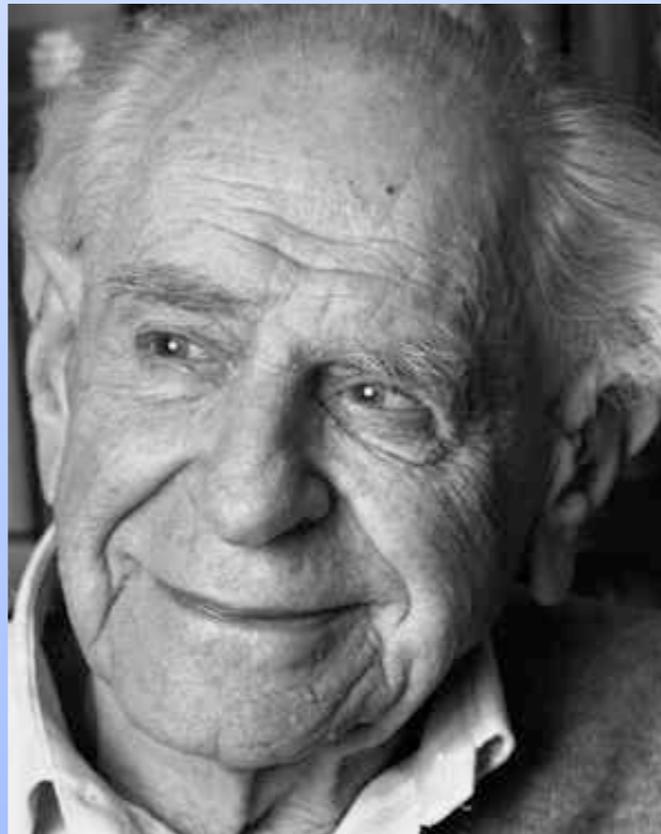
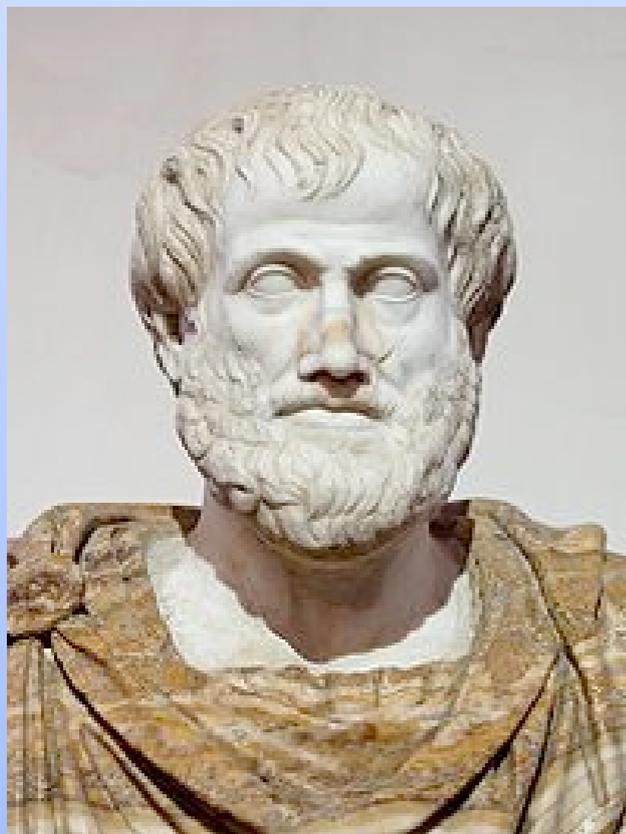


# Philosophy of Science

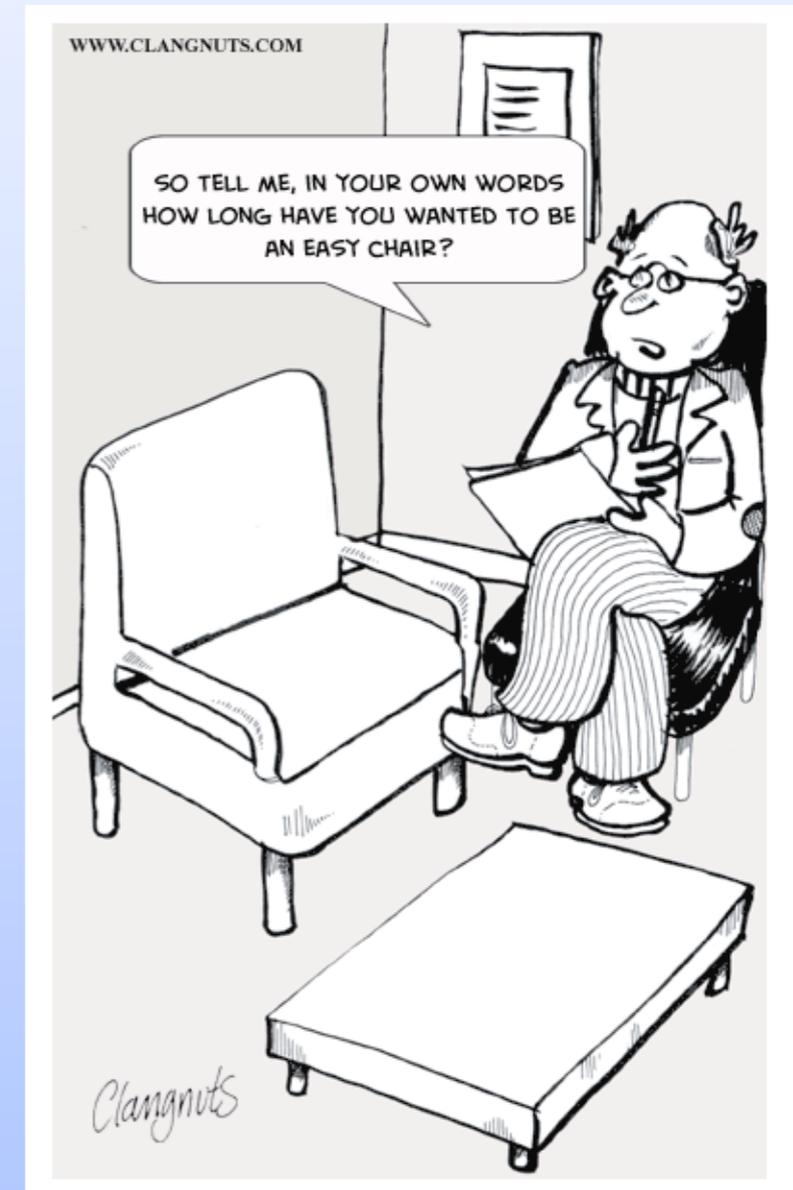
IMPRS Retreat 2010

S. Anderl, I. Nestoras, R. Schmidt



## Philosophy of science - the „therapist’s“ point of view:

- What is science (and what is not)?
- What are the goals of science (what can we hope for)?
- What are the methods of science (what are we doing and what should we)?
- What are factors influencing science („we are just humans...“)?
- How is science progressing (can we claim progress)?



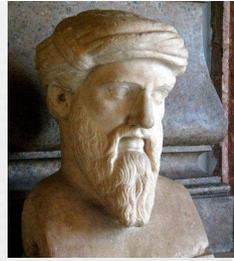
# **Ancient Greek Philosophy -** Philosophy and science

**Karl Popper -**  
Science = showing that something is wrong

**Thomas Kuhn -**  
Puzzles and revolutions



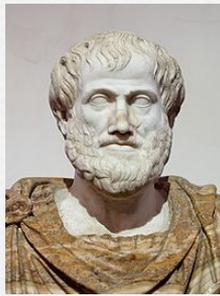
Thales  
624-547 BC



Pythagoras  
582-496 BC



- How scientific thought started
- The Ionian philosophers
- From where does everything come?
- From what is everything created?
- How do we explain the plurality of things found in nature?
- How might we describe nature mathematically?



Aristotelis  
384-322 BC



- The first distinction of experimentalism vs. theoreticians
- Mysticism against science (Pythagoras)
- Aristotle's scientific method and the middle ages

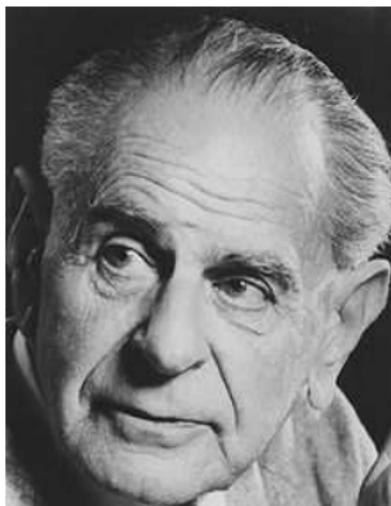
*Where is the fine line of distinction between mysticism and scientific method ?????*

*Where is the point that science stops and philosophy starts ????*

*What is the thing that creates the connection between science and philosophy ????*

*Where do you find the differences between the modern way of thinking and the ancient one ??*

- 1 Sir Karl Raimund Popper
- 2 Induction and Falsification
- 3 Falsification as Demarcation between Science and Pseudo-Science
- 4 Questions



# Sir Karl Raimund Popper

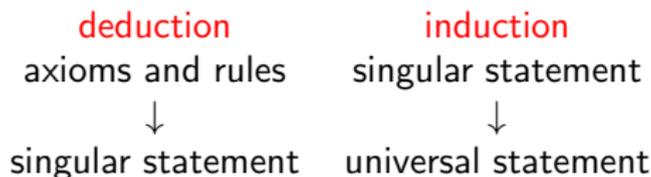
Austro-British philosopher:

- one of the greatest philosopher of science of the 20th century
- also a social and political philosopher

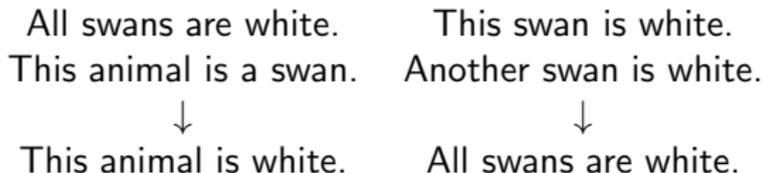
28 July 1902	born in Vienna
	his parents were Jewish origin, but converted to Christianity
1919	became attracted by Marxism
	→ disillusioned by its doctrinaire character
	→ remained a supporter of “social liberalism“ throughout his life
1928	doctorate in philosophy
1934	published his first book “ <b>Logik der Forschung</b> “ (“The logic of scientific discovery“ 1959)
1937	rise of Nazism → emigrates to New Zealand
	lecturer of philosophy at Canterbury University College
1946	moved to England,
	professor at the London School of Economics
17 Sep 1994	died in London, his ashes were taken to Vienna and buried at Lainzer cemetery

# Induction and Falsification

Induction:



example



⇒ **principle of induction**: premisses about objects we examined → conclusions about objects we haven't examined

⇒ **problem**: inductive conclusion not a priori justified

→ otherwise: no wrong conclusions possible (e.g. black swan)

→ only justified as long as successful → induction is prerequisite

# Induction and Falsification

Popper states that induction is only a method to extract new hypotheses, not to justify them

→ **falsification** as an alternative

falsification:

- no proof of a nature law by a single statement
- but only **one counterexample** to falsify a theory
- new methodology: consider nature laws as hypotheses  
→ keep them as long as you cannot falsify them
- you have to know how to falsify a theory

⇒ achieves two things:

- avoids problem of induction
- defines when a theory fails

*"Ein empirisch-wissenschaftliches System muss an der Erfahrung scheitern können"*

(An empirical-scientific system should have the possibility to fail due to experience)

- a theory is scientific if it is falsifiable
  - ▶ theory should make some definite predictions
  - ▶ theory falsified if prediction turns out to be wrong
- not falsifiable theories: pseudo-science (e.g. mathematics, logic, religion and philosophy)
- theory doesn't become better or more probable if tested successfully
- scientific progress: falsification of theories and replacement by a better one

# Demarcation between Science and Pseudo-Science

examples:

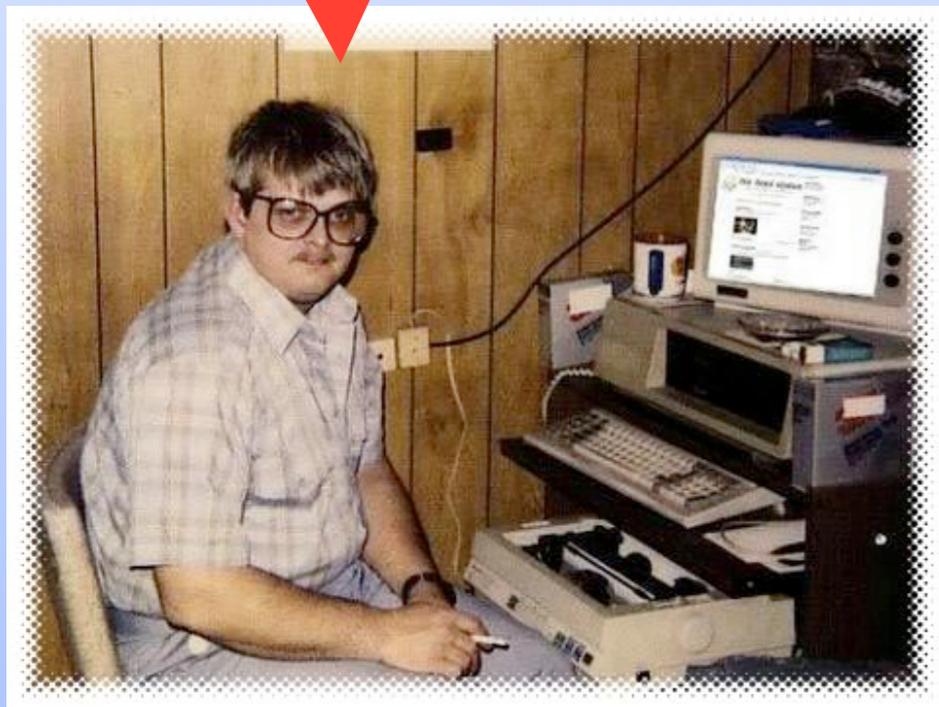
- **Freud's psychoanalytic theory**
  - can explain every behaviour of a patient
  - will never be wrong
- **Marx's theory of history**
  - could be made compatible with any possible course of events
- Einstein's theory of gravitation (**general relativity**)
  - definite prediction: light rays of distant stars would be deflected by the gravitational field of the sun
  - was tested successfully

# Questions

- How trustworthy is the principle of induction?
- Is scientific research done by induction or falsification today?
- Is falsification an useful method to do science?
- Is falsification a satisfactory demarcation between science and pseudo-science?
- What would be a theory which cannot falsified?
- How would you demarcate science from pseudo-science?



# Science as historical endeavour



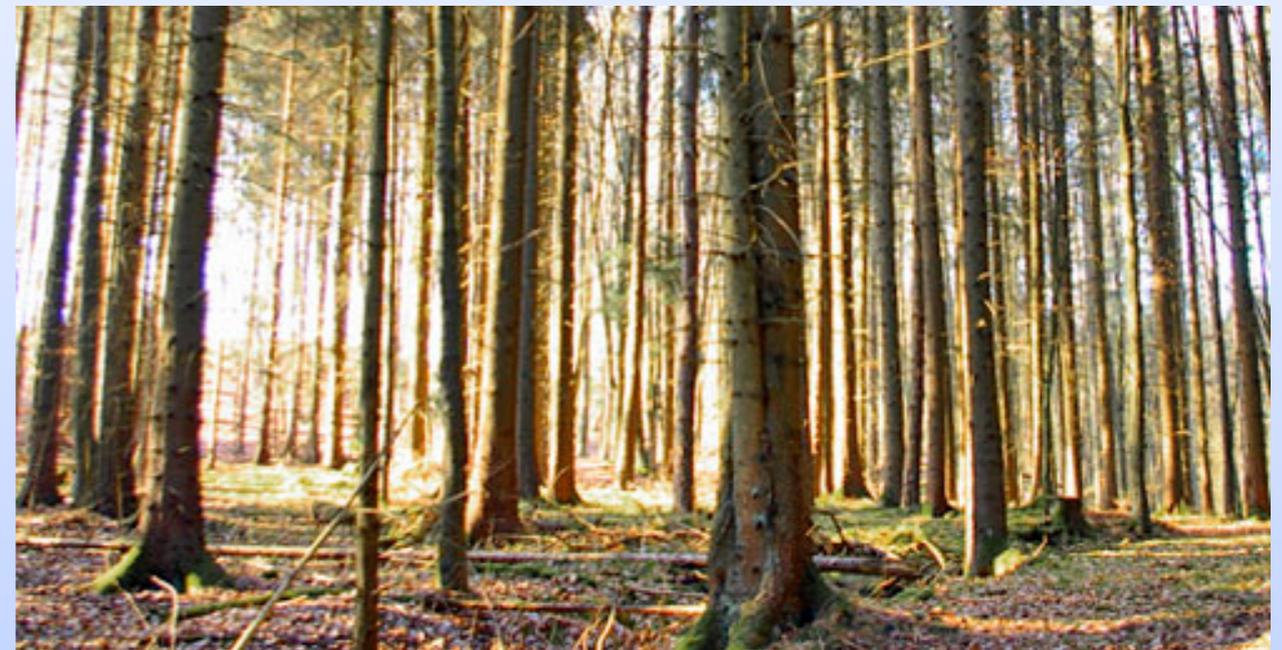
Scientists are humans embedded in a social and historical environment

=> Do observations and experience unambiguously determine our knowledge about the world?

=> How much is science influenced by the temporary circumstances?

# Pre-paradigm phase - „building up a field“

- What is relevant?? => accidental collections of facts.
- No criteria to distinguish the important from the unimportant.
- What are appropriate methods?
- several „schools“ exist.



not seeing the forest for the trees...

# Normal science: solving puzzles

Finally one school becomes established:

## Normal science:

„the attempt to make nature suit the paradigm“

- clarification and articulation of the paradigm
- designation of important facts
- adjustment of facts and theory



# Normal science: solving puzzles

## Solving Puzzles:

- Belief that a solution does exist
- Existence of rules, which constrain the set of possible solutions and methods



# Crisis

Discoveries: nature doesn't fulfill the expectations: insight, **that** there is something „strange“ + idea about **what** it is

- Typically we rather see the things we expect to see
- Anomalies must somehow be expected „awareness of problems“
- Concepts must be changed

Reactions:

- Normal science is able to cope with the problem
- Problem is archived
- A candidate for a new paradigm is developed



# Scientific revolutions



Revolution:

Non-cumulative epochs, in which a paradigm is replaced by a contradicting new one („paragdigm shift“)

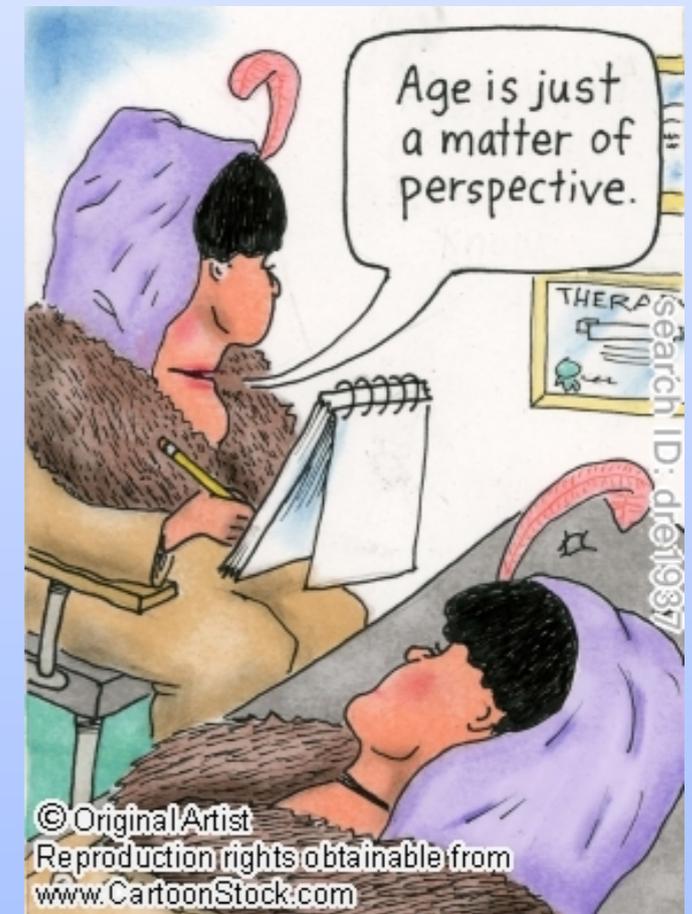
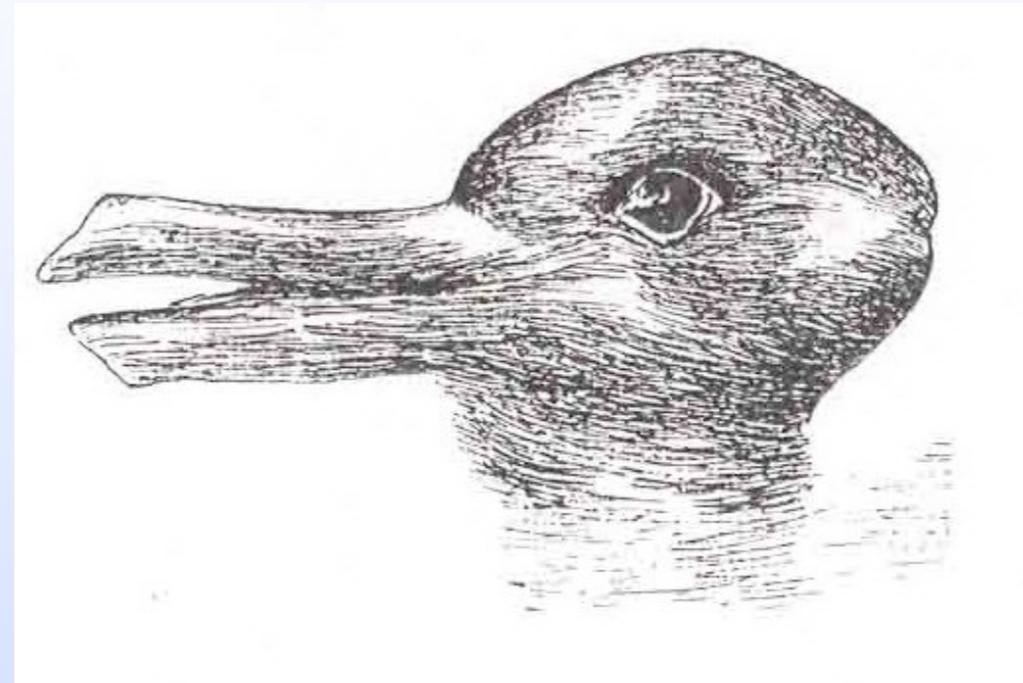
- Feeling that the existing tools don't work anymore
- Polarization into different camps
- There is no superior institution anymore which is able to decide the discussion => persuasion not convincement

# Incommensurability

The new paradigm makes scientist see something else:  
„they live in a different world“.

=> Empirical foundation is not constant, the content of experiences is changed.

- Different problems
- Different norms and definitions
- Different equipment and concepts or different use of them



# Scientific relativism?

Science generates a scientific tradition from the recent point of view: „**linearization**“ cumulative increase of knowledge => is this procedure justified?

Are there **core-principles of science**, which are beyond temporary, historical and sociological influences?

Do we know **more** (or just different things) today than people knew 300 years ago?