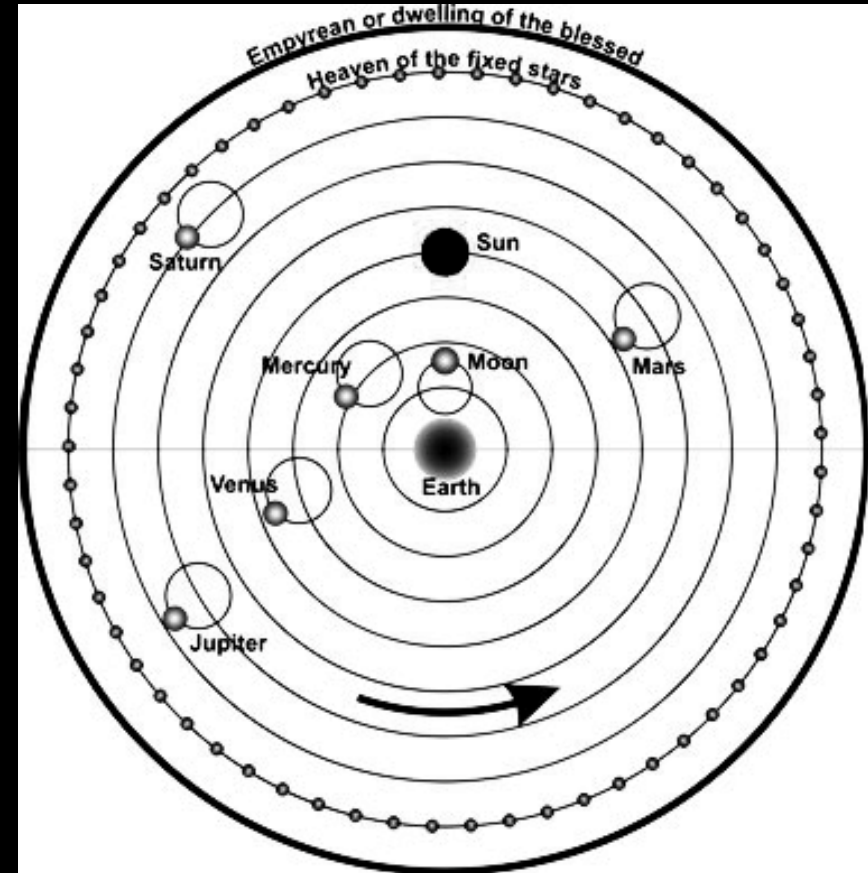


Plato's Allegory of the Cave



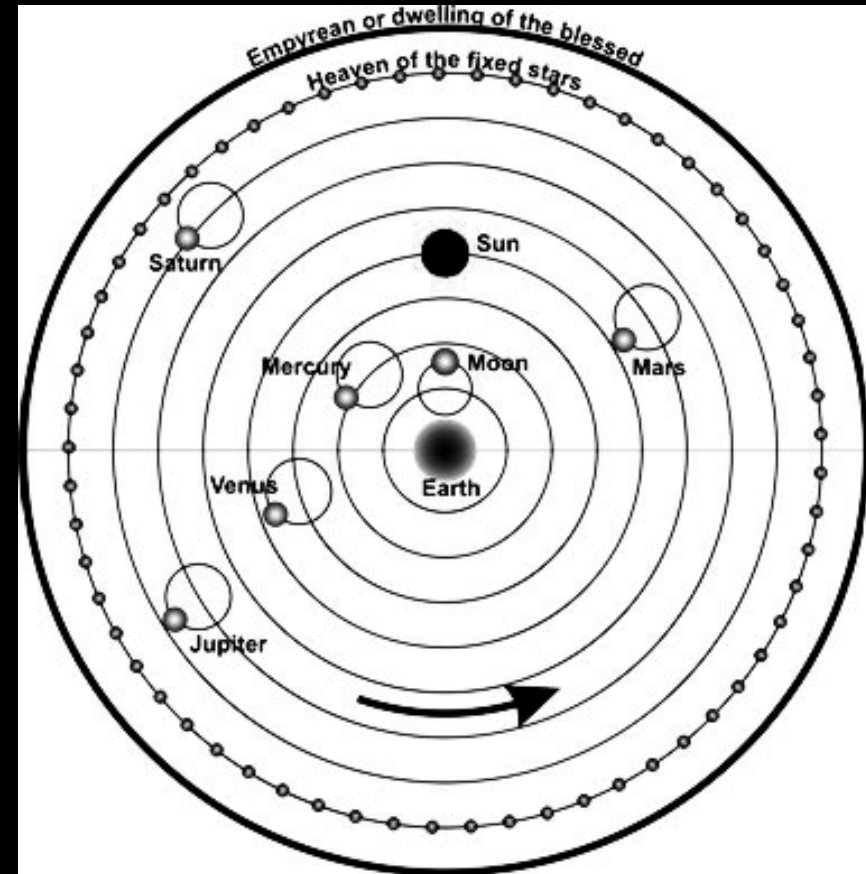
Ancient Greek Science-Philosophy (Sci-Phi)

- **Plato's dictum:**
all phenomena in the heavens can be explained with uniform circular motion
- **Aristotle's elaboration:**
the heavenly bodies are attached to ~50 transparent, concentric rotating spheres around the spherical Earth



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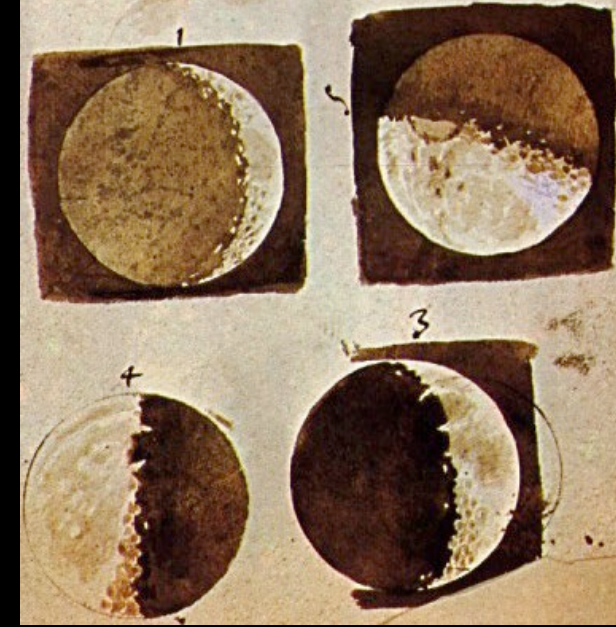
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refined over next millennium → Ptolemaic model

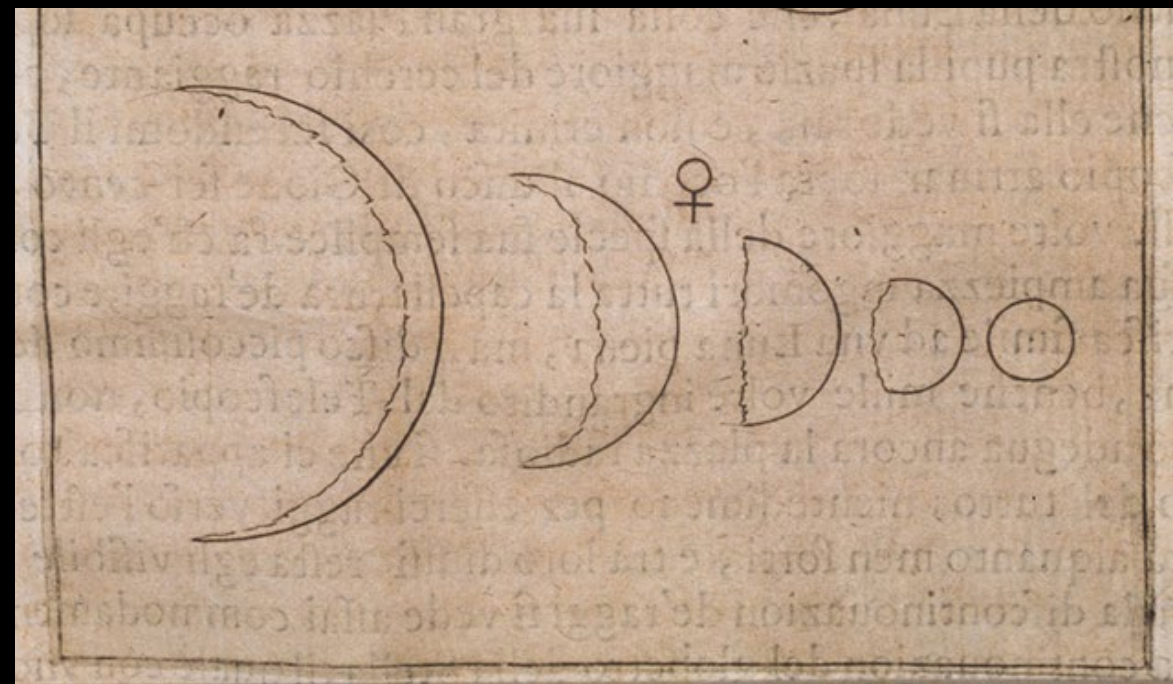


Sunspot Animation,
from drawings by
Galileo Galilei,
5th through 29th
June, 1612



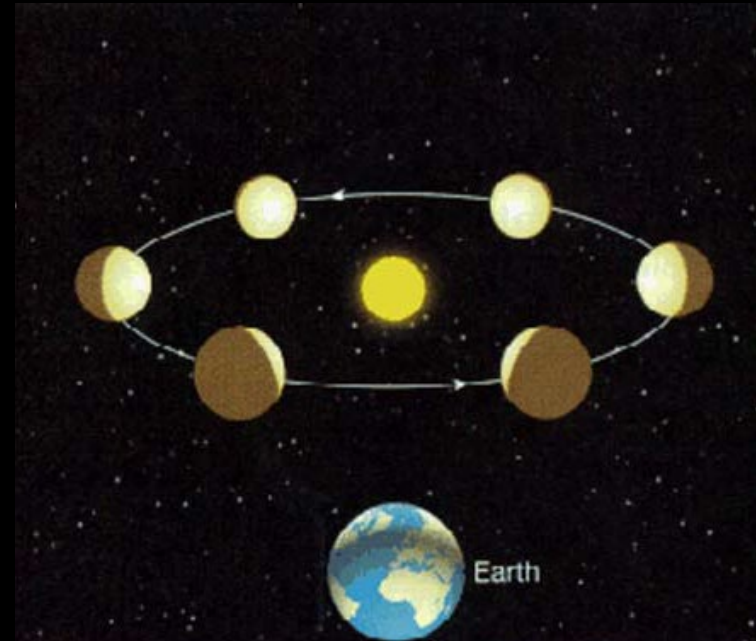
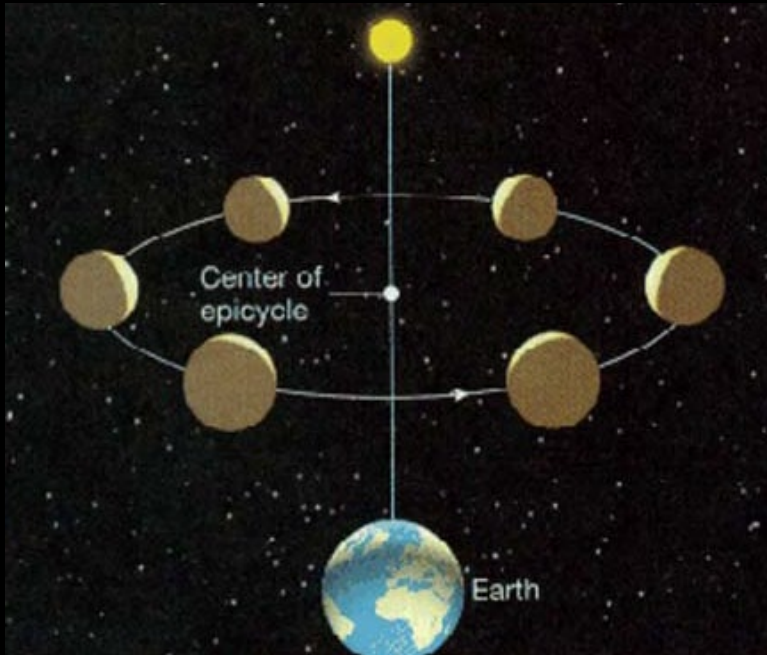
Observationes Joviales
1610

20. Janis mand H. 12	○ **
30. mart	** ○ *
2. Febr.	○ ** *
3. mart	○ * *
3. Ho. s.	* ○ *
4. mart	* ○ **
6. mart	** ○ *
8. mart H. 17.	* * * ○
10. mart	* * * ○ *
11.	* * ○ *



Galileo led us from sci-phi to modern science.

The turning point for heliocentrism



Using a heliocentric model, Venus' phases are explained.
Using the Ptolemaic Earth-centric model, they are not.

Is a model "truth"?

The Catholic Church argued the heliocentric model was a "mathematical supposition" and saying otherwise would "restrict God's omnipotence."

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Galileo's logic sounded to the Church like "inductive" reasoning.

deductive (necessarily true) vs. **inductive** (could be false)

- | | |
|---|---|
| - <i>If it is raining, the streets get wet.</i> | - <i>If it is raining, the streets get wet.</i> |
| - <i>It is raining.</i> | - <i>The streets are wet.</i> |
| - <i>Therefore the streets are wet.</i> | - <i>Therefore it is raining.</i> |

But Galileo used neither induction nor deduction.

He pioneered **hypothetico-deductive** reasoning: *repeated experimental testing* of a model, which gains credibility if it passes multiple tests, but can be *falsified* if it fails just one test.

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- *If it is raining, the streets get wet. (fire hydrant?)*
 - *If it is raining, people carry umbrellas. (threat of rain?)*
 - *If it is raining, people feel drops on their skin. (A/C? airborne spray?)*
- *The streets are wet, people are carrying umbrellas, people feel drops on their skin, and there's no fire hydrant, air conditioner, or aircraft in sight → Therefore it is raining... until we come up with a better idea!*

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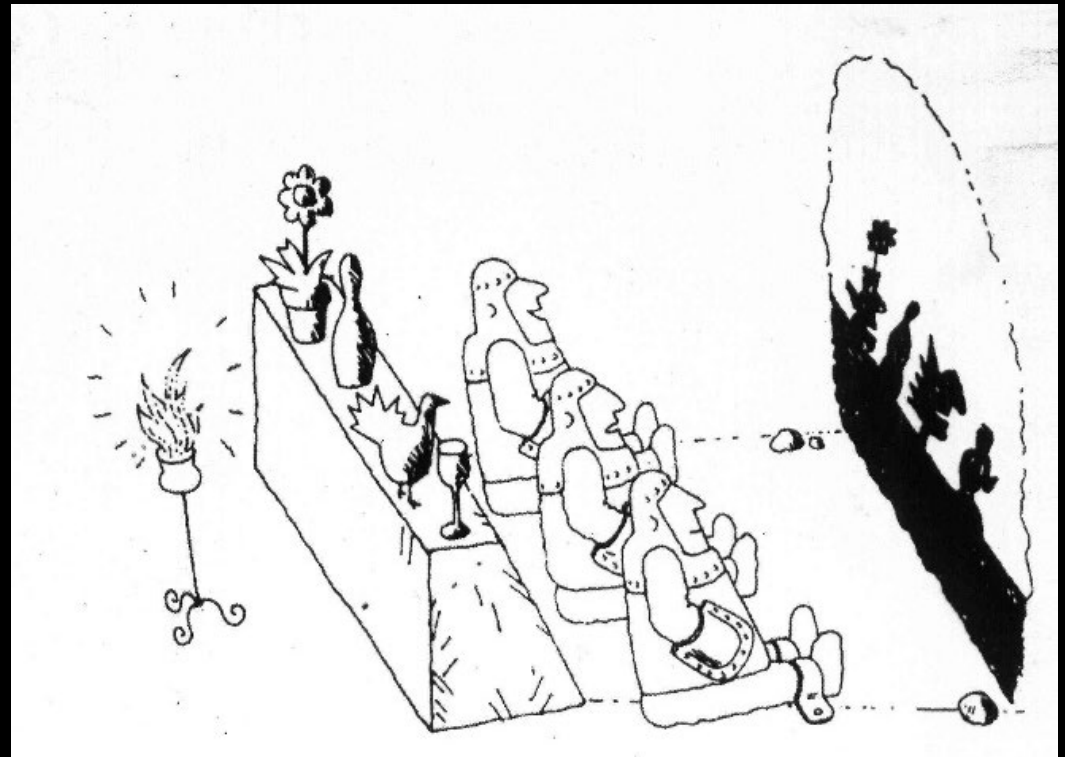
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This is truth in modern science.

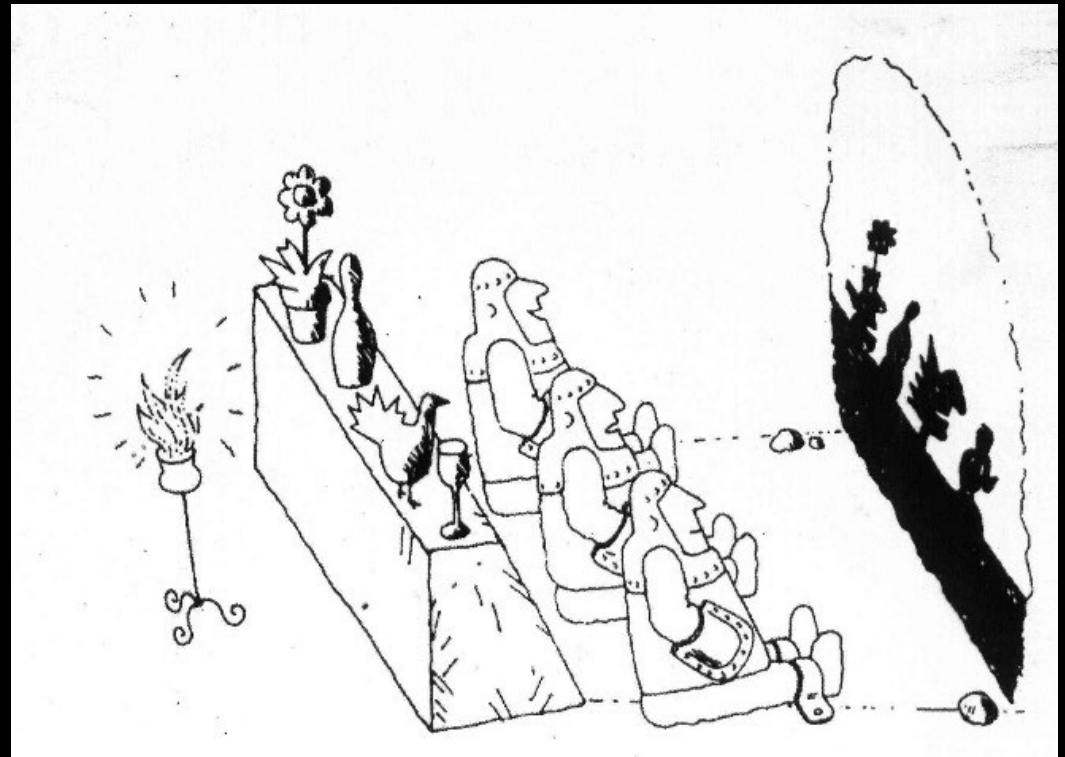
Science's path to truth is humble

We cannot
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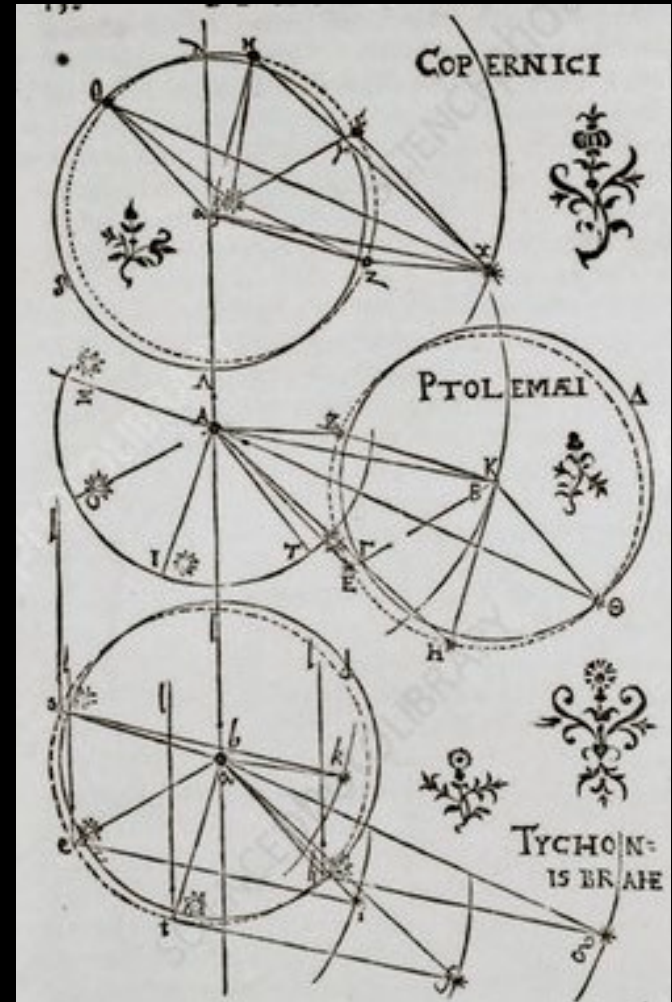
Yet we pursue it for those moments when we
think we glimpse **Truth**.

Kepler seeks Truth, not just truth

He is famous for his 3 Laws and exquisitely precise transit predictions.

But he wants to know why.

The Sun at the center must be the source of all motion. Do magnetic spokes from the Sun push the planets as the Sun rotates?

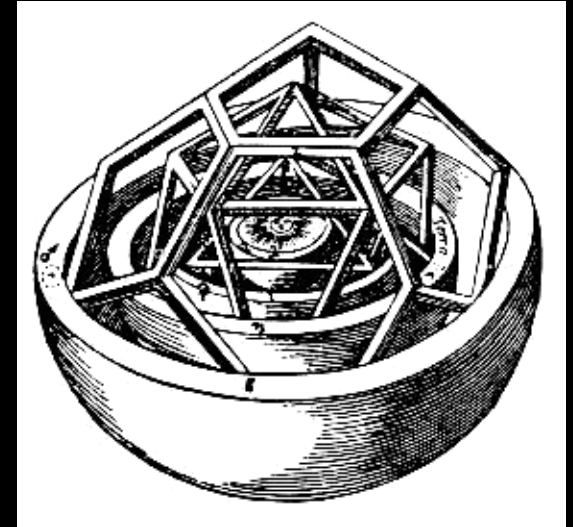
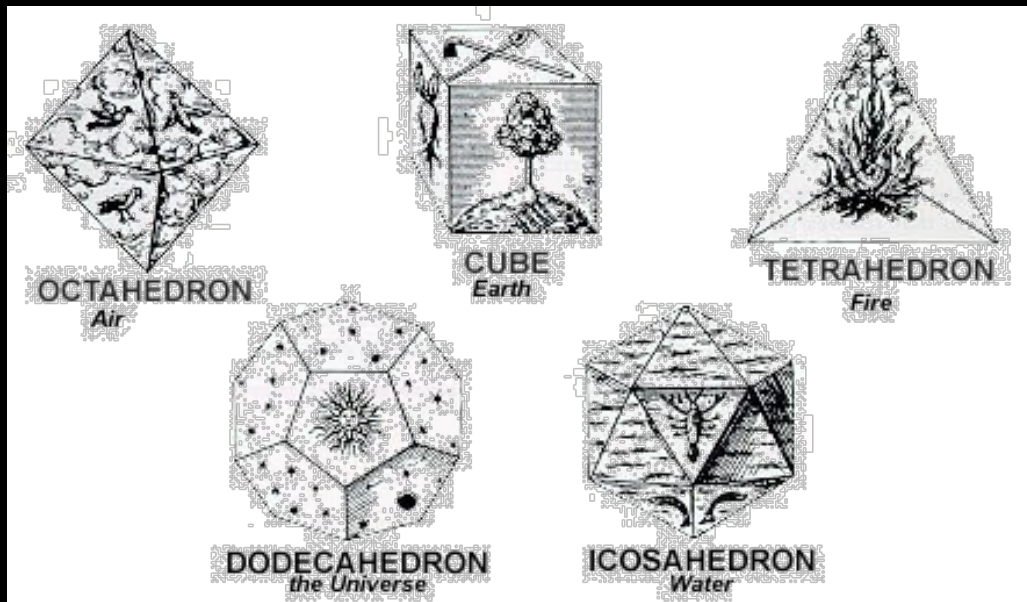


Astronomia Nova (1609)

Kepler seeks the mind of God

Mysterium Cosmographicum, 1597

Do nested Platonic Solids set the
spacing between planets?
Is this why there are six planets?



*“Geometry is one and eternal shining in the mind of God.”
Harmonices Mundi, 1619*

Why do we seek Truth, the mind of God, through astronomy?

new science of *awe*, psychologically defined by

- perceived vastness (physical size, complexity, superlativeness)
- need for accommodation (cognitive realignment)

- *Keltner & Haidt 2003*

Effects of Awe

- goosebumps, chills, fast breathing
- sense of smallness of self
- increased critical thinking
- sense of connectedness
- expanded perception of time
- greater kindness and generosity

Theory and anecdotal accounts suggest that some intense awe experiences can provoke such profound cognitive accommodation that they create life-lasting changes in how people view themselves and the world.



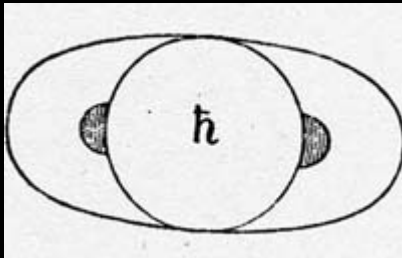


Find a partner.

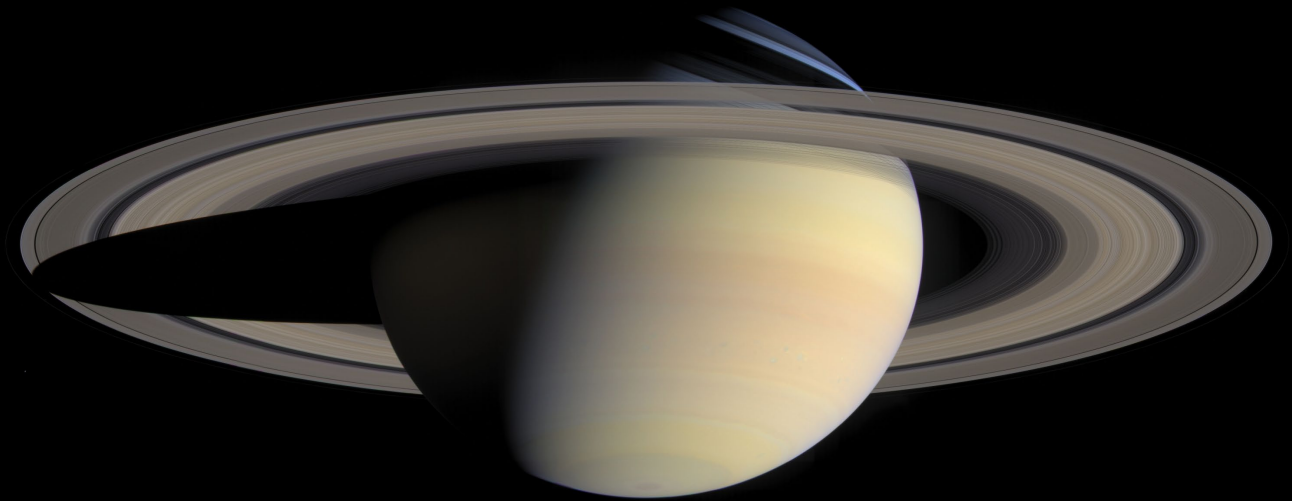
*Share an awe experience you had recently,
or one that changed you.*

Awe and Astronomy

“Measure what is measurable, and make measurable what is not so.” – Galileo



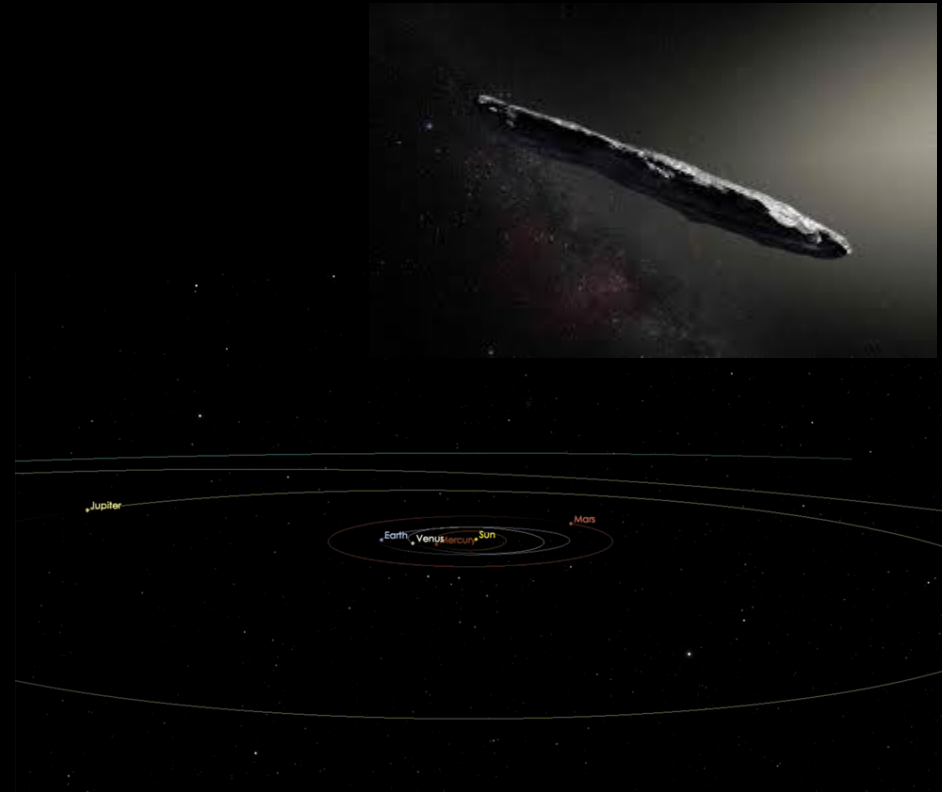
Saturn through
Galileo's telescope,
1610



Cassini's first year at Saturn (2004)
In Saturn's Rings teaser: 1:46-2:03 and 2:19-2:28

And yet more awe...

- Unexpected discoveries
- Mind-bending concepts
- Sheer size, scale, improbability

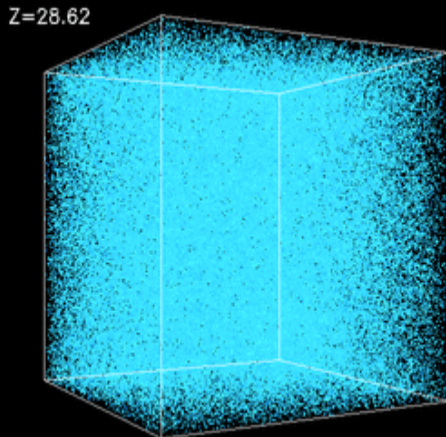


When my work gives me chills...

- When I see a correlation no one's ever seen before
- When I realize the data mean the opposite of what everyone's been thinking
- When all the pieces fit together into a new chapter of the story of galaxy evolution

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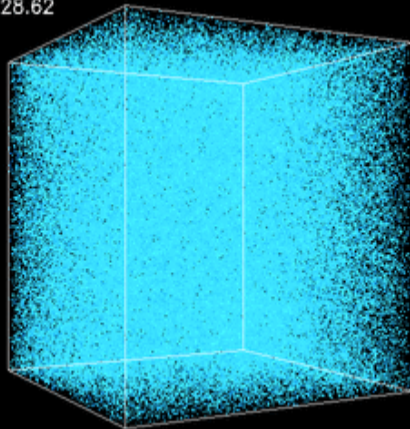
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$Z=28.62$

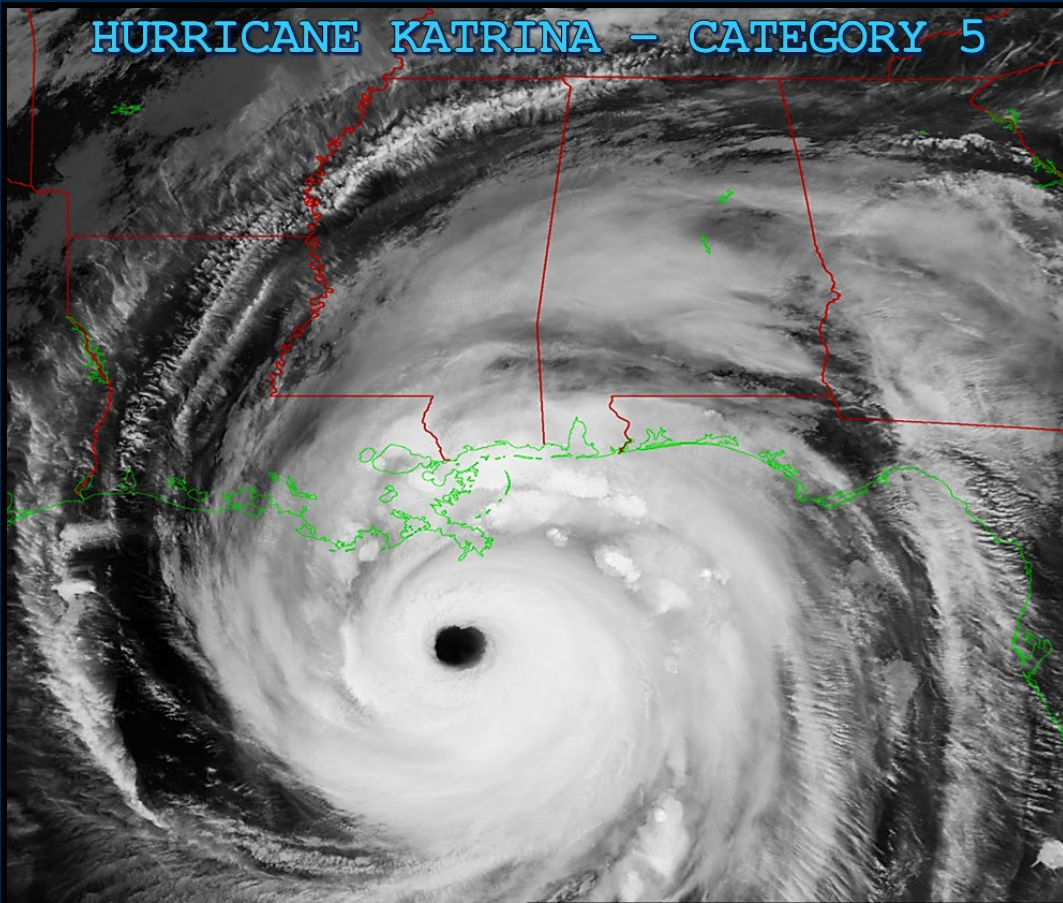


What about negative awe?





HURRICANE KATRINA - CATEGORY 5



2005

What can heal us?



Awe again.

We Need the Stars To Withstand the Suffering

What times are these

When to speak of trees is almost a crime

For it is a kind of silence about injustice. - Bertold Brecht

And what are trees, Bertold,
but power exercised: their sun-greed
sucks the smaller saplings dry
and leaves the rose bush gasping.

Since the beginning, the gold coin
of this cosmos has been violence -
equity but paper money,
often laundered, seldom clean. And yet, Bertold,

the greedy trees stand tall, offering
a careless generosity of shade
to half-eaten corpses.

Listen to the music of their leaves
as they drum the wild wind's saraband.

How sweet, the tartness of their harvest.

Gaze long enough at them

and calm takes root, then courage flowers.

This is the second wind.

- Nancy Kenney Connolly <http://www.softblow.org/connolly.html>



And the Truth that should
inspire the greatest Awe is that
we exist at all.

<https://www.youtube.com/watch?v=h3lWwMHFnA>