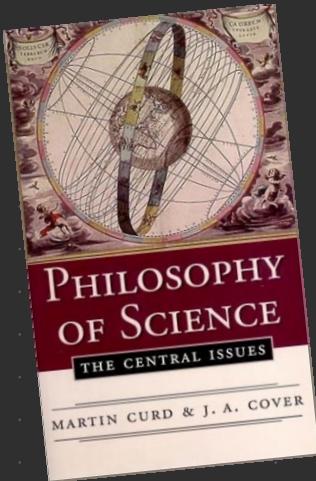


Philosophy of Science: The Central Issues

based *
on →

UvA course



* ~ 500 / 1.3 k

=> Presentation

1 out of 3 🤓

⚠ Abstract, linguistic.
Sometimes hard to find good
examples & metaphors.

Terminology

+ others
please ask anytime!

Paradigm:

- (1) conceptual framework of entities & interactions
- (2) set of epistemological methods (ontology dep.) for (1)
- (3) set of goals, values, and ideals for (2)

Ontology

study of being, existence, and reality

Epistemology

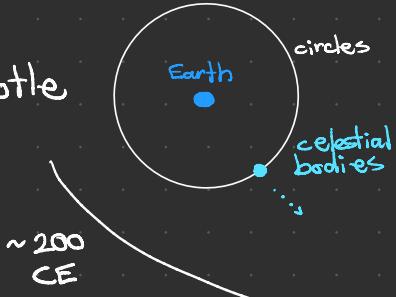
theory of nature, origin, and limits of knowledge

Philosophy

Greek: "philia sophia" → philosophers → "lovers of wisdom"

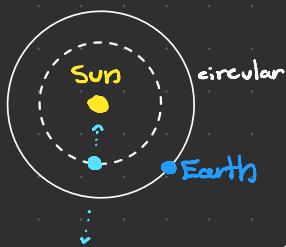
Historic Paradigm Shifts in Physics

Aristotle



~200 CE

Ptolemy



circular

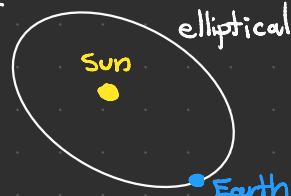
~1540s

Copernicus



~1610s

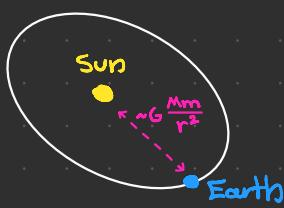
Kepler



elliptical => away from Plato's
~2000 yr long influence
of perfect circles

~1680/90s

Newton



- laws of motion & gravitation
- unified framework
- deterministic Universe

Before:

- Earth vs. celestial physics
- Aristotle's forces vs. natural
- Cartesian vortex theory
- Kepler's "Anima matrix"
- no action-at-a-distance

⋮

Maxwell's
... EM Theory



Einstein's
... SR & GR



... QM & QFT ...

Science vs. Pseudoscience

Demarcation Criteria

Karl Popper



- falsifiable / testable
- risky predictions
- ↳ e.g. Einstein > Freud

Thomas Kuhn



- puzzle-solving tradition
(astronomy vs. astrology)
↳ e.g. Ptolemaic replaced before testing

Irene Lakatos



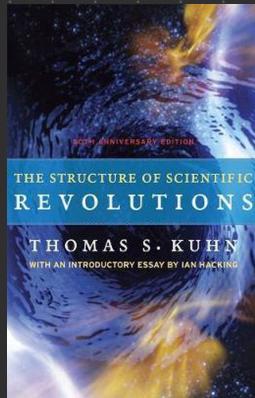
- research programmes
(novel vs. ad hoc)
- all is unfalsifiable due to extrapolations from limited evidence

Paradigm Shifts

Thomas
Kuhn



~1960s



"bomb shell"



lots of erroneous arguments

- "normal" ↗ "revolutionary" science
- rival paradigms incommensurable (holist view)
- cumulative exception, destruction of old theory norm
(caloric → thermo | Newton mass → Einstein mass/energy)
- {accuracy, consistency, scope, simplicity, fruitfulness}

Kuhn: ambiguous, contradictory sets

=> $\begin{cases} \text{theory choice subjective (relativism)} \\ \quad ("conversion experience") \\ \text{theory-ladenness of observation} \\ \quad (\text{false due to Kepler-Ptolemy watch Sun ex.}) \end{cases}$

Relevancy?

► Historical:

- theological origins in 17th century western Europe
- Darwin no predictions, but fruitful
- rigid binary to dynamic thinking
- real-life consequences
 - (Arkansas case 1980s, economy/energy/policy decisions)

► Today? (personal attempt)

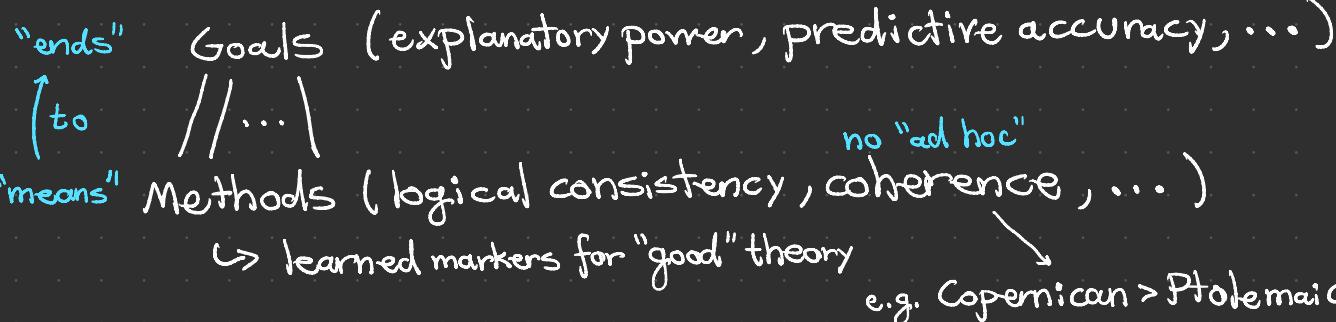
- accumulation of anomalies & tensions
- rival DM & DE physics, no evidence for predictions
- our choices effect science

Epistemology since Kuhn

Ernan
McMullin



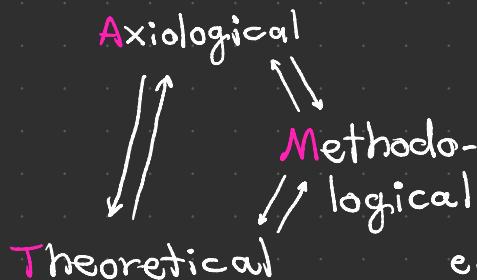
Hierarchical



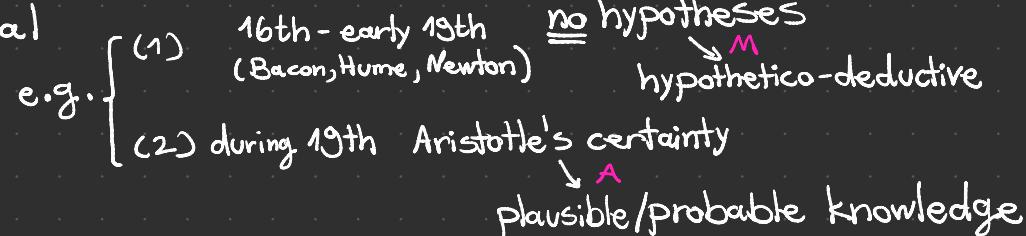
Larry
Laudan



Reticulational



- ~~Holism~~ → piecemeal change of A/T/M
- History lens compresses time → seemingly violent shifts
↳ instead, gradual A/T/M transitions



Q: Objectivity in Science? A: Social Nature of Science

Before → positivists: "context of ... discovery vs. justification"
accounts for subjective/social ← purges

Kathleen
Okruhlik



- science can't be isolated against (...) influences
 - ↳ e.g. androcentric community → biased questions/interpretations
(great historical bias examples)
- proposal: encourage diversity of scientists

Helen
Longino



- following methods / view on nature ≠ objectivity
 - ↑ paradigm/axiological dependent ↗ background assumption & belief dependent
- objective (i.e. intersubjective) nature of communities
 - (avenues for & openness to criticism, ~~individuals~~ diversity of interpretations)
! game theory strength

Refutation & Revision



Pierre
Duhem

&

Willard
Quine



→ Thesis

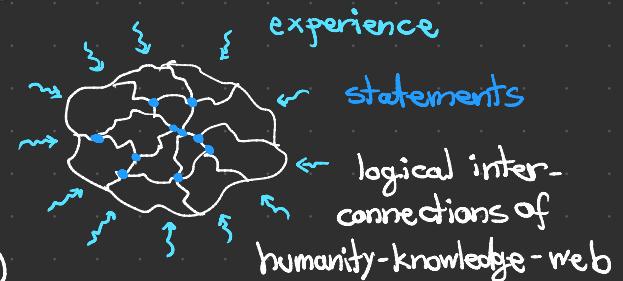
$$\sim(T \rightarrow O_1) \text{ and } (T \& A_1 \& \dots \& A_n) \rightarrow O_1$$

$$\Rightarrow \sim(\sim O_1 \rightarrow \sim T) \text{ and } \sim O_1 \rightarrow \sim(T \& A_1 \& \dots \& A_n)$$

e.g., Uranus anomaly → +1 planet Neptune (change A_x)

but Mercury anomaly → theory to Einstein's (change T)
(+1 Vulcan failed)

=>"crucial experiments" don't exist

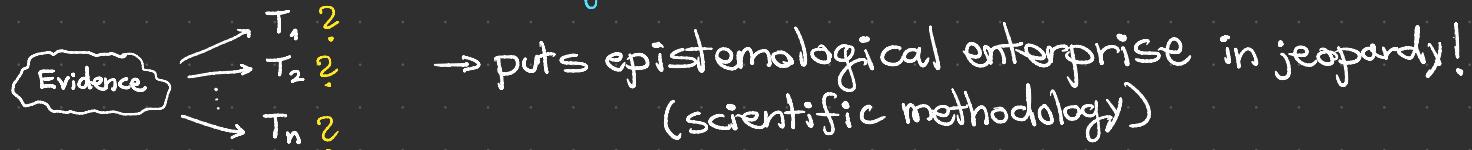


=> any statement is subject to revision

(interesting arguments & debates)

Underdetermination (UD)

⚠ concern: "Any theory can be made to be as well supported by any evidence as any of its rivals."
egalitarian thesis of UD



- equally empirically supported ≠ equally belief-worthy
embeddable in rational network?
- formal logic & deduction doesn't exhaust "rationality realm"
↳ deductive vs. ampliative (e.g. all observed planets orbit...)
- normative UD of $T_x \neq$ causal UD of scientists "belief" in T_x
- invalid extrapolations from local UDs
↳ e.g. Kuhn 5 ambiguous values \neq global UD, any values
(prediction sufficient for Decartes's Vortex vs. Newton)
shared standard
Earth radii expedition 17th cent.

Larry
Laudan



Key Takeaways

- Philosophy evolves scientific practice
 - ↳ (makes science negotiable & dynamic)
- Demarcation questions matter
 - ↳ (societal & educational consequences)
- Formal logic & evidence insufficient
 - ↳ (rationality despite uncertainty)
- Objectivity is multifaceted
 - ↳ (science as social process, not methodological result)