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“Let's have a look!”

Observations, theories, philosophical troubles

Dr. Nicola Mößner

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Facts are facts ...



“Look, alternative facts are not facts. They’re falsehoods.” (Chuck Todd at NBC *Meet the Press*)

# Facts are facts...

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- Facts in international politics
  - Shaped by social dynamics
  - Embedded in social institutions

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- Facts in international politics
    - Shaped by **social dynamics**
    - Embedded in **social institutions**
  - Facts in science
    - Alan F. Chalmers: scientific statements are regarded as **particularly reliable** because **science is based on facts**
    - What about the **influence of social dynamics and social institutions** in this context?
    - Are scientific facts better off with this regard?
-

# Facts are facts...

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- Why ask a philosopher of science?
- Philosophy as a **meta-discipline**
  - Socrates: *I know that I know nothing.*
  - Going **beyond the obvious**, i.e., going beyond commonly accepted ideas - think critically!

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  - Philosophy as a **meta-discipline**
    - Socrates: *I know that I know nothing.*
    - Going **beyond the obvious**, i.e., going beyond commonly accepted ideas - think critically!
  - Philosophy of science as **meta-science**
    - Critical analyses of **epistemic practices**
    - What are facts in science like?
    - What about social dynamics and institutions in this context?
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# Contents

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- What are scientific facts?
- Observation and observability
- What is theory-ladenness of observation?
- Social dynamics in science

# What are scientific facts?

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- What are scientific facts?
  - Facts – evidence (indicators) – data
  - Results of experiments and observations

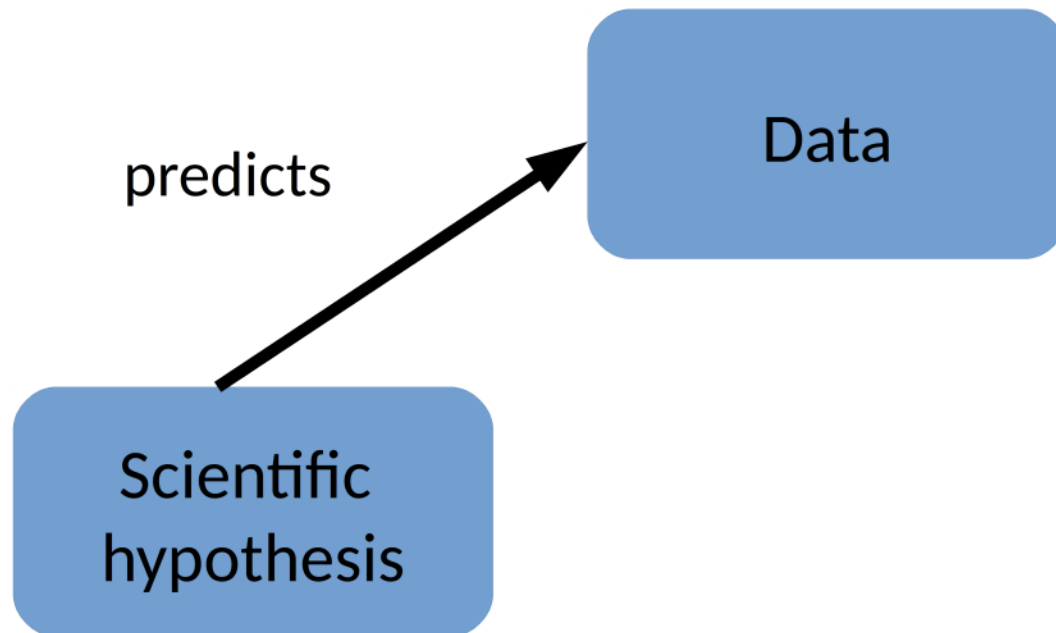
# What are scientific facts?

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- What are scientific facts?
  - Facts – evidence (indicators) – data
  - Results of **experiments and observations**
- Why do we need **reliable facts in science**?
  - Two tasks of scientific hypotheses (theories):  
**explanation** and **prediction** (of phenomena)
  - **Testing** of scientific hypotheses: falsification or confirmation

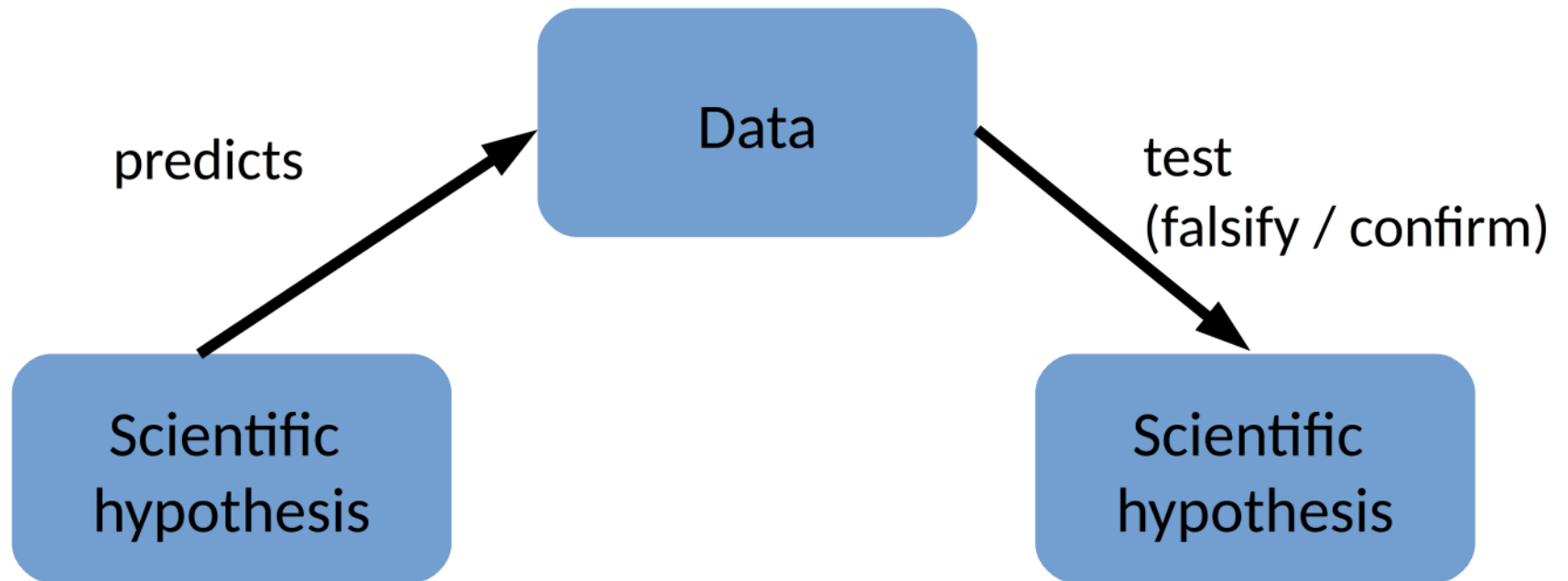
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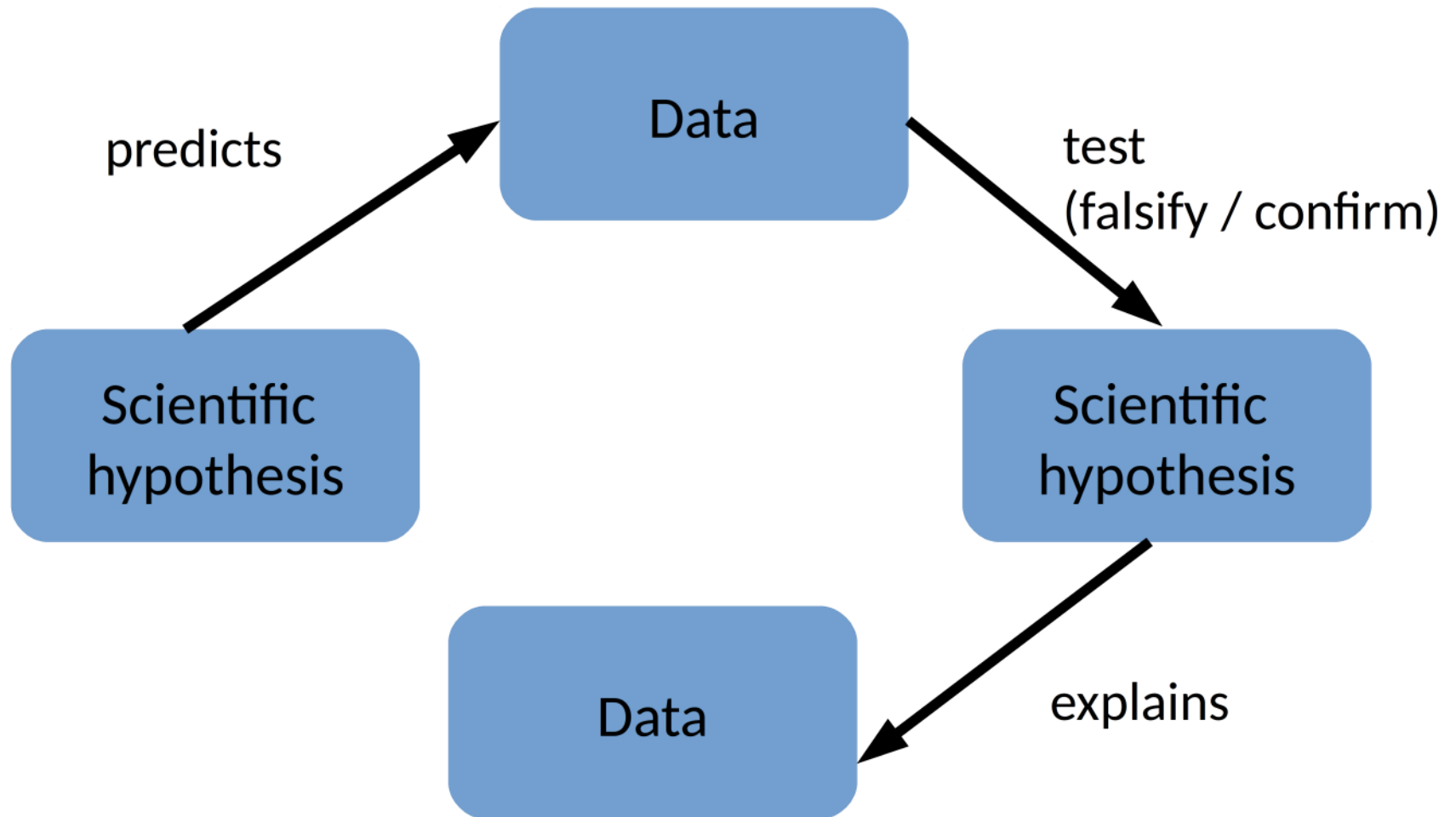
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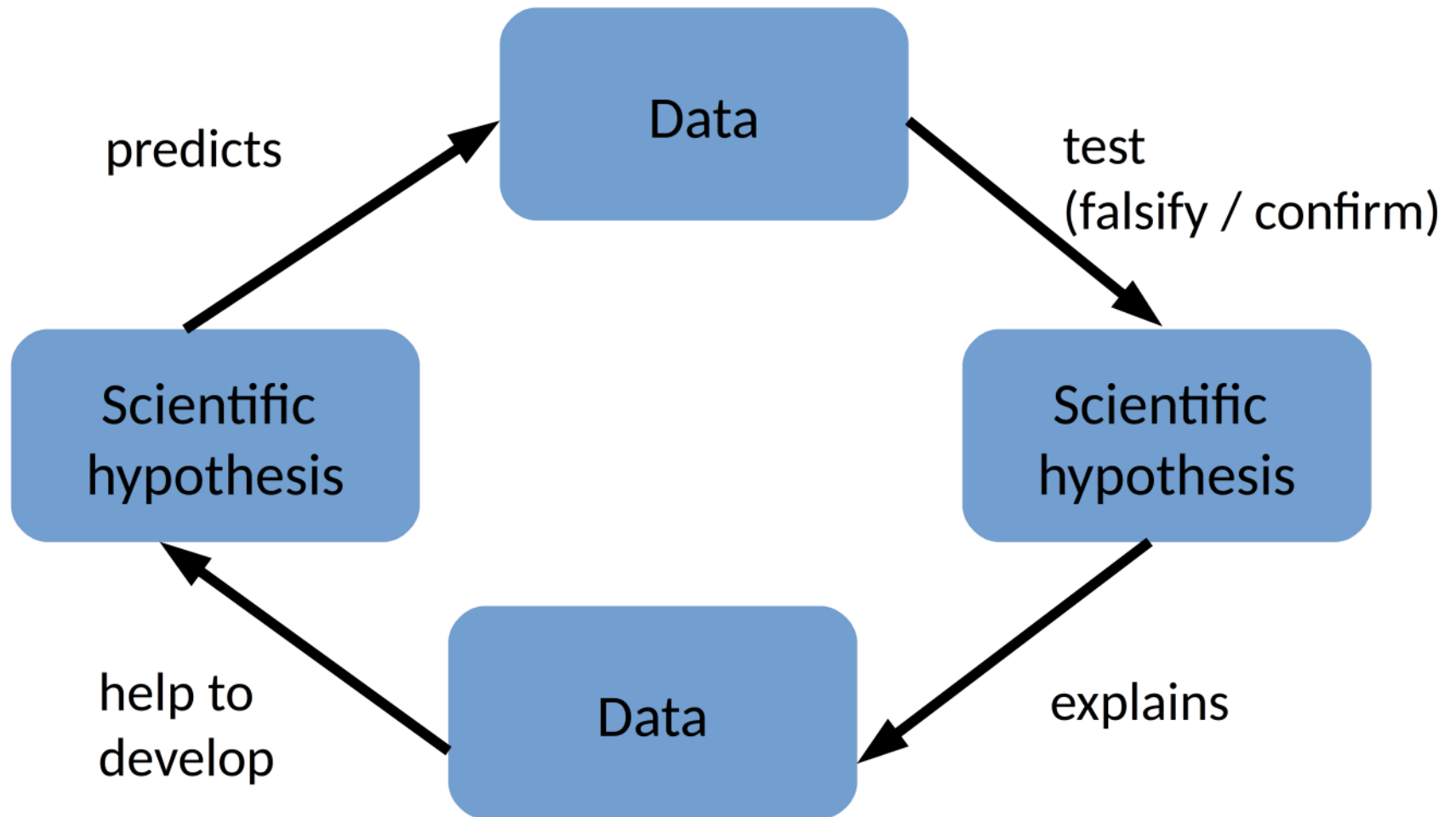
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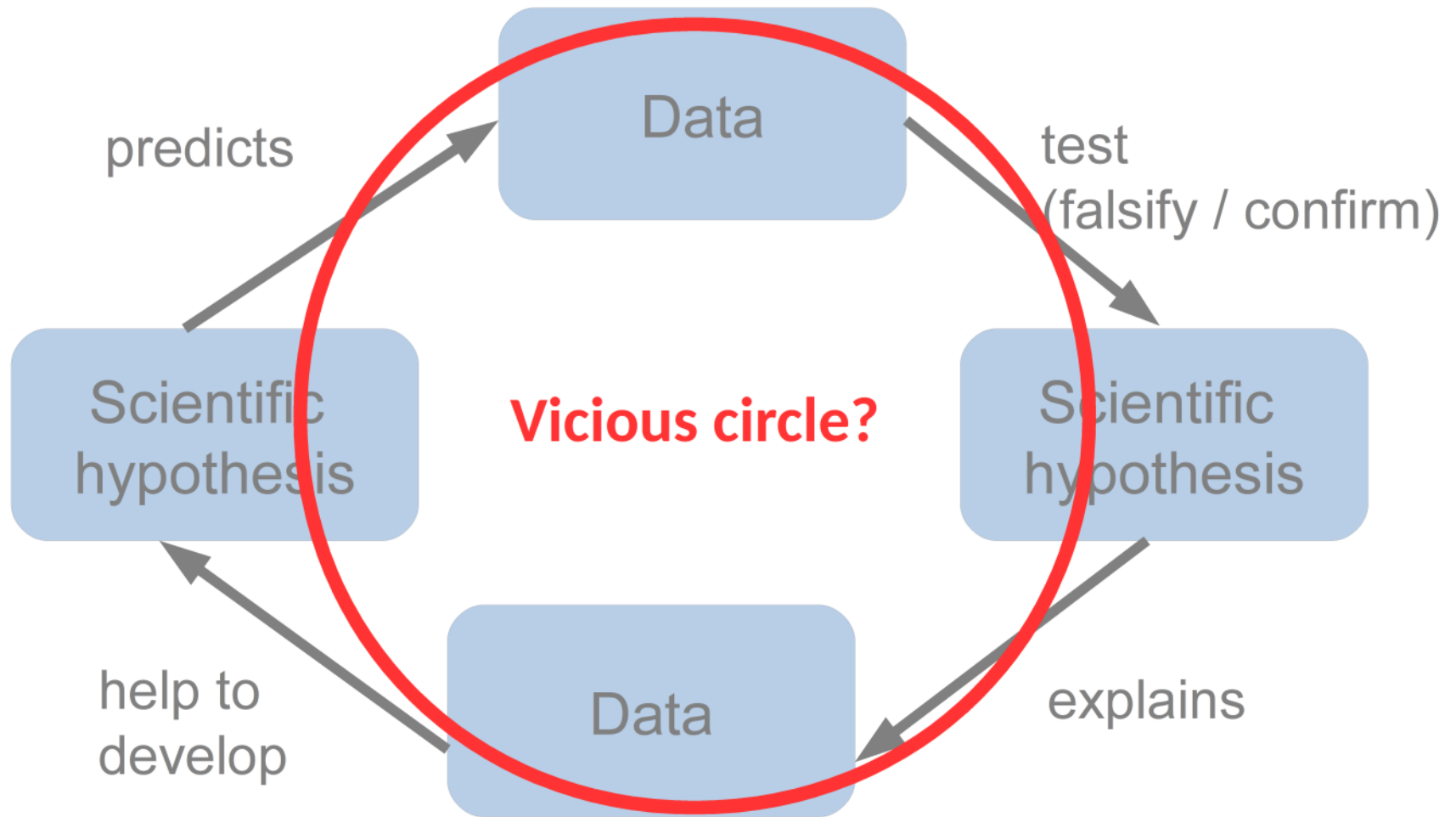


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# Observation and Observability

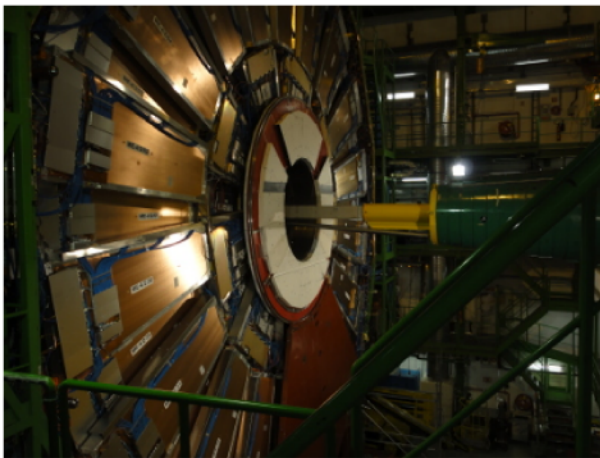
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- Why should we be **worried about data?**
  - Reliability can be questioned
  - Problem: **way of access**

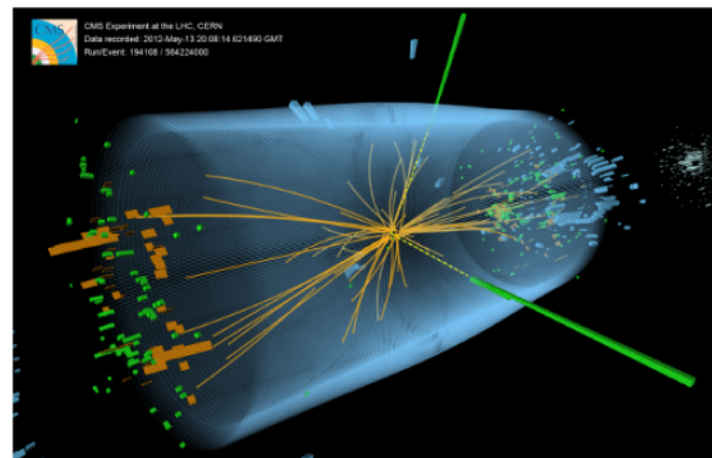
# Observation and Observability

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- Why should we be **worried about data?**
  - Reliability can be questioned
  - Problem: **way of access**
- Distinction between **observables** and **unobservables**



**CMS Detector** 2014

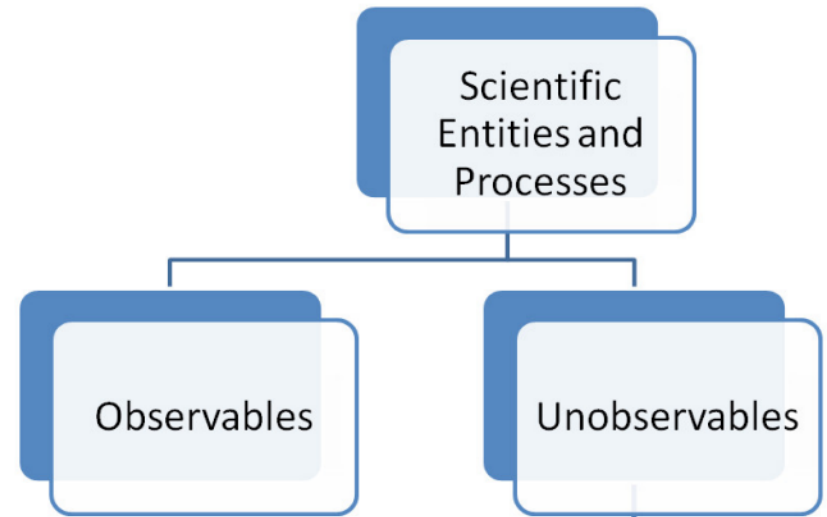


**Higgs boson**, event recording 2012

# Observation and Observability

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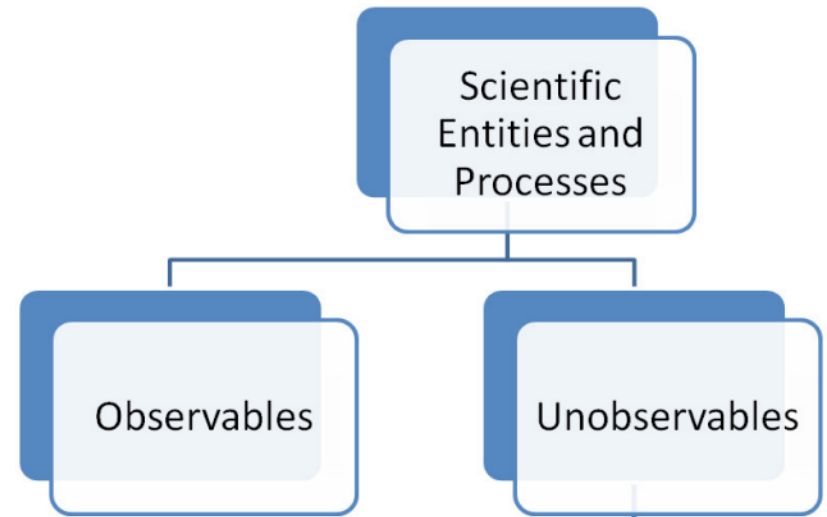
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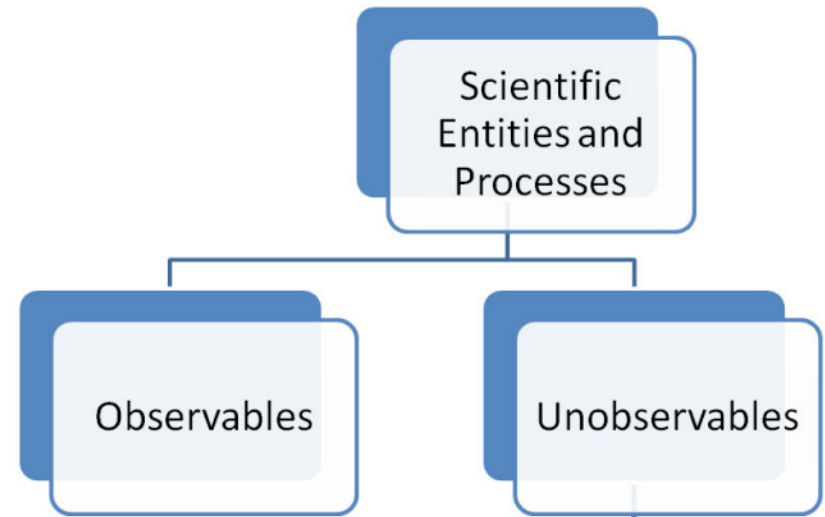
- What is observable?
- **Radical** claim: **scepticism** (e.g. René Descartes)
  - Both, **observable** and **unobservable** parts of the world, are **questioned**



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- What is observable?
- **Radical** claim: **scepticism** (e.g. René Descartes)
  - Both, **observable and unobservable parts** of the world, are **questioned**
- **Moderate** claim: **Scientific realists** (e.g. Richard Boyd) vs. **anti-realists** (e.g. Bas C. van Fraassen)
  - No quarrels about observable part of the world
  - **Unobservable part**, however, is **contested**



# Observation and Observability

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Problem of **empirical underdetermination**:

- Unobservables are **relevant parts of scientific explanations**

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- An example from the history of science: Phlogiston vs. Oxygen

Observable phenomenon: **Fire**  
How to explain the  
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Explanation 2: Combustion =  
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- But: **what makes the difference** between observables and unobservables?

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Using glasses

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Using a  
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Using a tube full of water to detect neutrinos and, thereby, to observe mechanisms beneath the surface of the sun

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Grover Mawell:  
slippery slope argument

# Observation and Observability

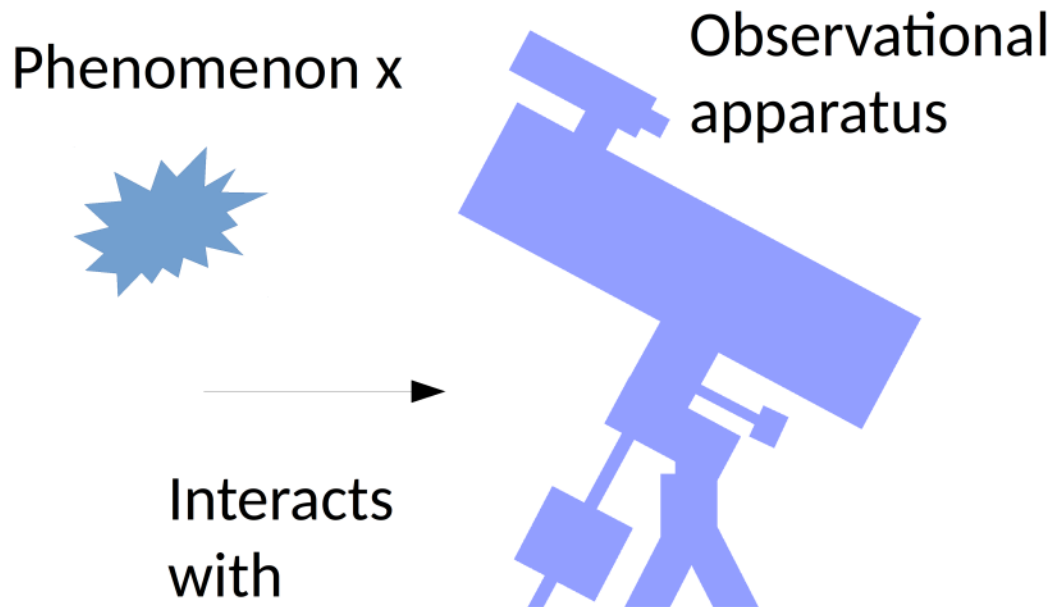
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- Alternative approach by Peter Kosso (1988)
  - Complexity of observational process
  - Information transmission model of observability

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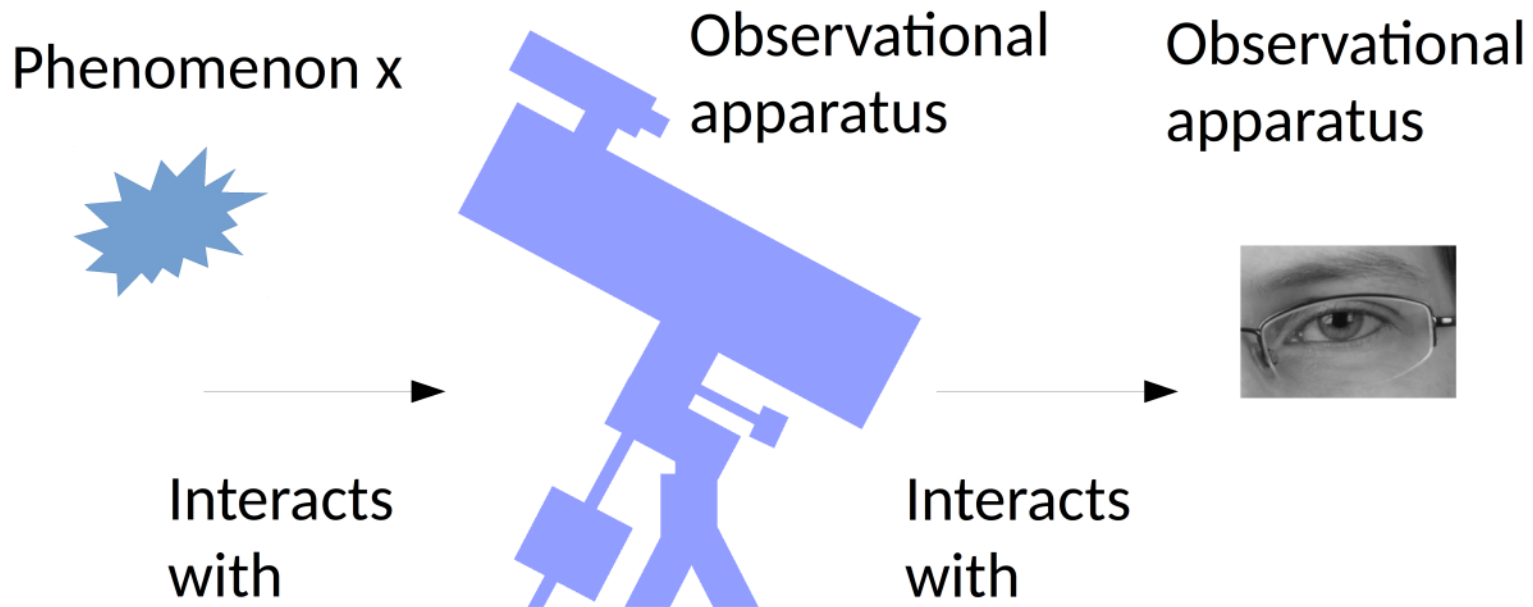
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# Observation and Observability

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## Dimensions of observability

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1. **Immediacy**: Does and, if so, how does  $x$  interact with the observational apparatus?
2. **Directness**: How many interactions take place?

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3. **Amount of interpretation**: How many different theoretical accounts are needed to explain those interactions?

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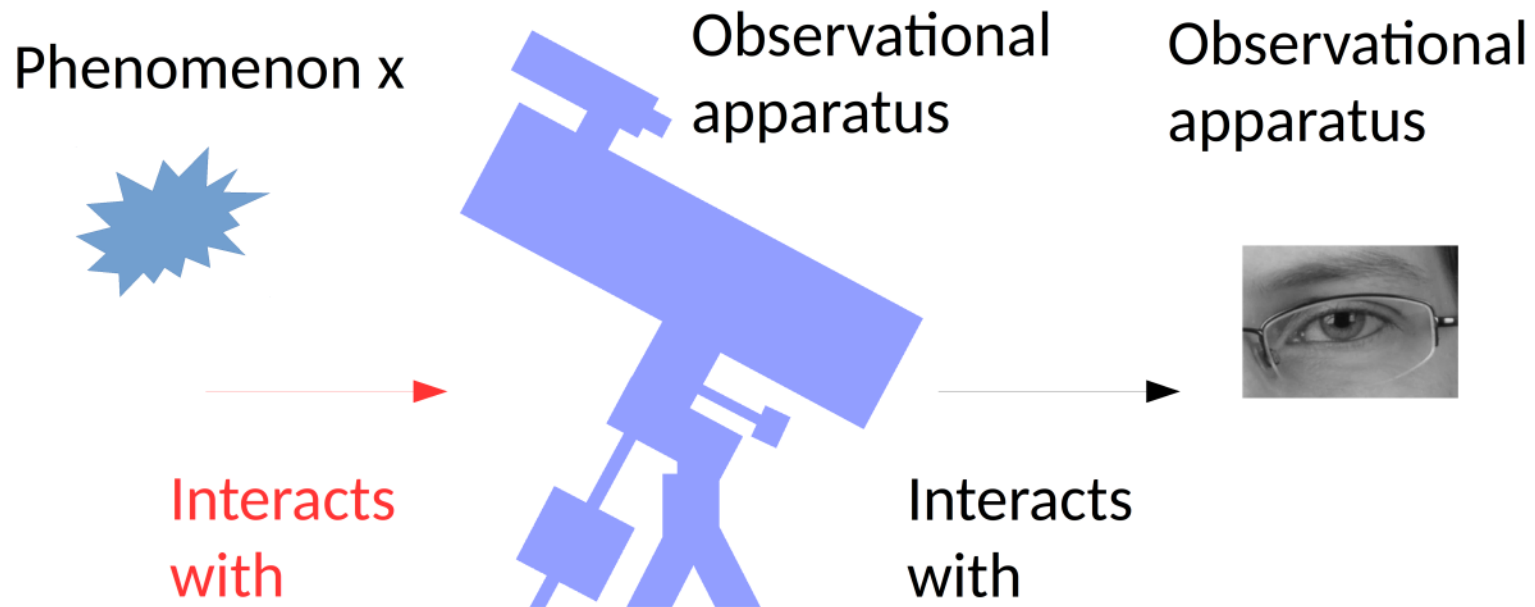
1. **Immediacy**: Does and, if so, how does  $x$  interact with the observational apparatus?
2. **Directness**: How many interactions take place?
3. **Amount of interpretation**: How many different theoretical accounts are needed to explain those interactions?
4. **Independence of interpretation**: Is the theoretical approach that explains the observational data independent of the theory that is to be tested by those data?

# Observation and Observability

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## Dimensions of observability

1. **Immediacy**: Does x interact with the instrument? / Is x **detectable** or not?

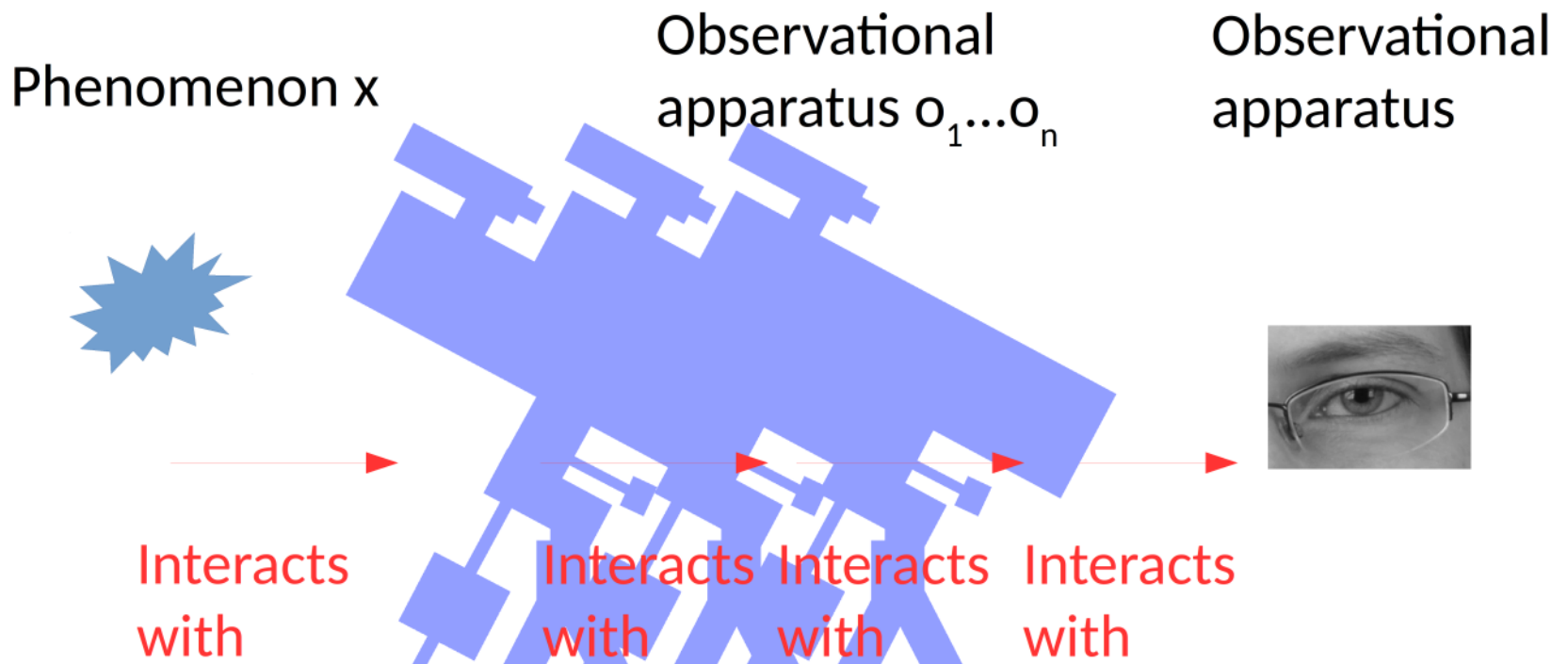


# Observation and Observability

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## Dimensions of observability

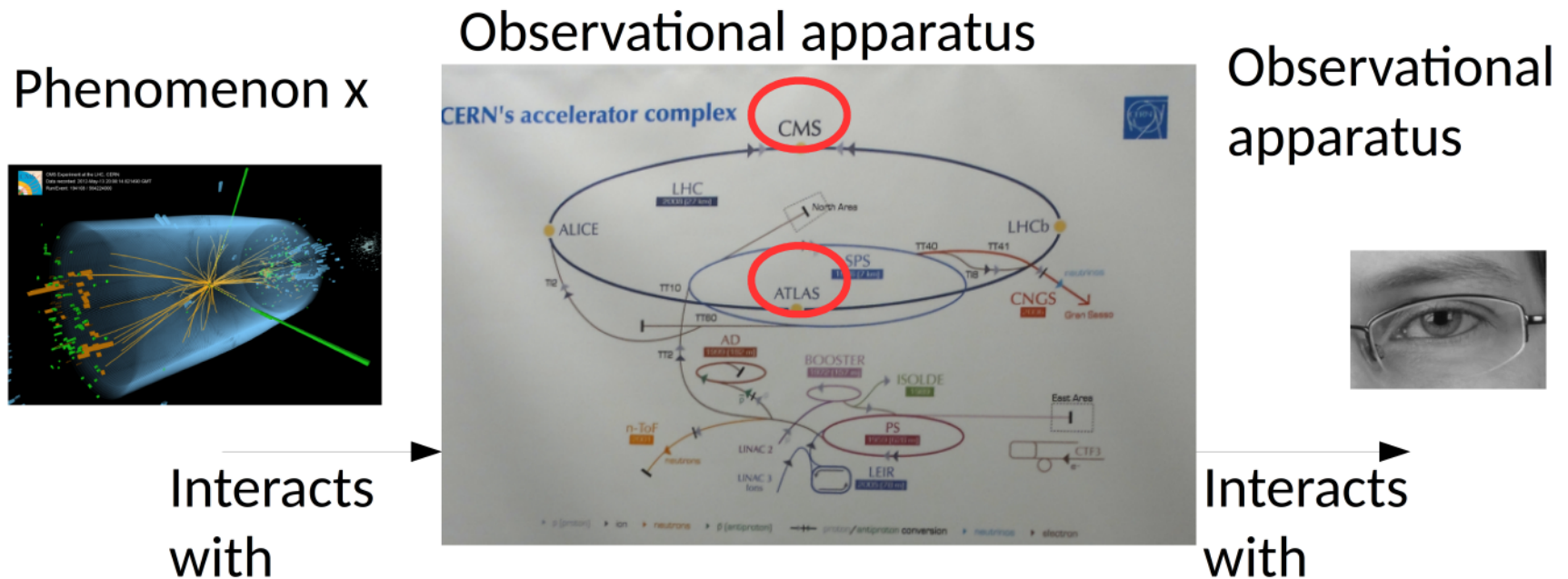
### 2. Directness: How many interactive steps take place?



# Observation and Observability

## Dimensions of observability

3. **Amount of interpretation:** How many **different instruments / theories** are involved?

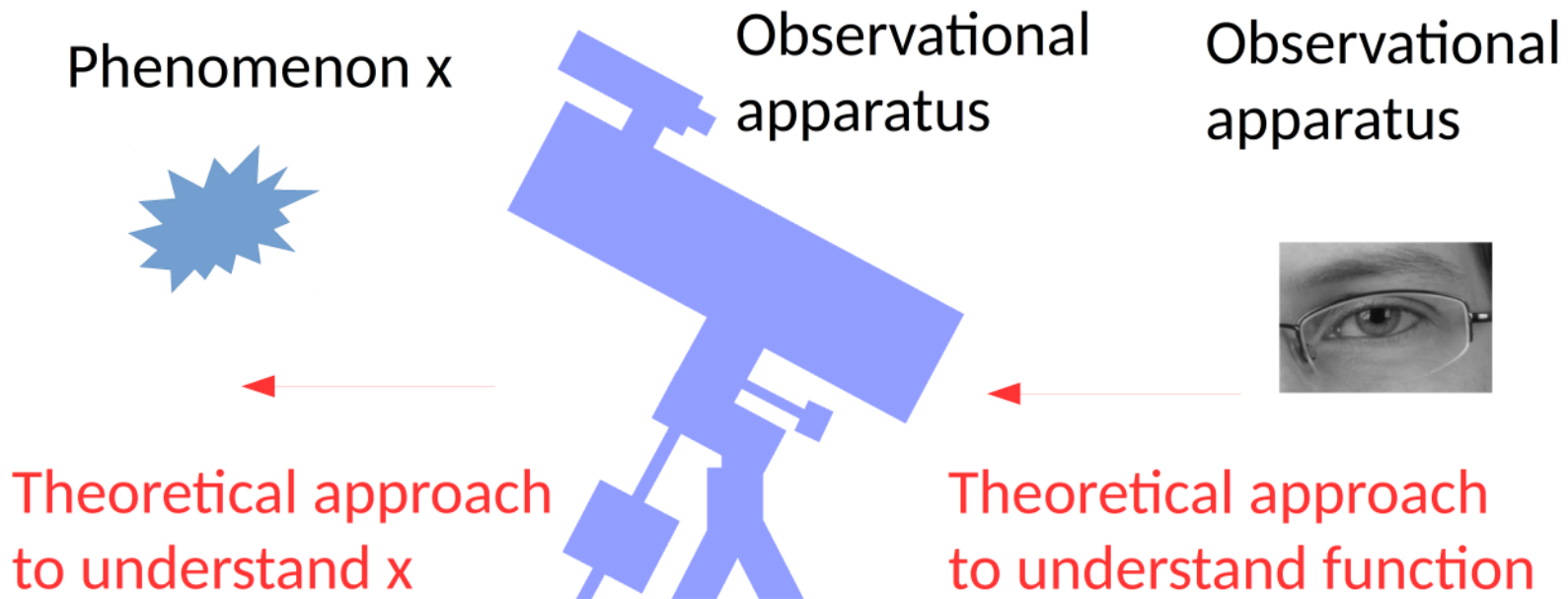


# Observation and Observability

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## Dimensions of observability

4. **Independence**: Do we use **the same theory** to explain  $x$  and the observation of  $x$ ?



# Theory-ladenness of observation

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- Observation is a complex process, **not a binary relation** between observer and phenomenon
  - Ludwik Fleck (1935): Veni, vidi, vici assumption is a myth

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  - Relevance of **interpretation**, i.e. background theories

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  - Ludwik Fleck (1935): Veni, vidi, vici assumption is a myth
- **No brute facts** available in science
  - Relevance of **interpretation**, i.e. background theories
  - **“All observation in science is influenced by theory”** (Kosso 1993, 113).
  - Theory-ladenness of observation seems to be **unavoidable**
  - Why does this matter?

# Theory-ladenness of observation

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- Worrisome consequences of theory-ladenness
  - Do we **fabricate** the **evidence** that we are in need of?
  - Do we generate alternative “facts”?

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TV comedy  
“Zondag met Lubach”

The Netherlands welcomes Trump in his  
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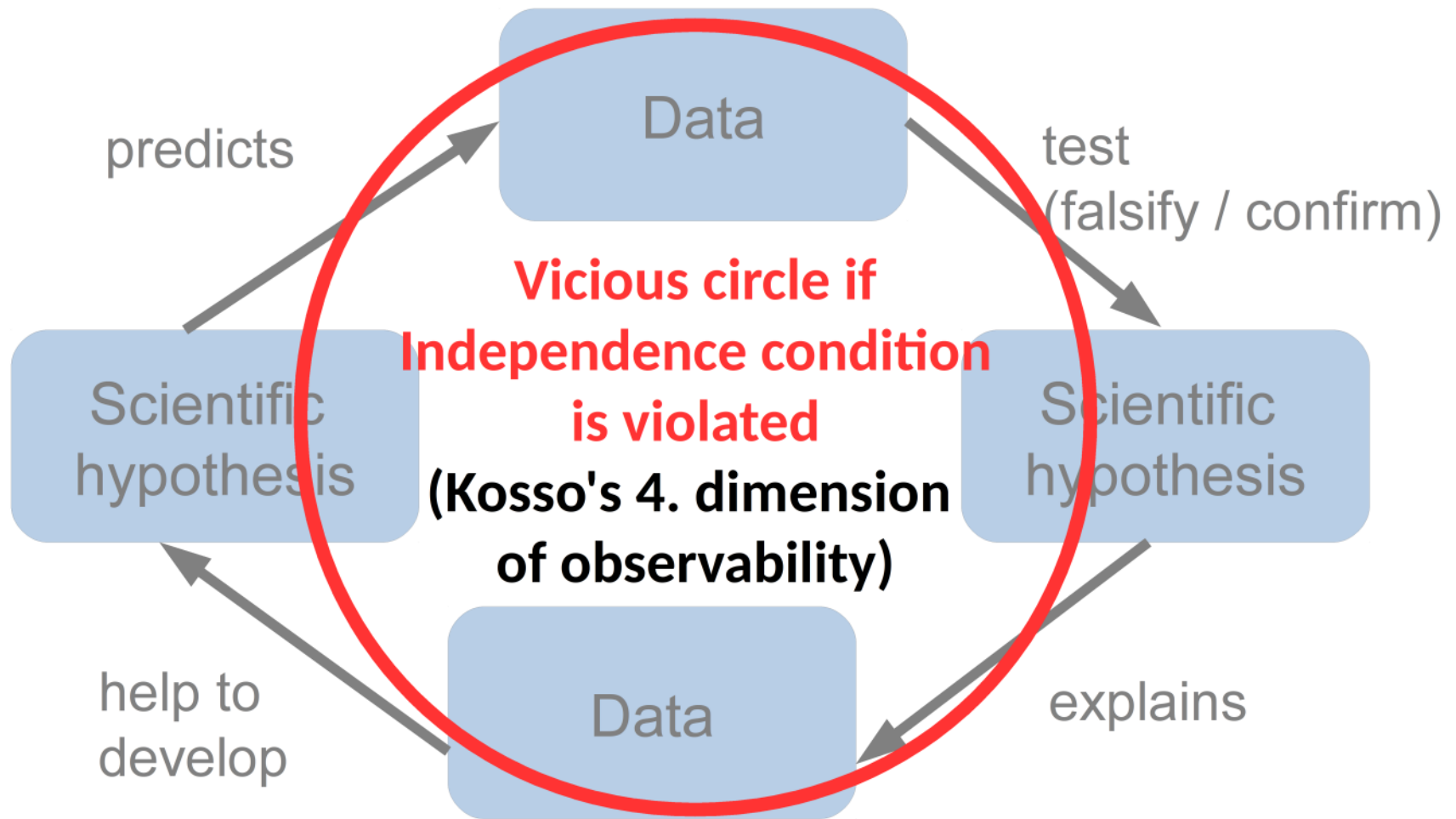
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  - Theories are needed to **interpret data**

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  - **Measuring** procedures are **influenced by theories**
  - Theories are needed to **interpret data**
  - Problems arise if the **theory** used to build the measuring device is **equivalent to** the **one** that **should be tested** by data produced by this device
  - How can we handle this problem?

# Theory-ladenness of observation

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Example: The discovery of the Higgs boson (2012)

- **Indirect measurement:** theoretical assumptions guided research

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Example: The discovery of the Higgs boson (2012)

- **Indirect measurement:** theoretical assumptions guided research

## 1. **Where to look for the data?**

- Instruments needed: e.g. particle accelerator working with a particular level of energy

# Theory-ladenness of observation

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Example: The discovery of the Higgs boson (2012)

- **Indirect measurement:** theoretical assumptions guided research

## 1. **Where to look for the data?**

- Instruments needed: e.g. particle accelerator working with a particular level of energy

## 2. **What counts as evidence?**

- Retrodiction: certain particles of decay allow inferences with certain probabilities

# Theory-ladenness of observation

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- Reliability considerations:
  - Special Issue “Synthese” 2017  
Vol. 194(2)

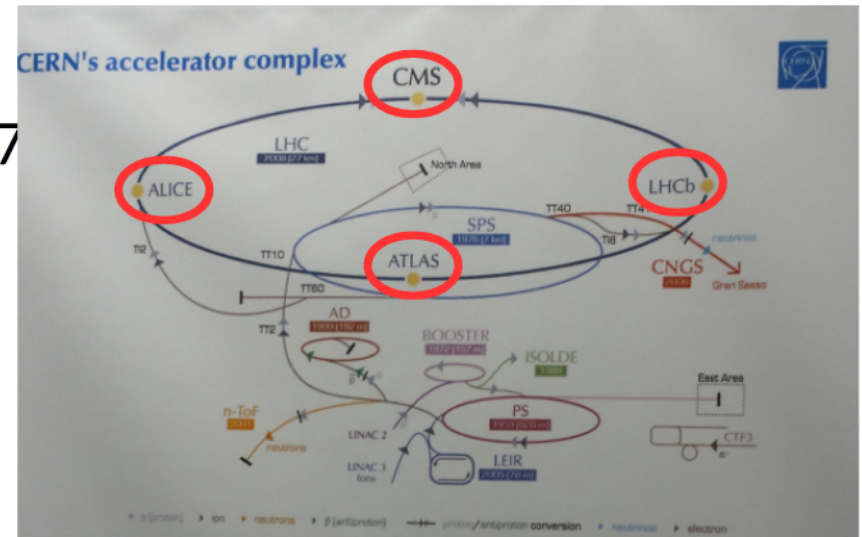
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  - **Statistical significance** of  
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# Theory-ladenness of observation

- Reliability considerations:
  - Special Issue “Synthese” 2017 Vol. 194(2)
  - Statistical significance of the data (five sigma)
  - Usage of different ways of access: different kinds of detectors at different experiments



# Theory-ladenness of observation

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- James Ladyman (2002): argument in favour of unobservables
  - At least **some** of them **are detectable** via instruments
  - “The greater the extent to which detections can be **corroborated by different means [different instruments / methods]**, the **stronger** the **argument for realism** in connection with their putative target.”

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  - At least **some** of them **are detectable** via instruments
  - “The greater the extent to which detections can be **corroborated by different means [different instruments / methods]**, the **stronger** the **argument for realism** in connection with their putative target.”
  - It would be **miraculous** if different detective devices show the **same results**, in case there was **no real entity causing those results**

# Social dynamics in science

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- But why do we **focus** on the **Higgs boson** and hope for „new physics“ as a by-product only?

# Social dynamics in science

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- But why do we **focus** on the **Higgs boson** and hope for „new physics“ as a by-product only?
- Are **scientific facts** different from **facts in the social world**?
  - Facts in the social world are **dependent on human activity** (politics, economics, etc.): they are produced
  - **Scientific facts** are **independent** of human activities: they have to be discovered, but are not invented
  - But: **measuremental theory-ladenness** calls for attention

# Social dynamics in science

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- Ludwik Fleck (1935), Thomas Kuhn (1962): **more wide-ranging social influences** in science
  - Science as a social institution bound by tradition
  - **Paradigm / thought style**: shared practices, background beliefs, social conventions

# Social dynamics in science

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- Ludwik Fleck (1935), Thomas Kuhn (1962): **more wide-ranging social influences** in science
    - Science as a social institution bound by tradition
    - **Paradigm / thought style**: shared practices, background beliefs, social conventions
    - Relevance of **education** and scientific training
    - Students are taught **what is relevant to their community**
      - × What is an interesting phenomenon to observe?
      - × How to observe correctly?
      - × How to interpret the data?
-

# Social dynamics in science

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- Kuhn's strong thesis:  
scientists sharing different  
paradigms live in different  
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# Social dynamics in science

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- Kuhn's strong thesis: scientists sharing different paradigms **live in different worlds**; they perceive different phenomena
- Picture Puzzle: **shift in perspective**
- Martin Carrier calls this “**perceptual theory-ladenness of observation**”



Wikimedia Commons: Wenzel Hollar  
(1607-1677): "Landschafts-Kopf"

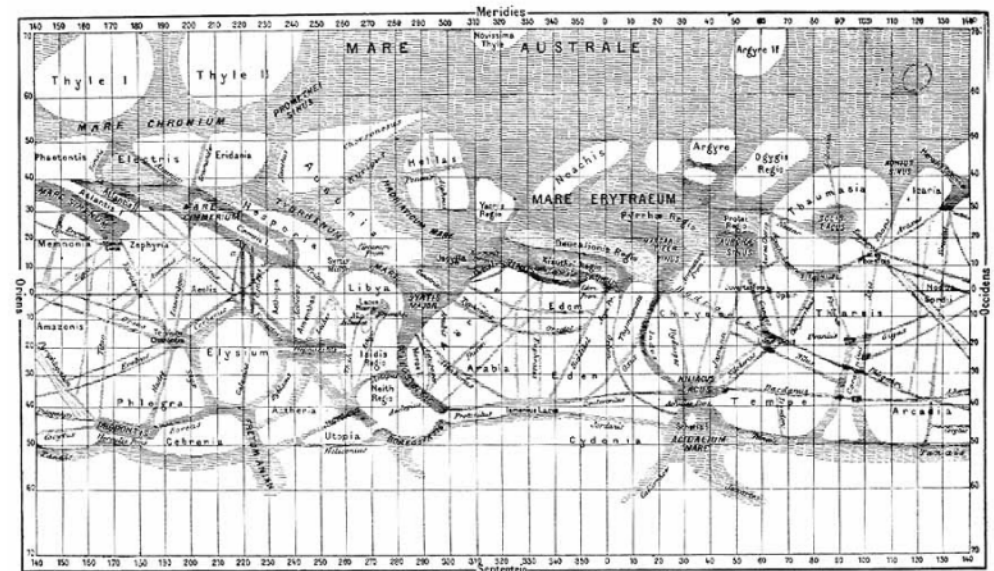
# Social dynamics in science

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- But: **thesis is too strong** – communication still possible as well as revisions of faulty hypotheses
- **Nature's resistance** to unduly interpretation

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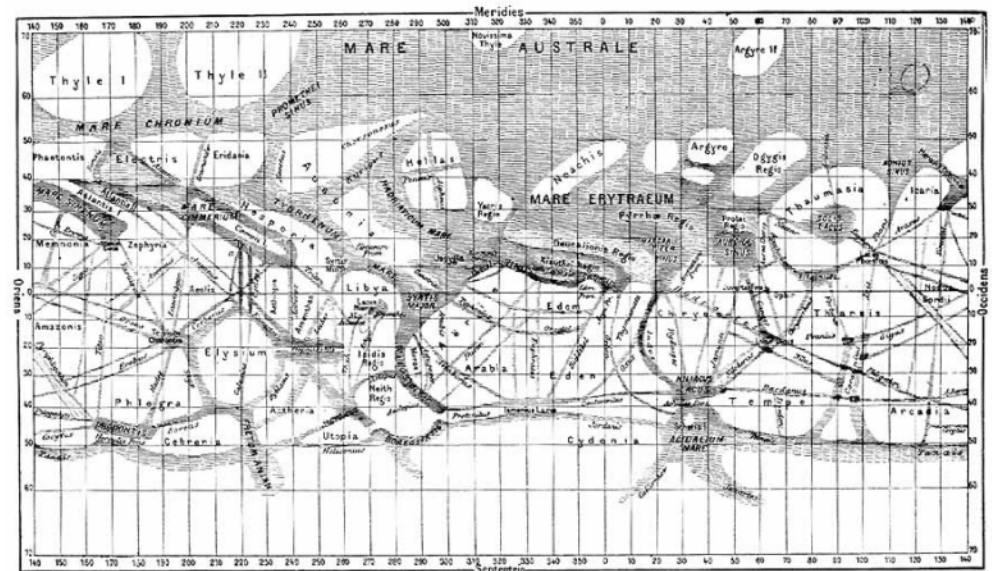
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- Example: Giovanni Schiaparelli's “**Martian canals**” 19th century
- Evidence of intelligent beings?
- **Problem of translation:**  
canali = channel  $\neq$  canal



Wikimedia Commons: Schiaparelli's map of Mars, compiled over the period 1877-1886

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- **Optical illusion:** human eye connects faint dots into lines



Wikimedia Commons: Schiaparelli's map of Mars, compiled over the period 1877-1886

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- However, social influences are still wide-ranging, why?

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  - How to get funding?
  - How to satisfy your reviewer to publish an article?
  - How to get your paper accepted at a conference?

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  - Does this **narrow the focus of science**?
    - Case study by Michael Gordin (2012) on Immanuel Velikovsky (“Worlds in Collision”)
    - **Science** versus **pseudo-science**
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But this is the topic  
for another talk  
in philosophy of science....

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