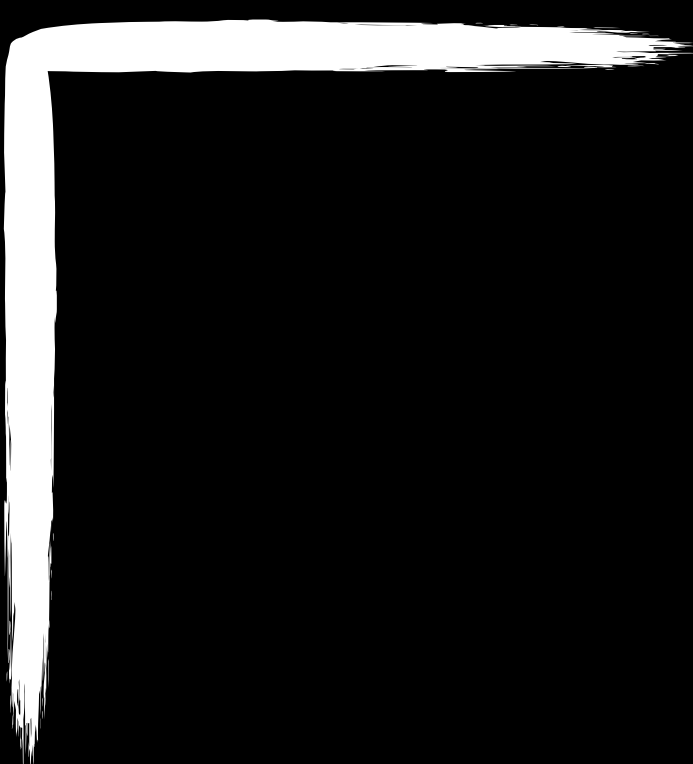




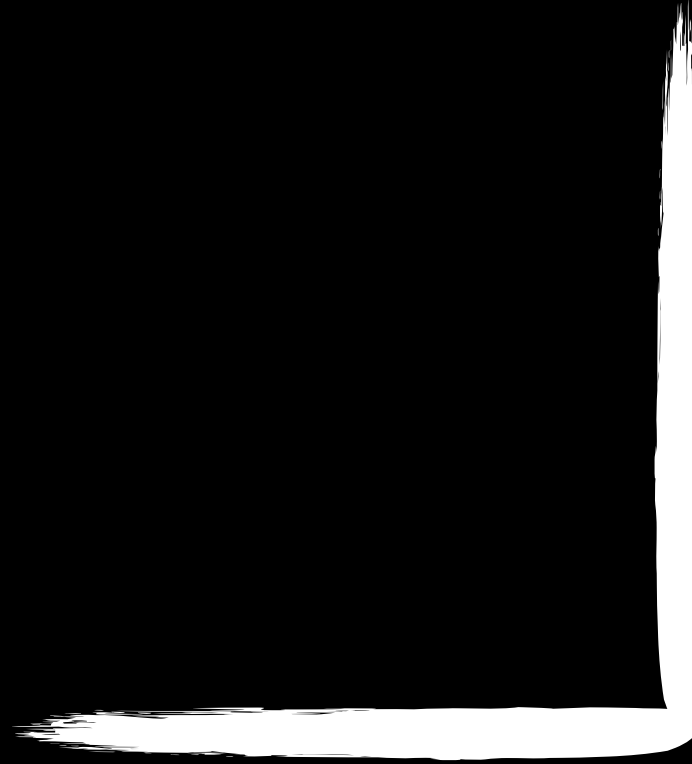
# Philosophy of Science I

February 16th 2024

## Session 4 - Causation and The Special Sciences



Case Study!







**Is Biology a science?**





**Is Psychology a science?**



# Where are we at?

We are trying to make sense of **what entails a scientific explanation.**

We have seen that **laws of nature** (LoN) seem to play a crucial role in such explanations. That begs the question of what these laws are.

Upon unveiling certain features of LoN, now **we can ask whether science and the scientists work accordingly across the board.**

**Q: Natural/special sciences students, do you work accordingly?**





# History of Psychology

---

RAND B. EVANS, EDITOR  
East Carolina University

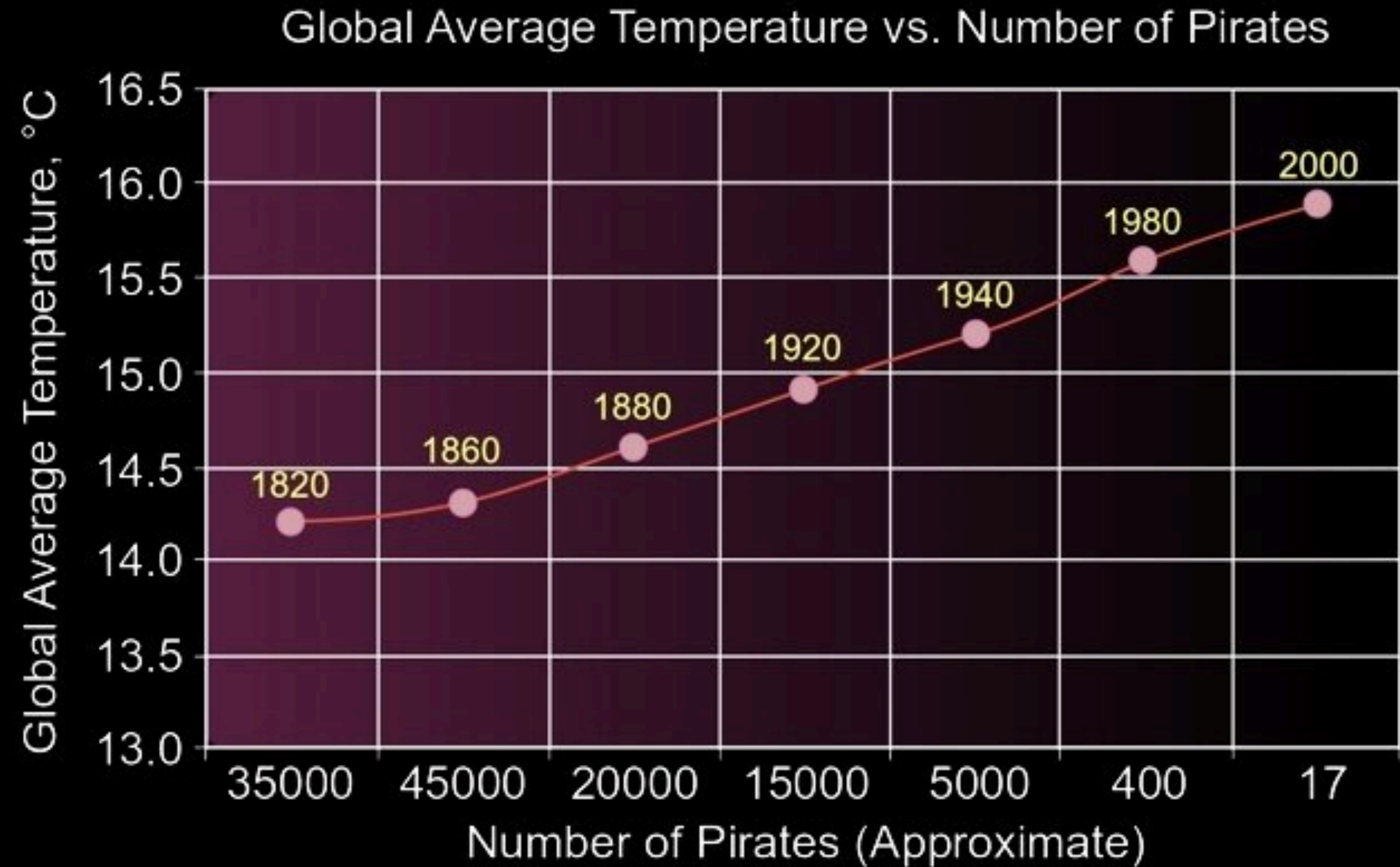
## **One hundred years of laws in psychology**

KARL HALVOR TEIGEN  
Department of Psychology, University of Tromsø

Mainstream psychology in the 20th century has been conceived as a nomothetic science, but few psychological “laws” have been proposed. A PsycLit search of journal abstracts from 1900 to 1999 yielded a total of 3,093 “law” citations, or 22 per 10,000 entries, with two psychophysical laws (Weber’s law and Stevens’s power law) and two learning laws (Herrnstein’s matching law and Thorndike’s law of effect) as the most frequently cited. The number of law citations has been decreasing throughout the century, to 10 per 10,000 entries in the last decade, with few references to laws of recent origin. This could be the result of increasing doubts about the lawfulness of psychological processes coupled with a general preference for less ambitious terms (such as *effects*, *principles*, *models*, or *functions*).



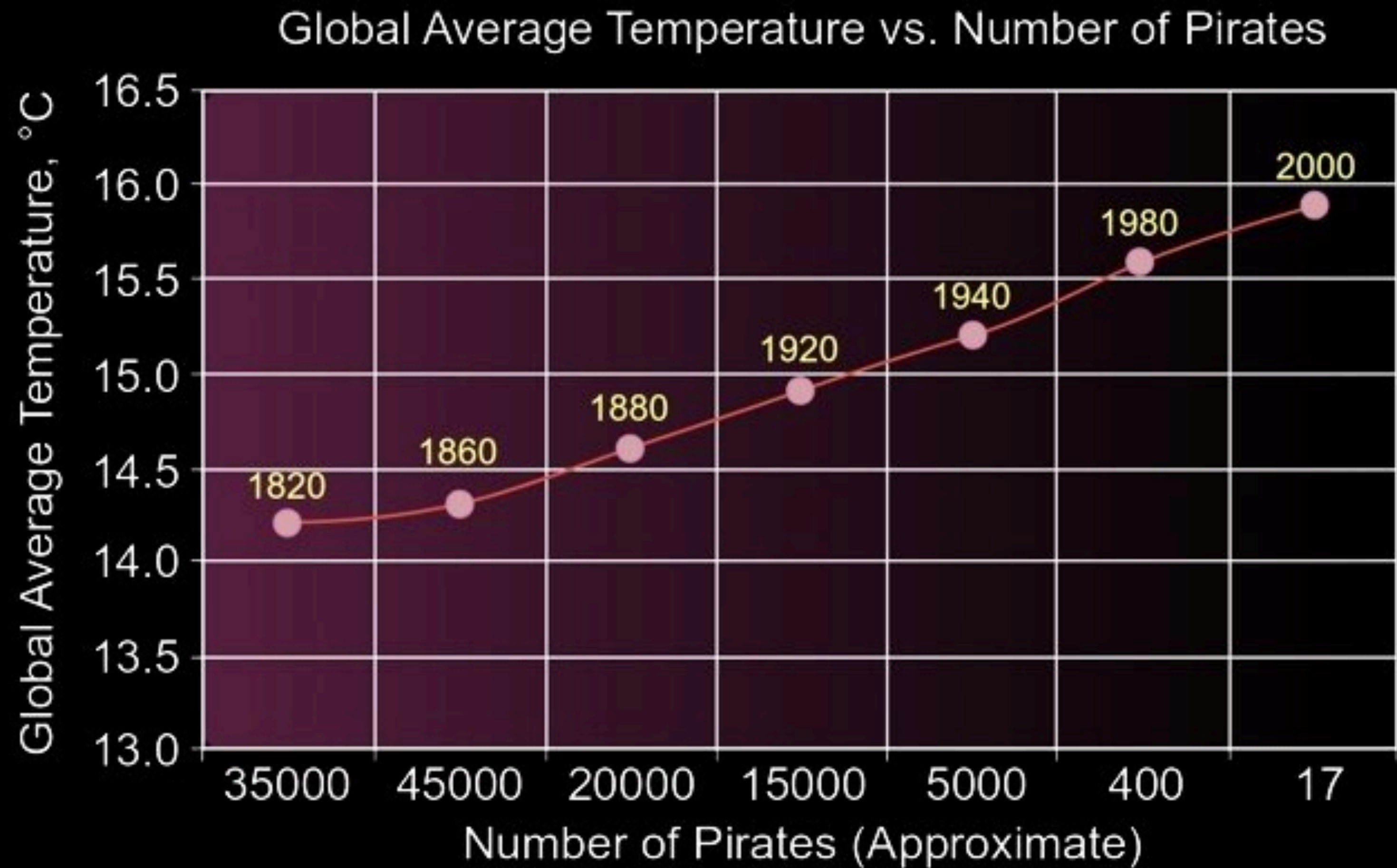
# Causation and the Special Sciences





- Global temperatures have been monotonically increasing since the early 1800s;
- The number of pirates has been monotonically decreasing since the early 1800s;

**Therefore,** global temperatures are rising because pirates are disappearing.



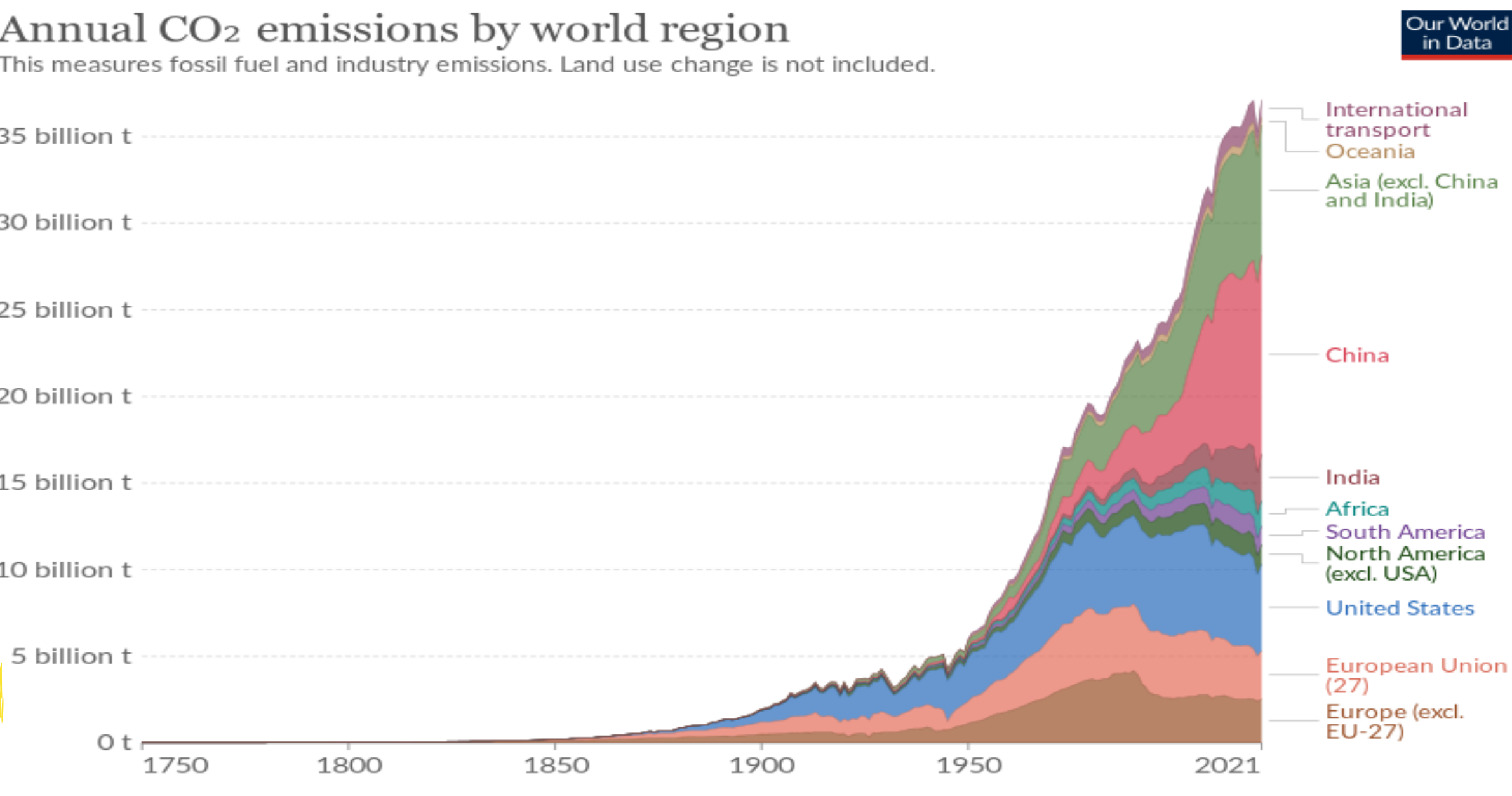
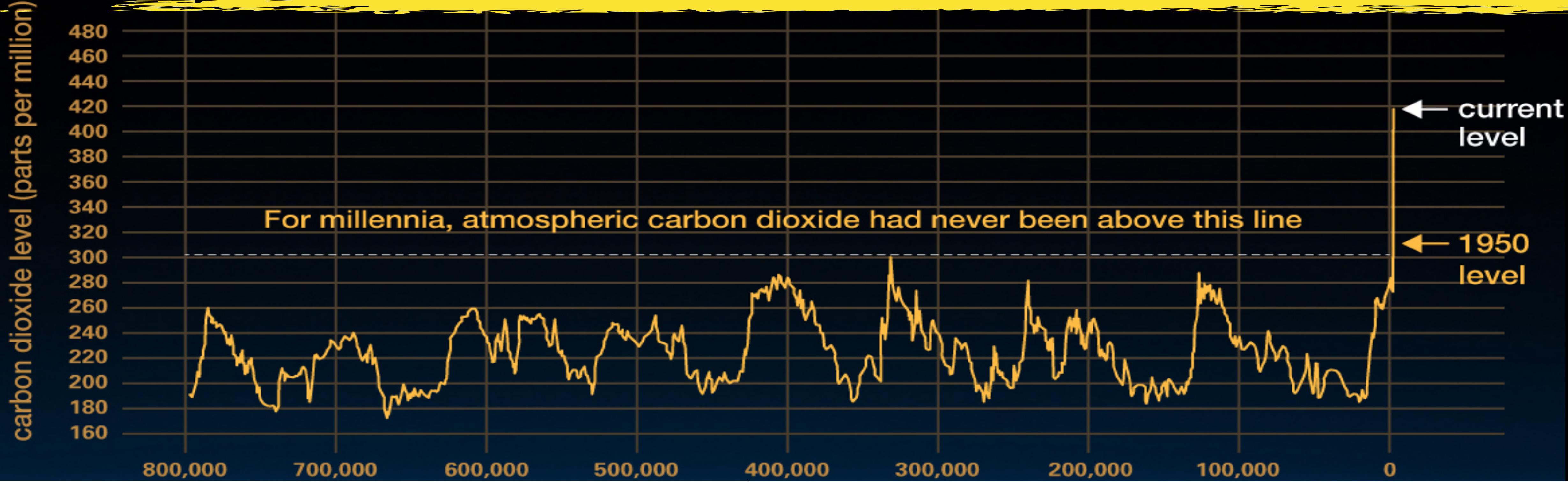
- Global temperatures have been monotonically increasing since the early 1800s;
- The number of pirates has been monotonically decreasing since the early 1800s;

**Therefore,** global temperatures are rising because pirates are disappearing.

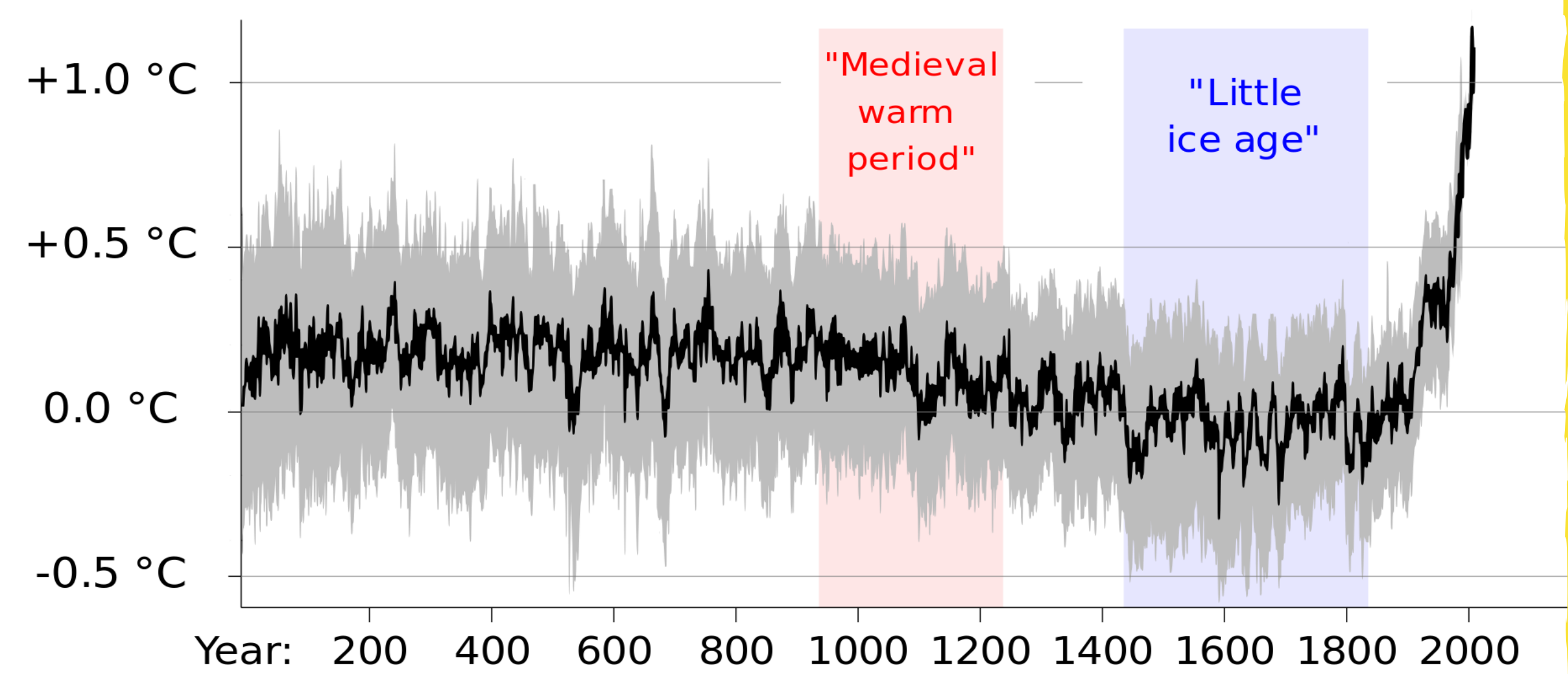
- ✓ Premises are true and empirically testable
- ❑ Premises include laws of nature
- ❑ This is a deductive argument

**Let's try  
again!**





## Global Average Temperature Change



Source: Global Carbon Budget (2022)

## Some additional facts:

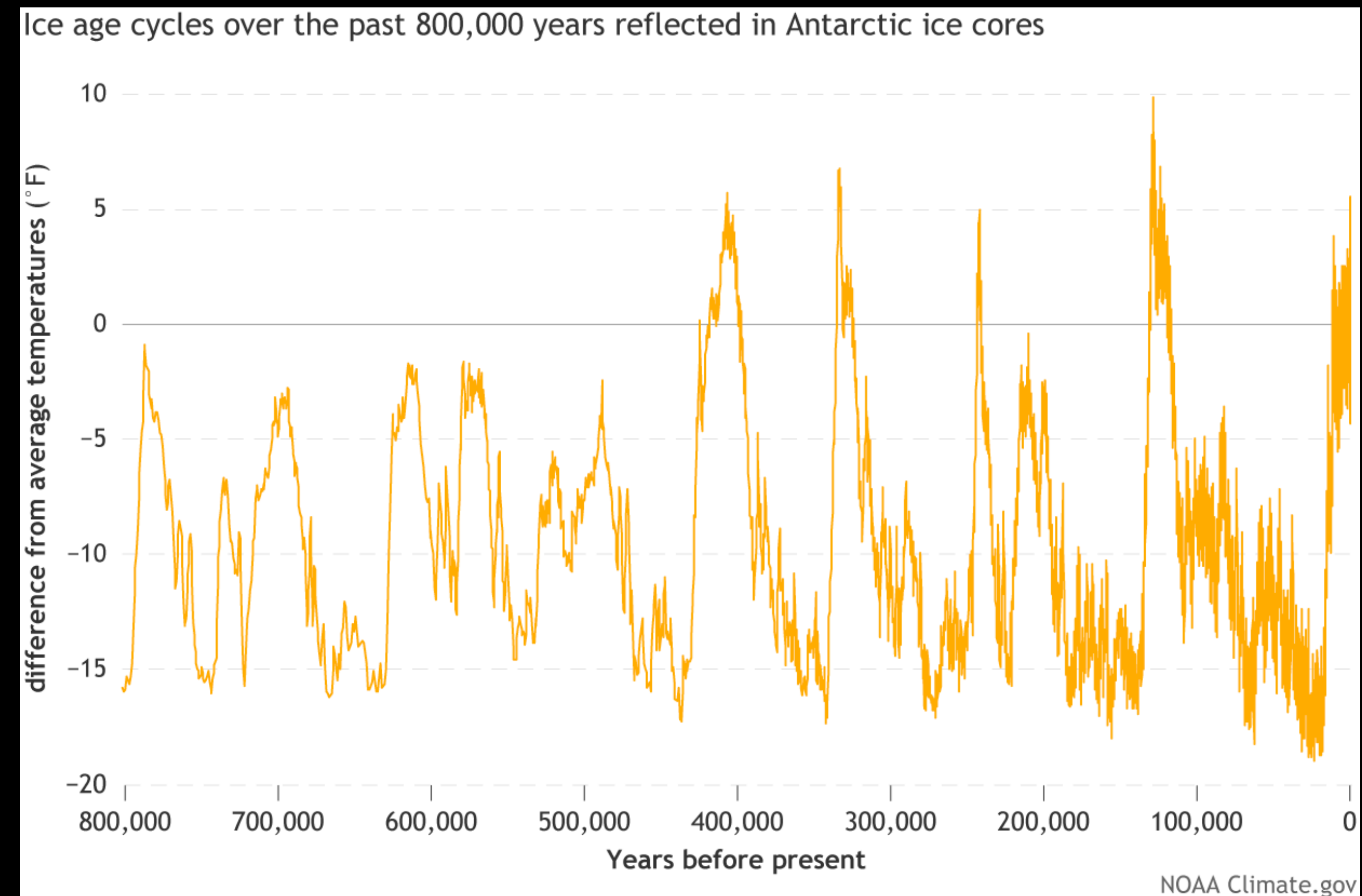
- Approximately 30% of the solar radiation that reaches the Earth is reflected back as infrared radiation.
- Carbon dioxide has a molecular structure that can absorb and re-emit infrared radiation.

Q: Can we sketch a D-N explanation for the global temperature rise now?



The main issue resides on the strong requirements that a **law of nature** is:

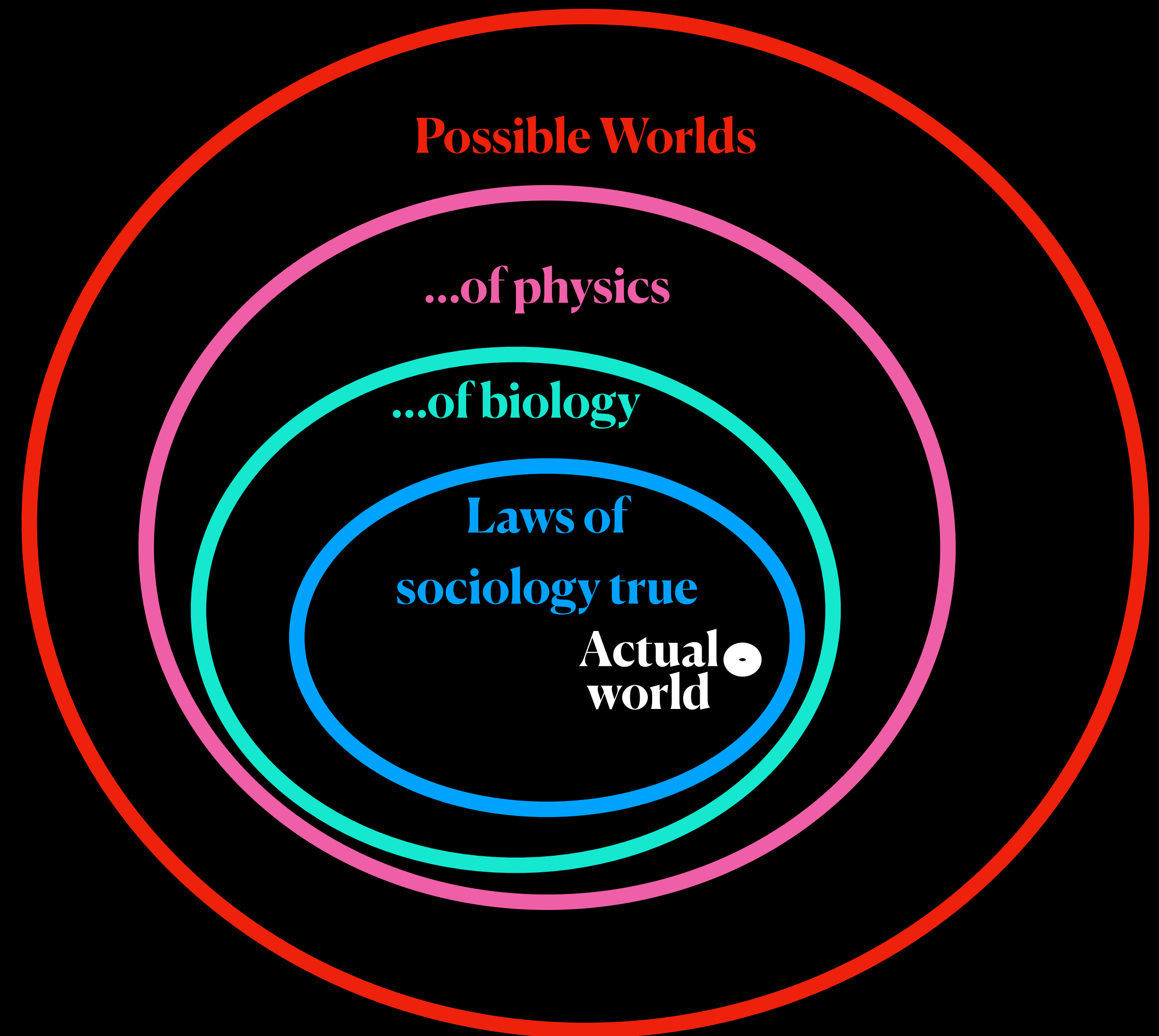
- **Universal** (e.g. any two massive bodies...)
- **True** (exceptionless)
- **Necessary** (if modern humans were not around, then the global average temperatures would not increase?)
- **Synthetic:** true by facts of the world



# Laws in physics vs. in the special sciences

Some philosophers have concluded that there are no laws in the special sciences given their lack of universality and degree of contingency.

Q: Does the diagram make sense to you? Would it be possible to share the same laws of biology in a world with different physical laws?





**Question:** if the D-N model of scientific explanation doesn't work, what does? And how can we find out?

# Causation (of change or movement)

- **Material:** this is the aspect of change or movement determined by the material that **composes** the moving or changing things;
- **Formal:** ... caused by the **arrangement, shape, or appearance** of the thing changing or moving;
- **Final** (purpose, *teleology*): ... **for the sake of** a thing to be what it is;
- **Efficient (agent):** This consists of things apart from the thing being changed, moved, or explained - the immediately prior event that gives rise to, produces, or brings about what the explanandum describes.





# What justifies causal beliefs?

**Do we experience causal relations? Do we observe any “causal glue” if we record “a cause and an event”?**

In actuality,

- We observe their temporal ordering
- We observe their spatial proximity
- We observe that events of some type are followed by events of some other type (e.g. decreasing pirates and increasing temperatures?)





# On efficient causes' issues

Two main **problems**:

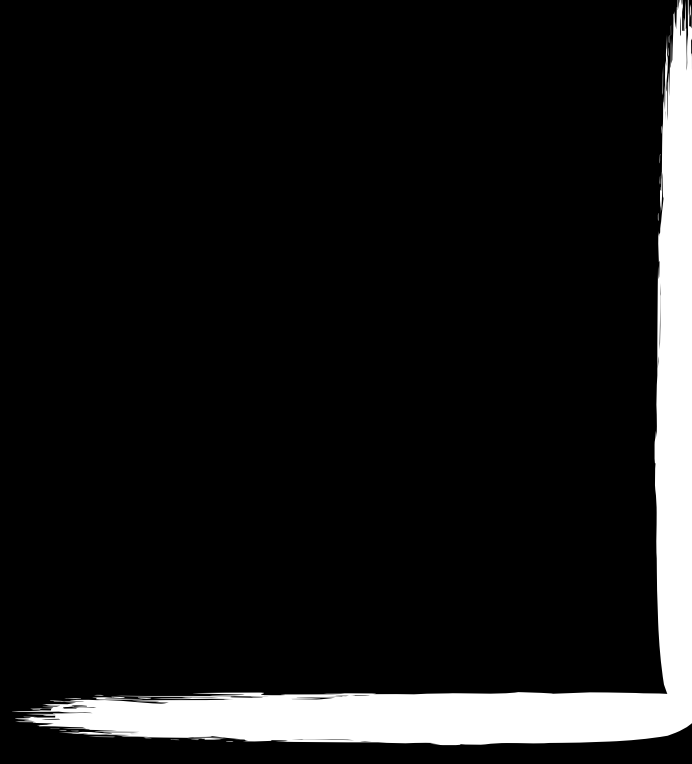
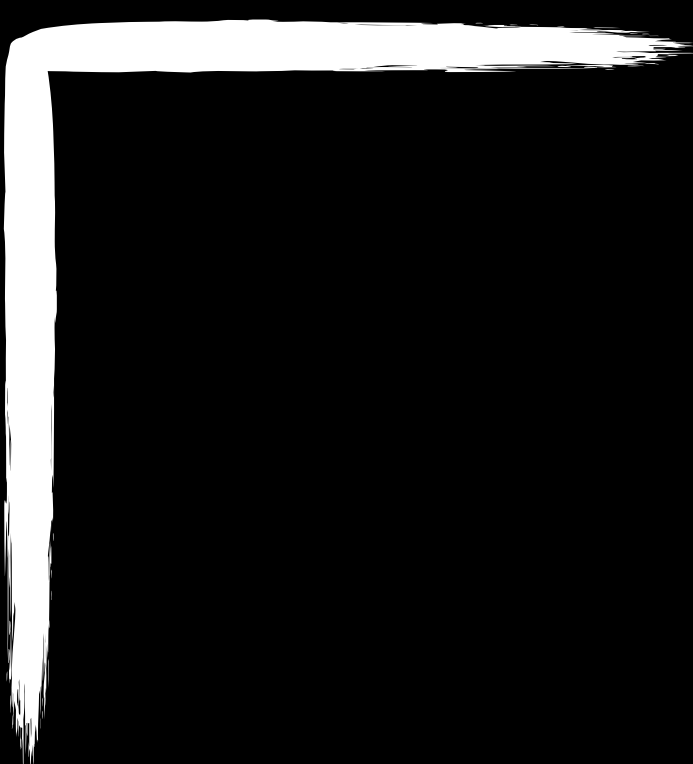
- How to distinguish causal sequences from coincidences?
- Causes seem to be at most necessary, but not sufficient







**Difference-maker**



# Questions?



# Interventions

Woodard argues that **C causes E** if there is some “intervention” on C that does or would have changed E.

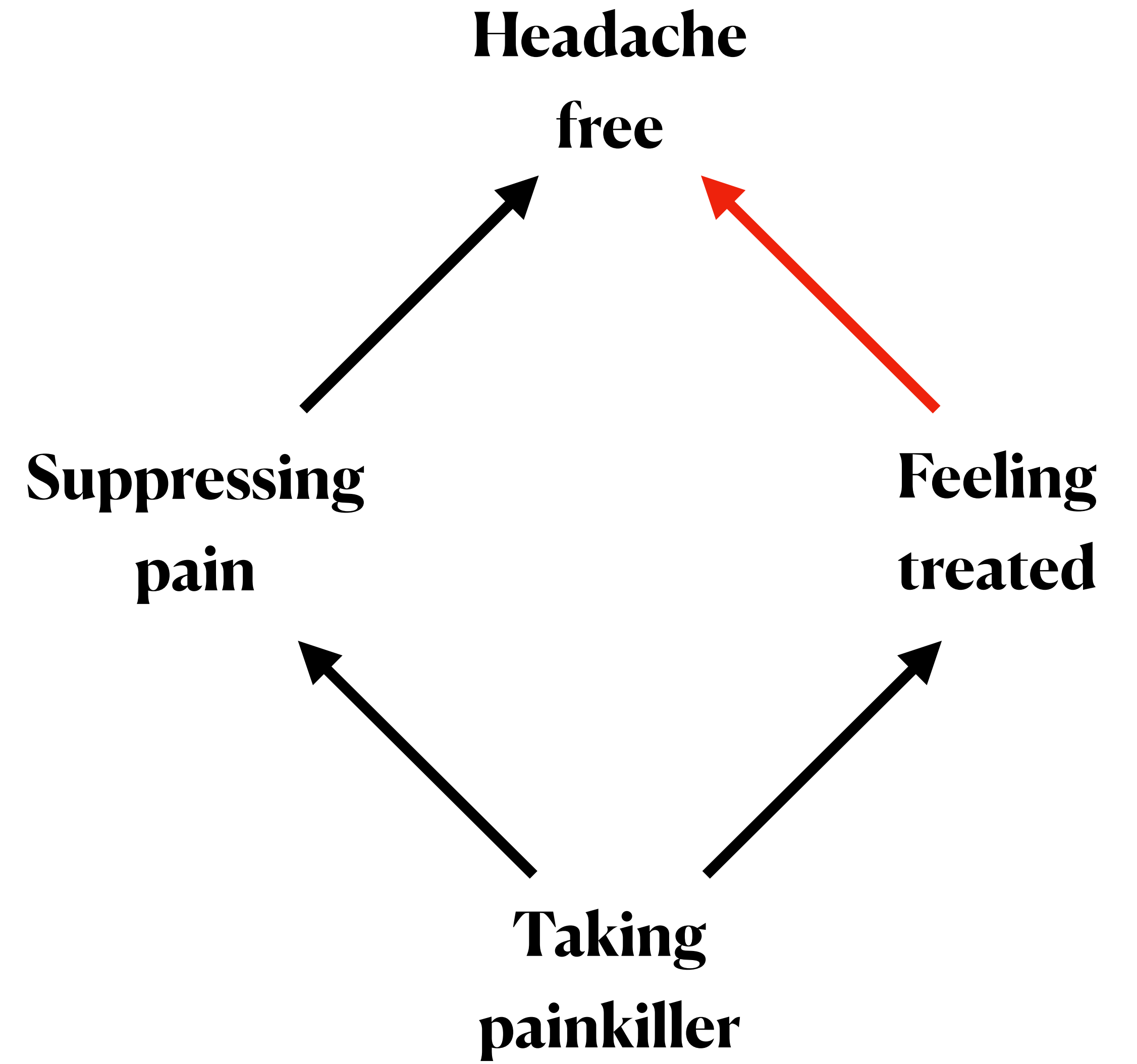
Interventions help to identify causes even while ignorant of the relevant laws of nature (or in their absence), since they define “objective” relationships between explanans and explananda.

Q 1: Example of intervention in physics, biology, psychology, economics, and politics?



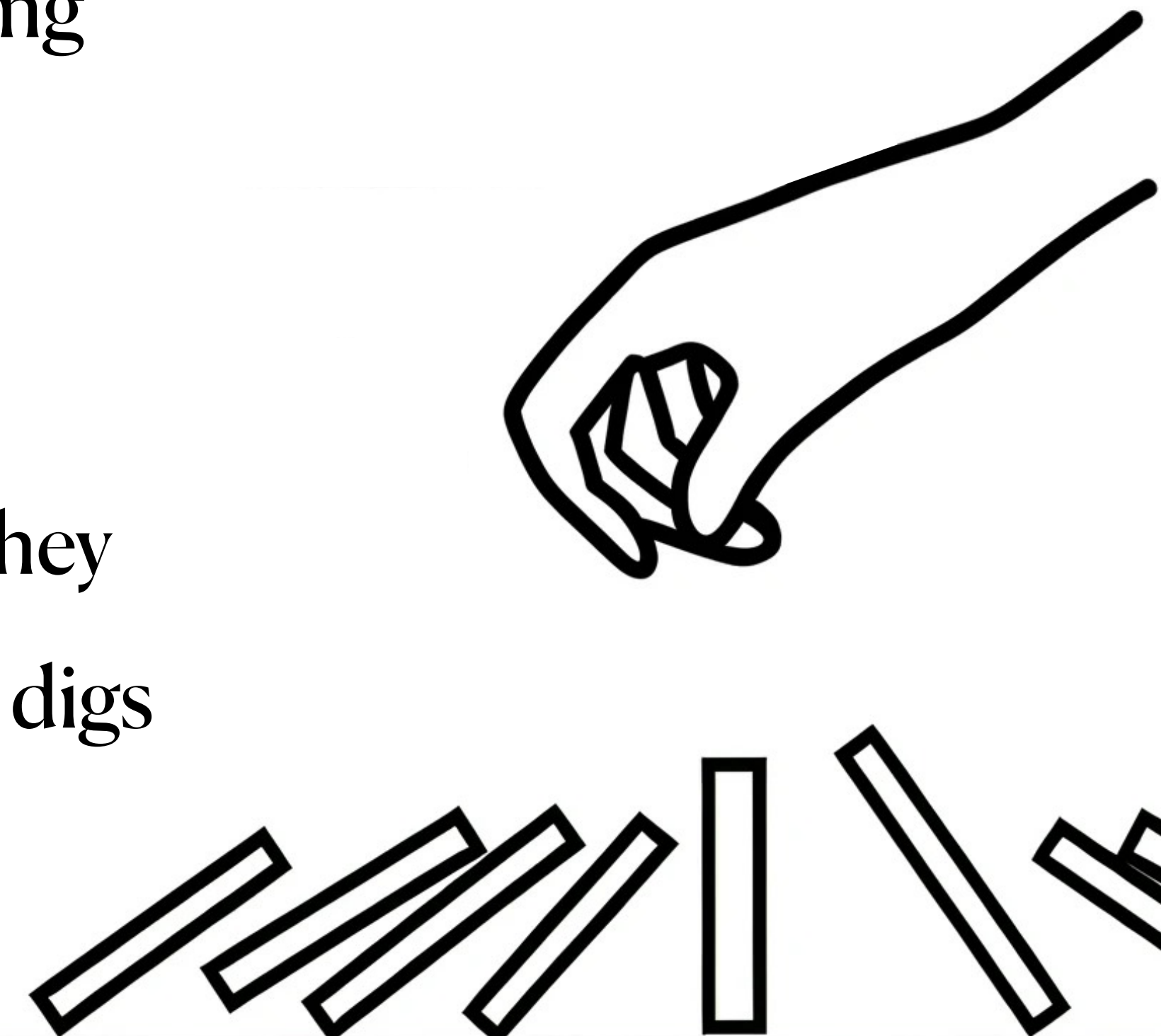




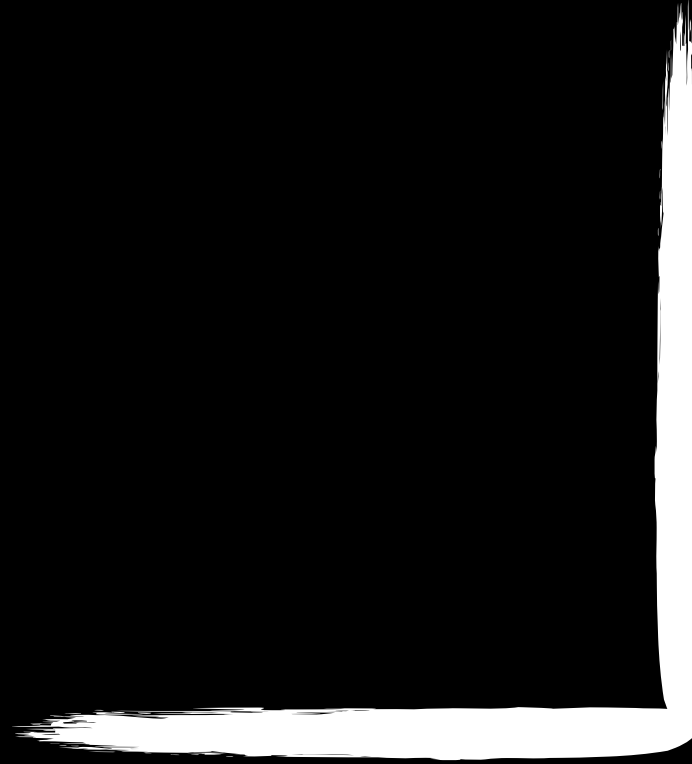
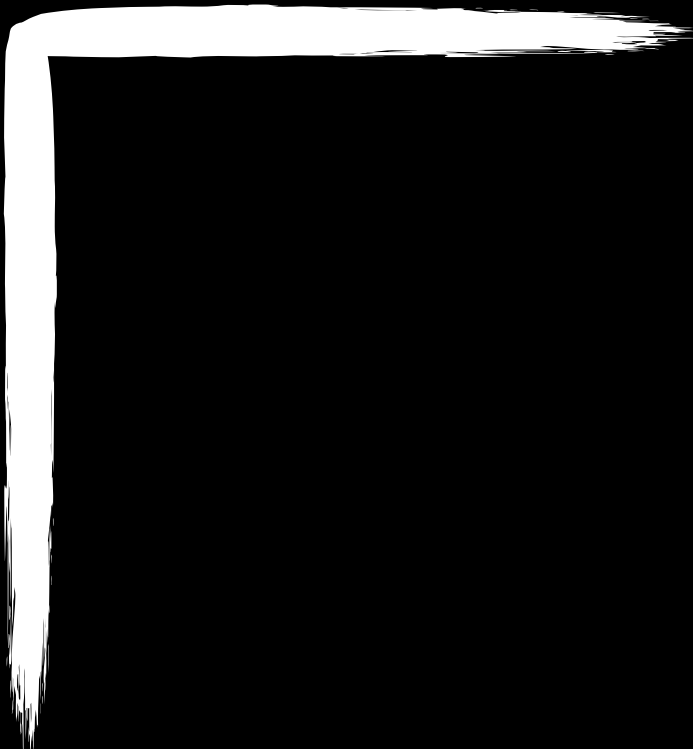


## Some questions are raised though:

- What about situations where no intervention can ever be done? A single universe? Past events? So, strong reliance on the truth of counterfactual conditionals, thus also facing the challenge of causal necessity
- What if the intervention directly causes the change in E, passing through C?
- Why these local regularities, that are **not** invariant under all possible interventions, still can provide explanations? Because they are effective, they are nonetheless based on laws of nature if one digs deeper.







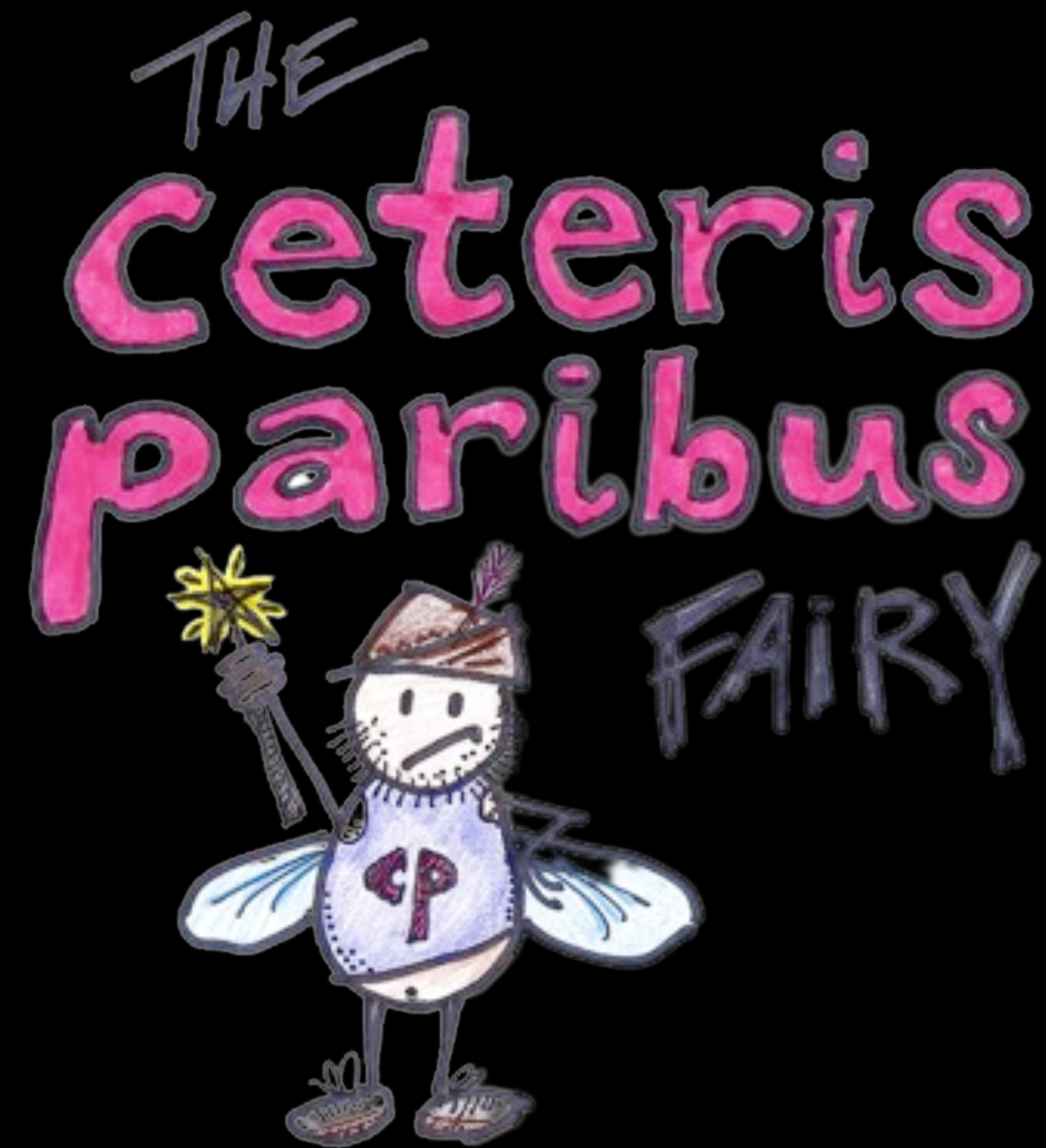
# Questions?

# Other things being equal...

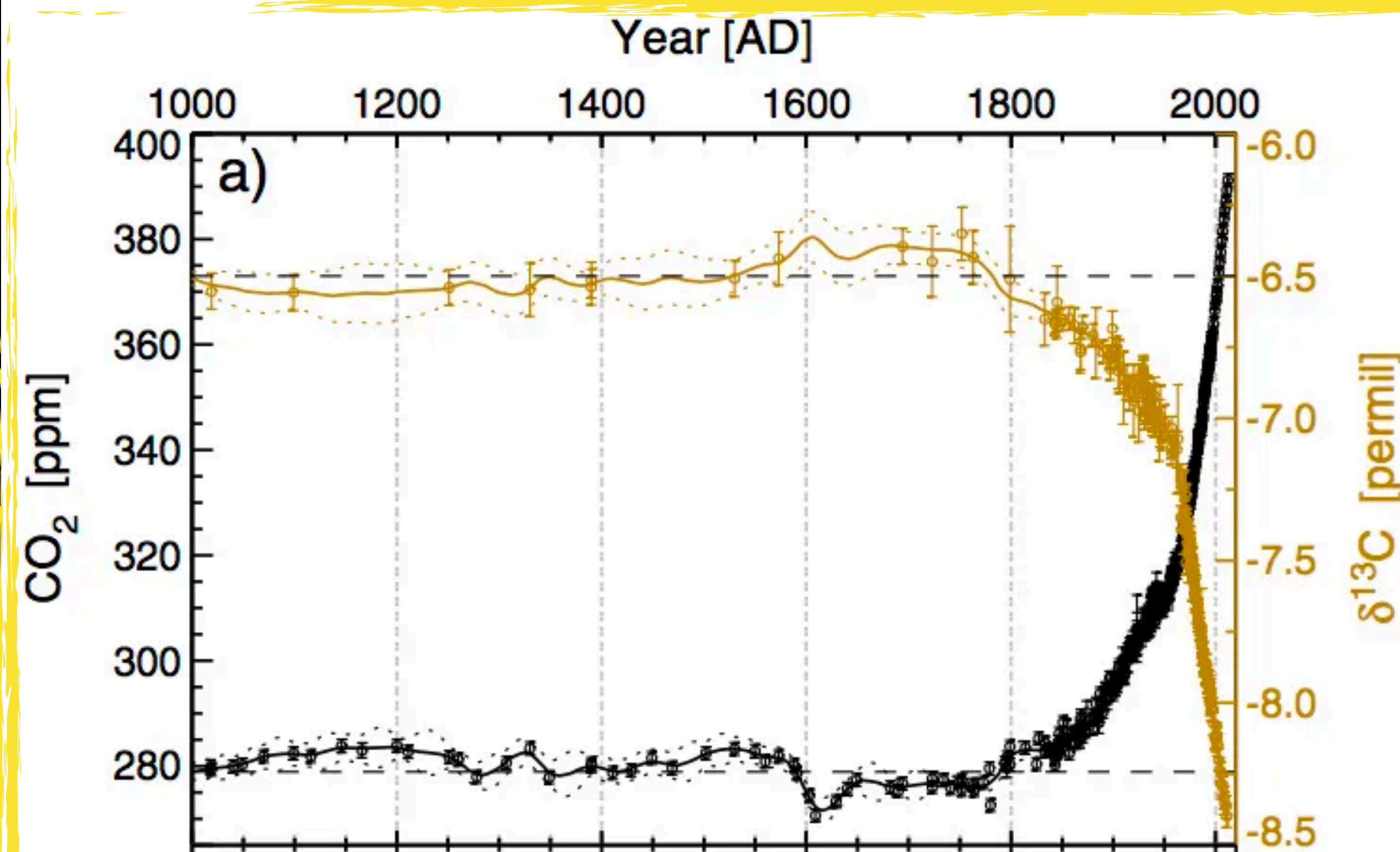
- We have identified that causes might be **difference-makers**. But they are not sufficient.
- But laws, rather than causes, were sufficient. As they possibly underwrite causal sequences, to **recover sufficiency** we need to name all the other conditions, which along with the cause, will bring about an effect.
- By these conditions remaining the same we can arrive at an explanation by the given cause.

Q1: What are the issues with the unstated conditions?

Q2: Is there any (physical) law that is not CP-like?







## *ceteris paribus* on Volcanic Activity

**Could CO<sub>2</sub> increase in the  
atmosphere be due to volcanos?**

- organic matter is strongly negative -- it sucks in a lot more <sup>12</sup>C relative to <sup>13</sup>C. So, when we burn organic material, we release a much higher proportion of <sup>12</sup>C to <sup>13</sup>C
- if you want it to be volcanoes, need both a sharp increase in emissions since 1800 *and* a change in the composition of the carbon dioxide they emit.

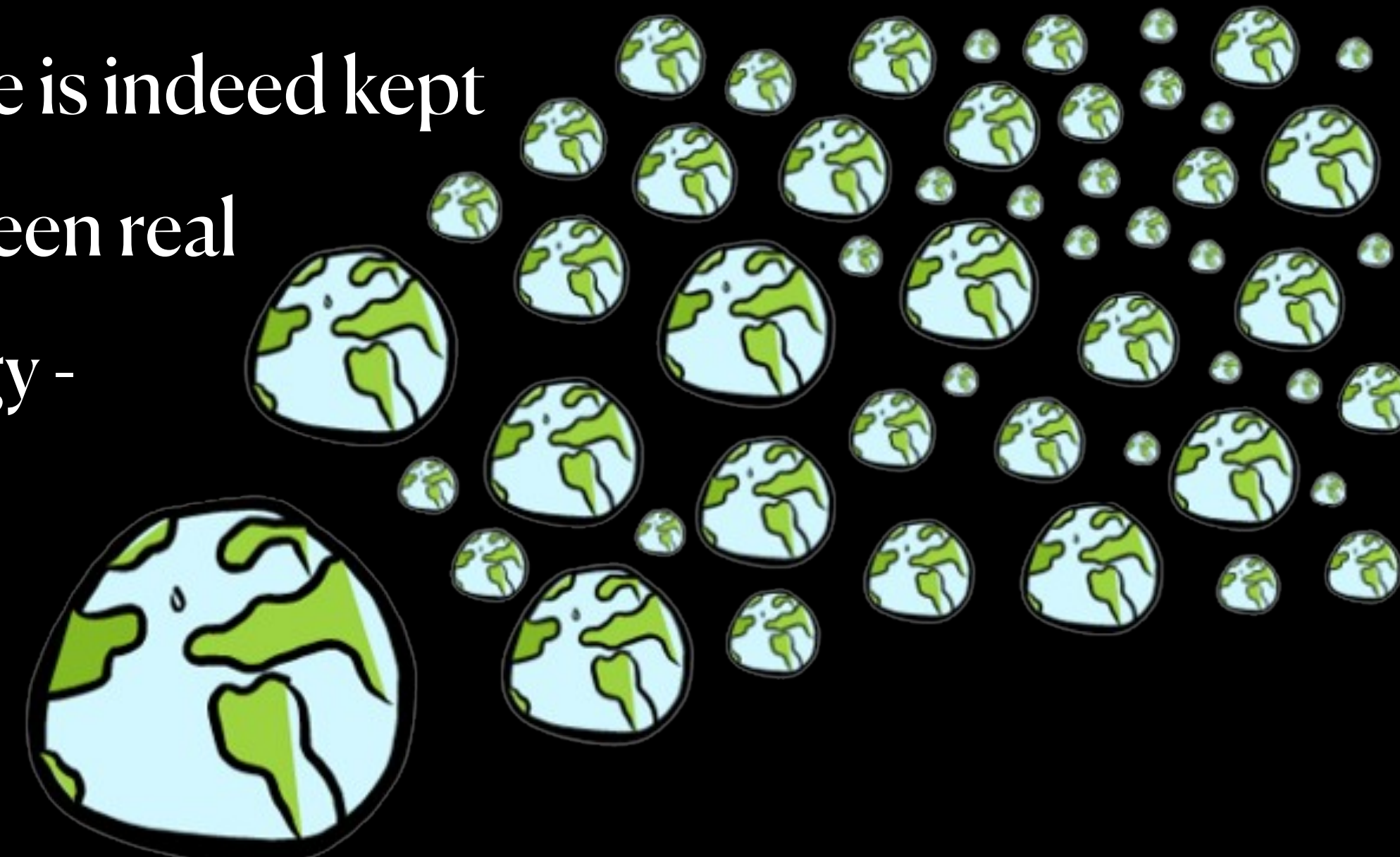
**This has not happened in either case - *ceteris paribus*!**



# On the other hand...

The very notion of **possible worlds** by Lewis undermines that any obtained result by intervention can ever achieve the status of a law. Similarly, they are hard to falsify as one can always use the unnamed conditions to excuse their failure.

Another issue with CP-laws is that **they make difficult the demarcation between scientific and non-scientific explanations**: As the number of conditions grows, not only they trivialize causal explanations, but also one needs to guarantee that everything else is indeed kept equal. That's exactly why it's hard to find differences in kind between real laws with inexhaustible CP clauses and pseudo-laws (e.g. astrology - some many parameters that you can always tweak things).



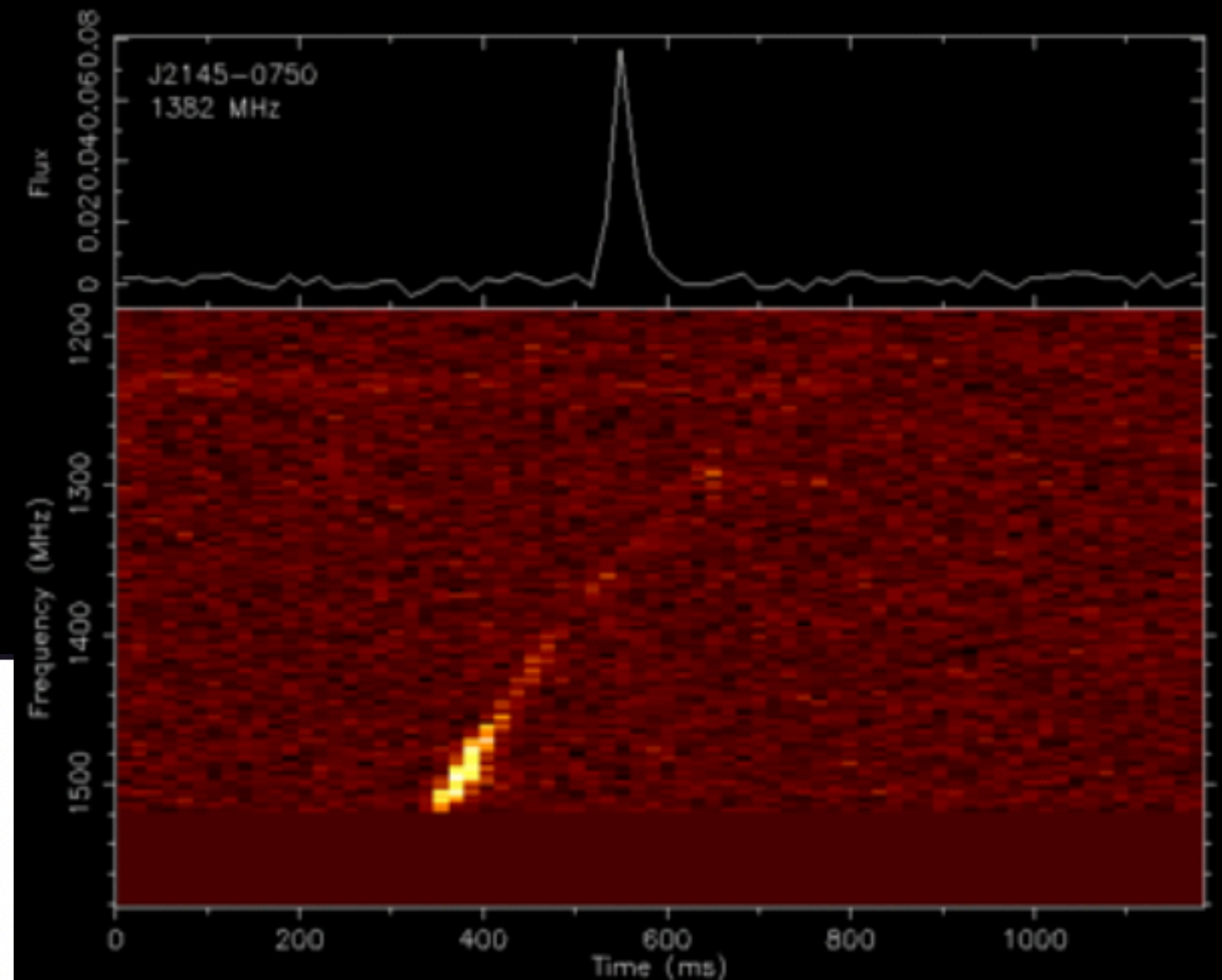


# The Peryton...

## Parkes Radio Telescope



- ~15 detections of “weird FRBs”
- All at the Parkes Radio Telescope
- All detection pointing towards the same source location in the sky
- Mostly occurring between 12:30-1 pm AEST
- Aliens?



### Fast Radio Bursts from Extragalactic Light Sails

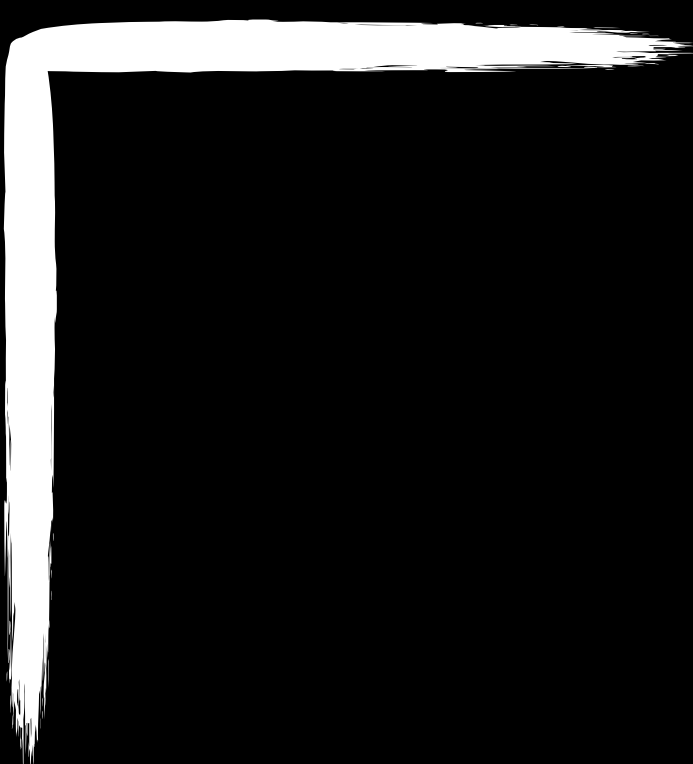
Manasvi Lingam, Abraham Loeb

We examine the possibility that Fast Radio Bursts (FRBs) originate from the activity of extragalactic civilizations. Our analysis shows that beams used for powering large light sails could yield parameters that are consistent with FRBs. The characteristic diameter of the beam emitter is estimated through a combination of energetic and engineering constraints, and both approaches intriguingly yield a similar result which is on the scale of a large rocky planet. Moreover, the optimal frequency for powering the light sail is shown to be similar to the detected FRB frequencies. These ‘coincidences’ lend some credence to the possibility that FRBs might be artificial in origin. Other relevant quantities, such as the characteristic mass of the light sail, and the angular velocity of the beam, are also derived. By using the FRB occurrence rate, we infer upper bounds on the rate of FRBs from extragalactic civilizations in a typical galaxy. The possibility of detecting fainter signals is briefly discussed, and the wait time for an exceptionally bright FRB event in the Milky Way is estimated.

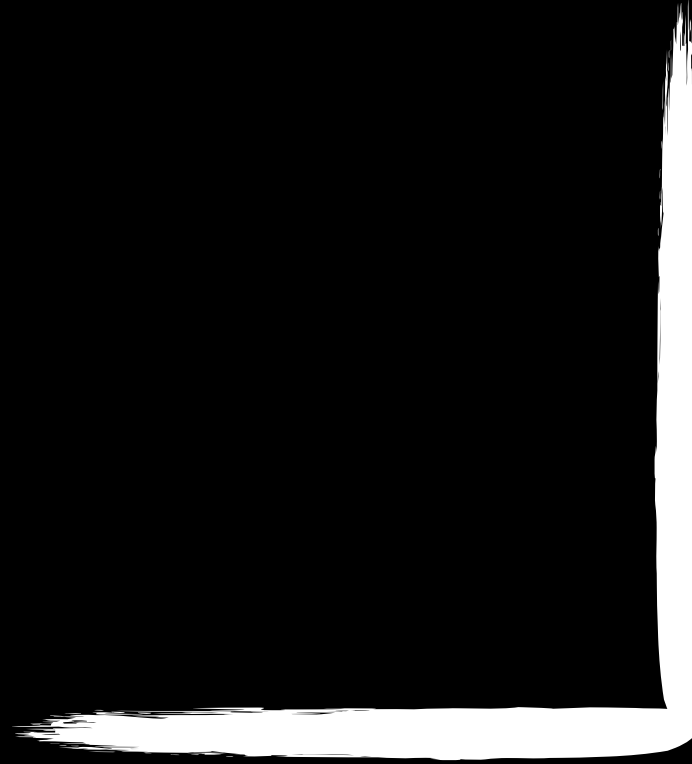




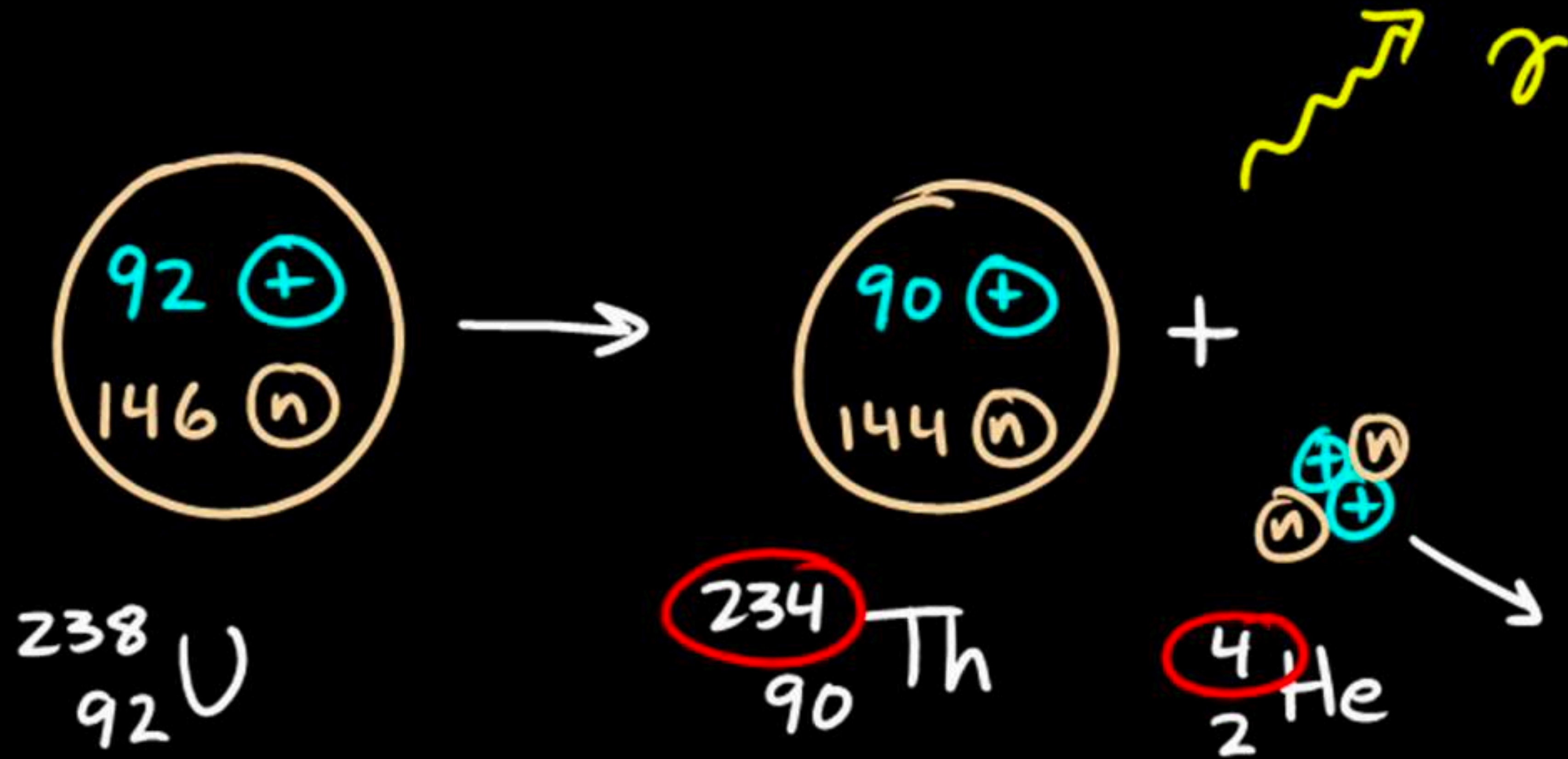




**Are there any other types of laws  
and causes out there?**



# The Decay of Uranium





BBC

Sign in

HomeNewsSportReelWorld

NEWS

Home | War in Ukraine | Climate | Video | World | UK | Business | Tech | Science | Entertainment & Arts

Health

# Morning smoking has cancer risk

🕒 8 August 2011

Another study in the same journal looked at 1,850 smokers, 1,055 of whom had head and neck cancers. It said people who smoked in the first half hour were 59% more likely to have developed a tumour than those who waited at least an hour.

BBC

Sign in

HomeNewsSportReelWorklife

NEWS

Home | War in Ukraine | Climate | Video | World | UK | Business | Tech | Science | Entertainment & Arts

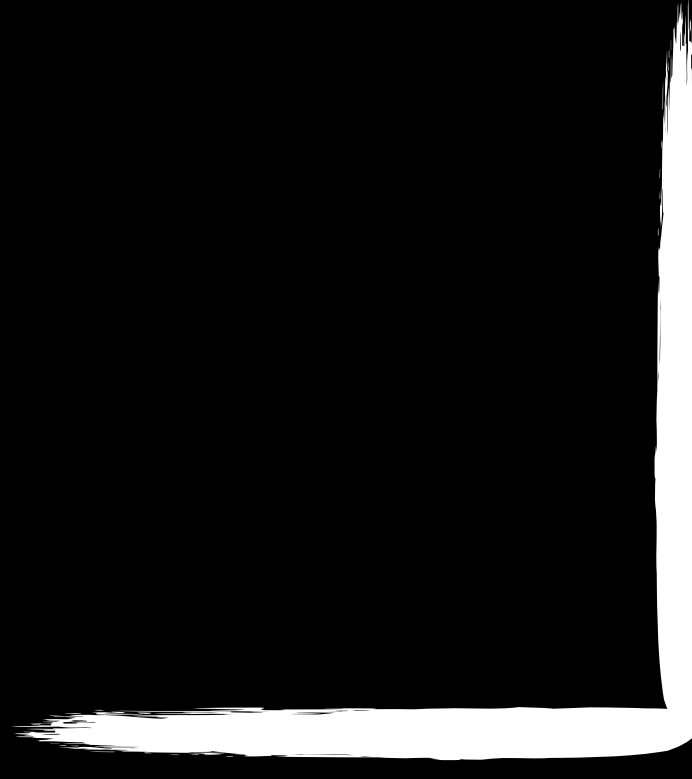
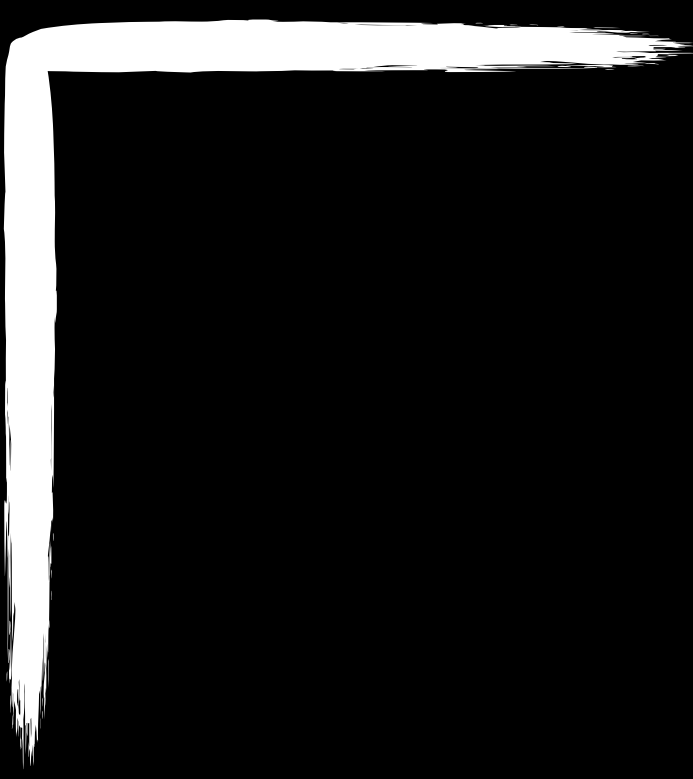
Health

# Plant-based diets good for the heart

🕒 25 May

The studies would have needed to have controlled people's diets for years or decades to see how that change in the blood played out.

But Prof Frikke-Schmidt used data from trials of statins to estimate maintaining such a diet for 15 years could cut the risk of cardiovascular disease by 20%.



**How are these different than what we  
have seen so far?**



# Statistical Laws and Probabilistic Causes

**Smoking increases the chance of getting lung cancer from 1.3% to 17%.**

- **What about the victims who never smoked?**

▶ That's ok! Different causes (no CP!)

- **What about the smokers who never got cancer?**

▶ Harder to reconcile. In fact, most smokers never get cancer



Q1: How does this challenge the inductive statistical account?



## Philosopher's response:

“Smoking can be said to cause cancer if, and only if, among all the different background conditions we know about there is no correlation between smoking and a lower-than-average incidence of lung cancer, **\*and\*** in one or more of these background conditions, smoking is correlated with a higher incidence in lung cancer rates.”



## Philosopher's response:



“Smoking can be said to cause cancer if, and only if, among all the different background conditions we know about there is no correlation between smoking and a lower-than-average incidence of lung cancer, \*and\* in one or more of these background conditions, smoking is correlated with a higher incidence in lung cancer rates.”

But,

- Relativizes causal claims to **\*our\*** knowledge of background conditions -> not very satisfactory
- Can't we go all in for all background conditions?  
-> collapsing probabilities





**Likelihood:** A calibrated language scale is used to communicate assessed probabilities of outcomes, ranging from *exceptionally unlikely* (<1%), *extremely unlikely* (<5%), *very unlikely* (<10%), *unlikely* (<33%), *about as likely as not* (33–66%), *likely* (>66%), *very likely* (>90%), *extremely likely* (>95%) to *virtually certain* (>99%).

It is unequivocal that human influence has warmed the atmosphere, ocean and land. Global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018. The average rate of sea level rise was 1.3 [0.6 to 2.1] mm yr<sup>-1</sup> between 1901 and 1971, increasing to 1.9 [0.8 to 2.9] mm yr<sup>-1</sup> between 1971 and 2006, and further increasing to 3.7 [3.2 to 4.2] mm yr<sup>-1</sup> between 2006 and 2018 (*high confidence*). Human influence was **very likely** the main driver of these increases since at least 1971. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical

**b) Impacts are driven by changes in multiple physical climate conditions, which are increasingly attributed to human influence**

Attribution of observed physical climate changes to human influence:

*Medium confidence*



Increase in  
agricultural  
& ecological  
drought



Increase  
in fire  
weather



Increase in  
compound  
flooding

*Likely*



Increase  
in heavy  
precipitation

**Very likely**



Glacier  
retreat



Global sea  
level rise

*Virtually certain*



Upper  
ocean  
acidification



Increase  
in hot  
extremes





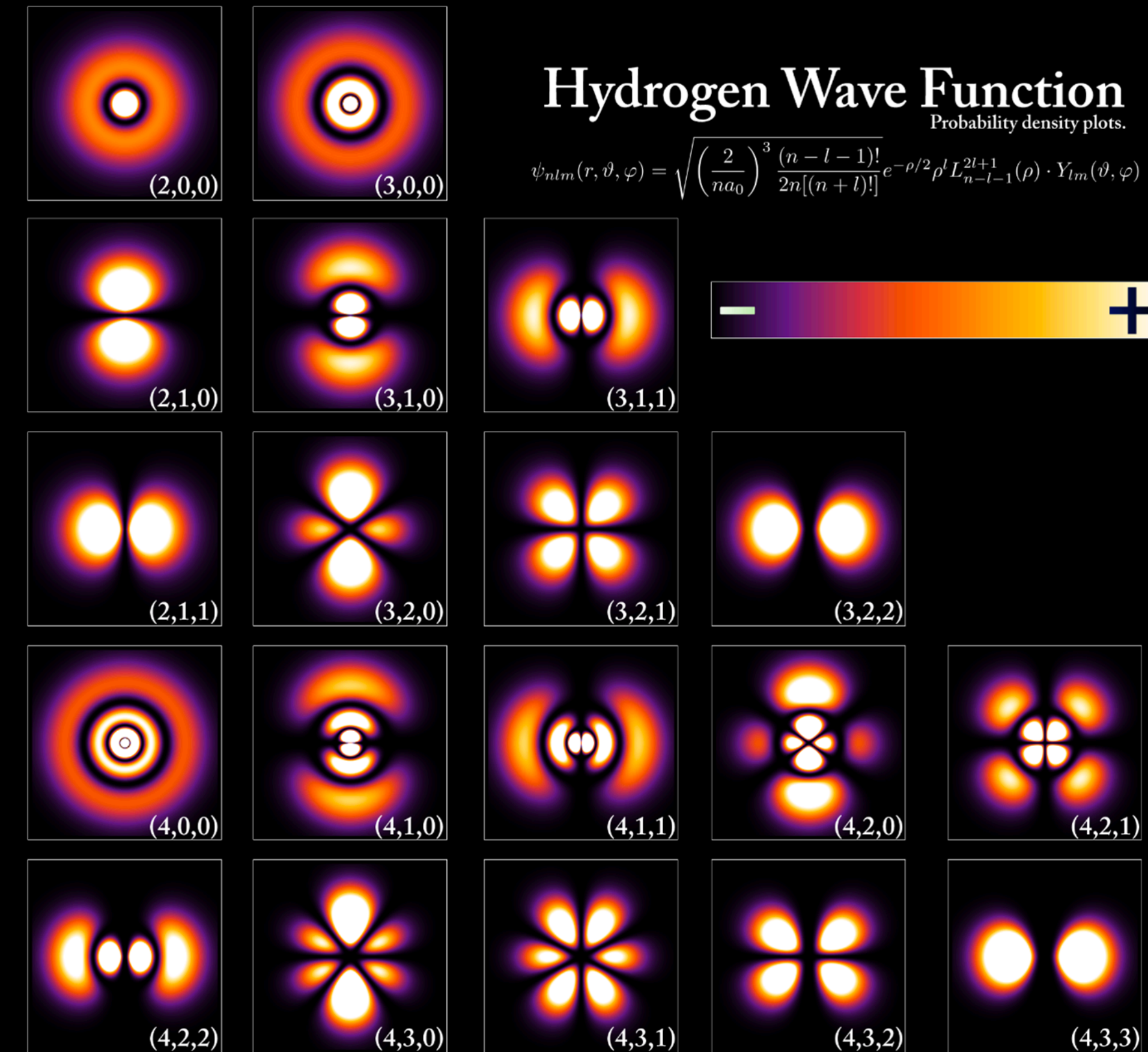
## Two kinds of probabilities:

- Epistemic: reflecting limitations on anyone's knowledge, e.g., dice in a closed box
- **Ontic**: “objective chances” that are fundamental to the world, e.g., quantum processes

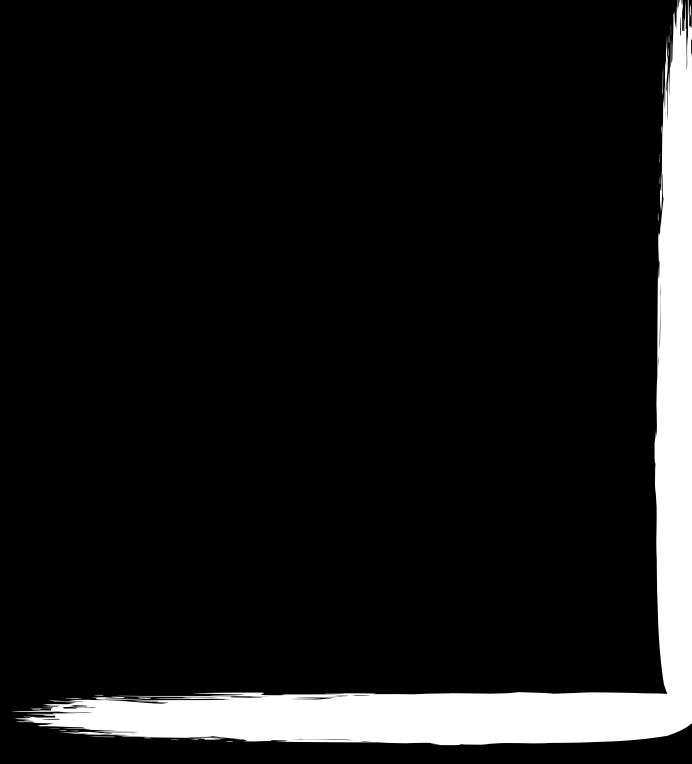
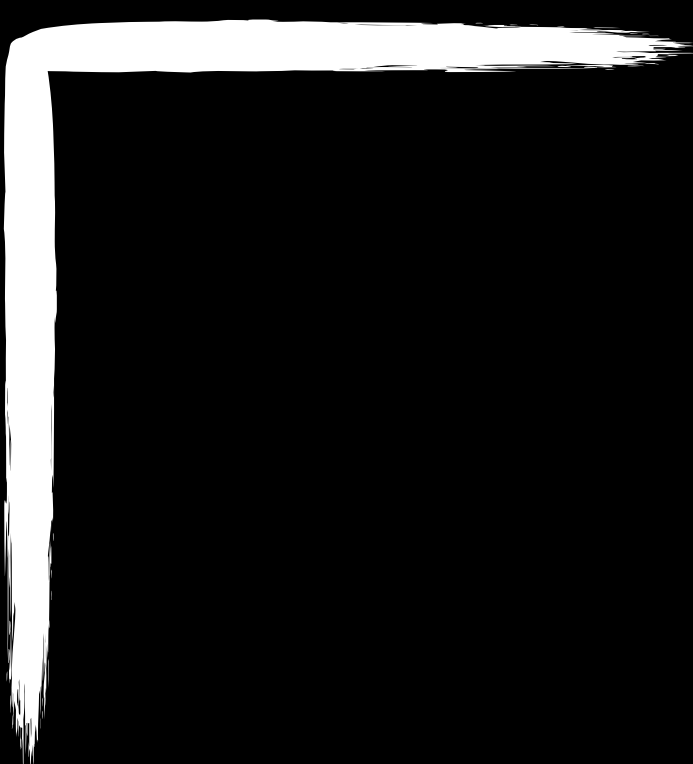


# Quantum Mechanics 101 and Interpretations

- Fundamentally deterministic, but main object (wavefunction) leads to a probability distribution (e.g., the spatial position of a particle)
- Can these **probability propensities** be grounded on more fundamental non-dispositional structures?
- Different commitments lead to different interpretations:
  - ▶ Non-local hidden variables satisfy the empiricist conviction of a fundamental non-disposition
  - ▶ Many-worlds interpretation take the probabilities as subjective







# Questions?



# Explanation as Unification

Perhaps the answer to what scientific understanding is resides on **unification**:

- Derivation of the more specific from the more general
- The basic beliefs is constrained by the need to systematize experiences



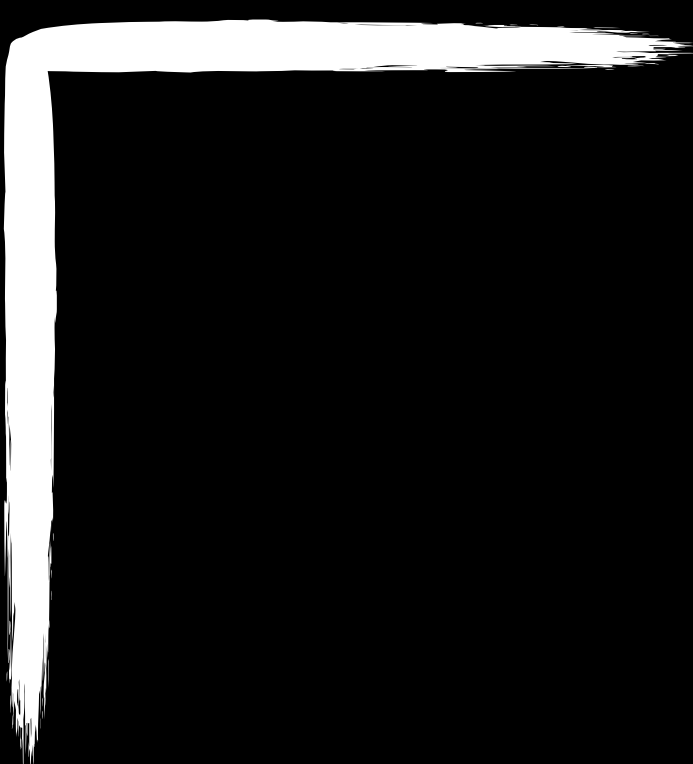
Q1: Why unification is appealing?  
Q2: How is it limiting?

Why is that appealing? Perhaps because nature seems to be rendered in a smooth, unified way? Perhaps because it saves computational power? Is it about simplicity? Perhaps because we have limited computational power, but nature might not be a computer? Would we care about unification if we had an infinite amount of computational power?

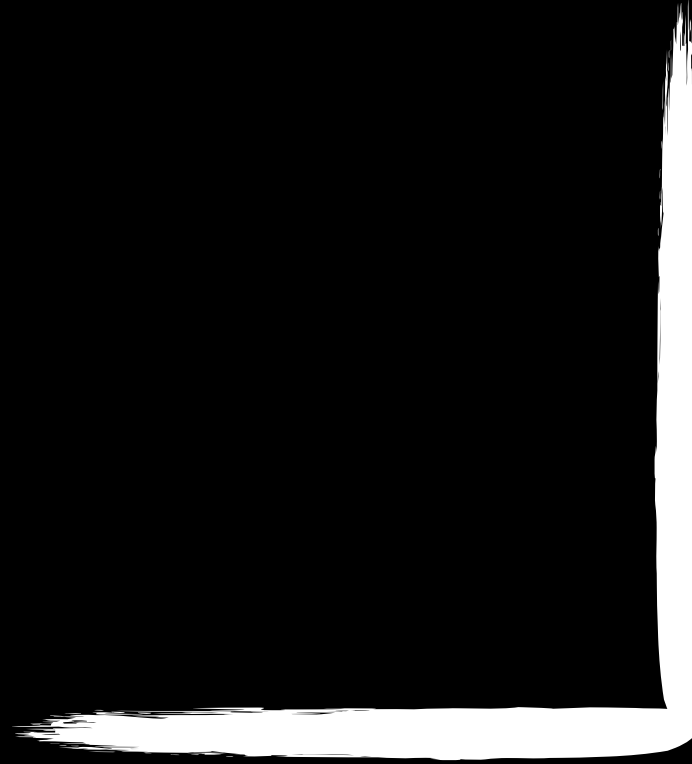
There is no guarantee that the universe's causal structure is fully available to us, either because it's too complex or too submicroscopic, or beyond the regime that we can measure for us to discern. Then, if nonetheless we can use unification FAPP, it will not enhance understanding of the way the world works, or will do only up to certain limits (effective).







**Are we asking too much? How  
do scientists actually work?**

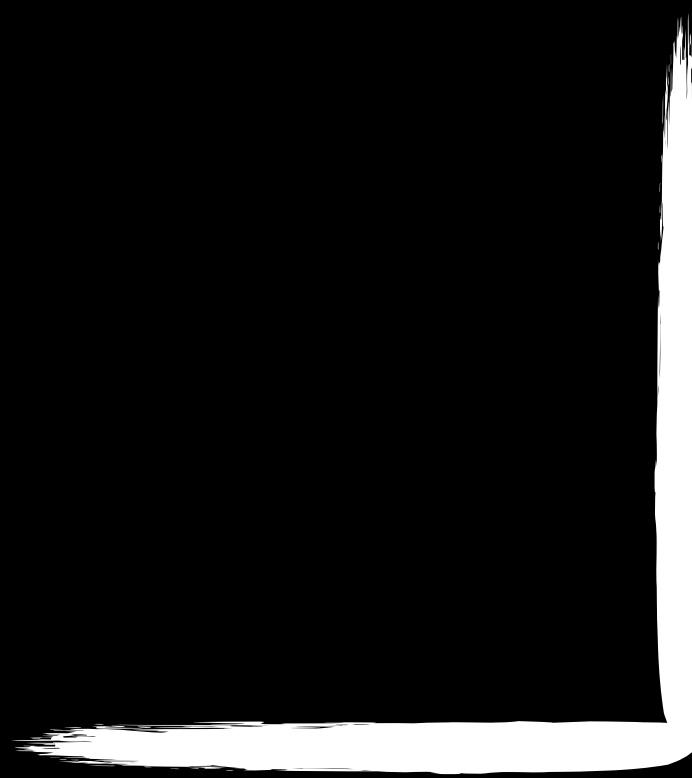
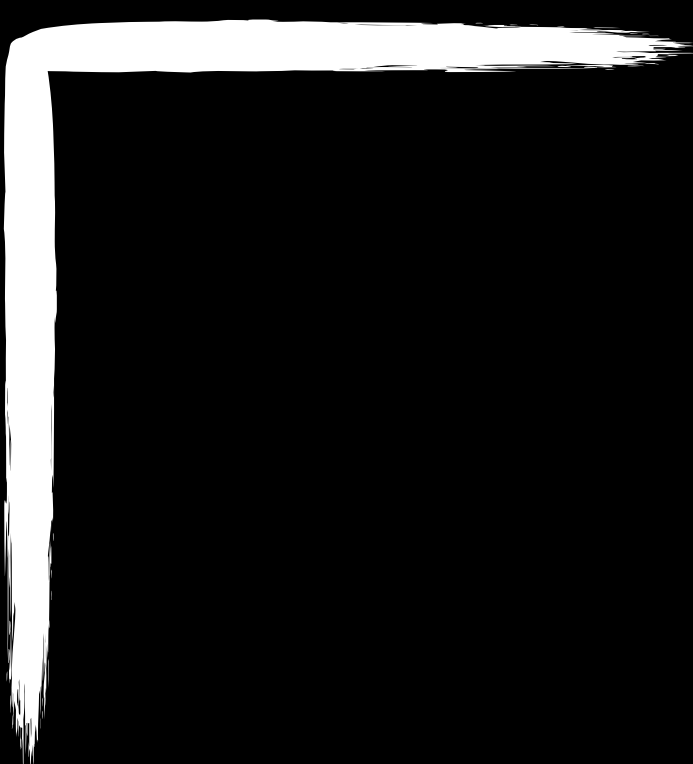


# Mitchell says so...

“...we need to think about scientific laws in a very different way: to recognize **a multidimensional framework** in which knowledge claims may be located and to use this more complex framework to explore the variety of epistemic practices that constitute science... **(the) dichotomous oppositions like “law vs. accident” and “necessity vs. contingency” produce an impoverished conceptual framework** that obscures much interesting variation in both the types of causal structures studied by the sciences and the types of representations used by scientists.”







Let's now carefully explore  
Mitchell's paper on *Dimensions of  
Scientific Law.*

# Next Time (Feb 23rd) - Realism

- To read (all on Athena):
  - Chapter 8 of Rosenberg & McIntyre
  - Wylie – “Arguments for Scientific Realism: The Ascending Spiral” (Sections 1-3)
- Come prepared for class discussion
- Other announcements



# Today!

We start with an exposition of Rosenberg&McIntyre's ch. 5 on **causation** and apply to a case study of climate change. Then, we will have a class reading exercise based on Mitchell's paper "Dimensions of Scientific Law".

**During discussions and readings, remember:**

- Engage respectfully
- Focus on understanding complex philosophical texts
- Focus on reconstruction and criticism of sophisticated arguments

