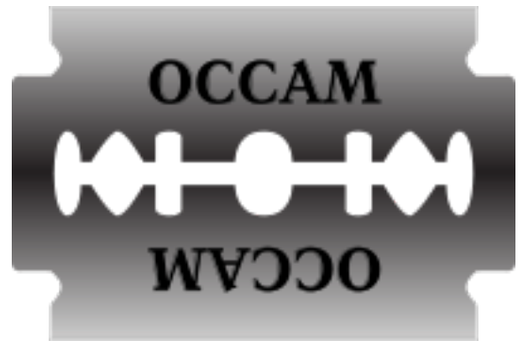


Lecture 6

Realism and Anti-realism
Kuhn’s Philosophy of Science

Realism and Anti-realism

Science and Reality

Science ought to describe reality. But what is Reality?

Is what we think we see of reality really real?

If not, what are we then dealing with in science? Is it *representations* of reality?

Philosophical Terms

There are several different attitudes towards reality in philosophy:

- Naive Realism : Reality is more or less as we experience it.
- Critical Realism: Reality exists but we cannot experience it directly. There is, however, a close connection between reality and our experiences of it.
- Idealism: Reality does not exist. The only existing things are our (or just my) experiences.
- Phenomenalism: Reality exists but we can only know it through *constructions* based on observations made by our senses.

In Science

In Science there are two attitudes:

- Realism: The goal of science is to describe reality as it is.
- Anti-Realism: The goal of science is to describe the *observable* part of reality as it is.We cannot say anything about the non-observable part of reality.

What is not observable?

- We can say that electrons are not (directly) observable.
- In a way we can say that atoms are observable. But once they were not.
- Feelings are perhaps just possible to observe subjectively.
- Abstract concepts are not observable.

The anti-realistic attitude

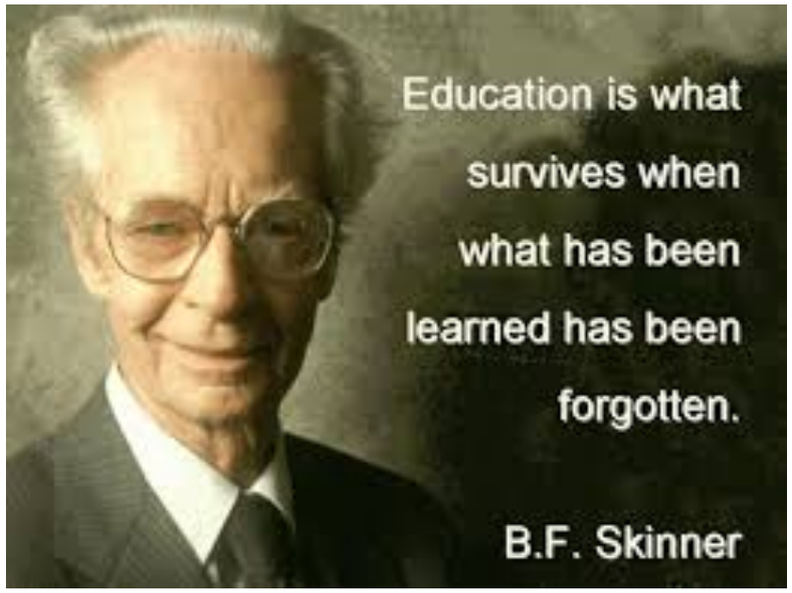
- Although the atoms in a sense, are observable, we should think about this example:
- Thermodynamic properties of gases can be explained by assuming that they are composed of atoms that move.
- According to anti-realists the existence of atoms is just a good fiction that helps us to explain the laws of thermodynamics.

Explanations of observations

- According to anti-realists is the core of science is the set of observable data.
- The purpose of the models is to explain these observable data.
- Anti-realism is also known as *instrumentalism*.

Behaviorism

- A special movement in psychology says that consciousness in a sense is a fiction.
- All scientific statements about consciousness must be based on observation.
- Consciousness is a fiction that describes these observations.
- This is a kind of *reductionism*.

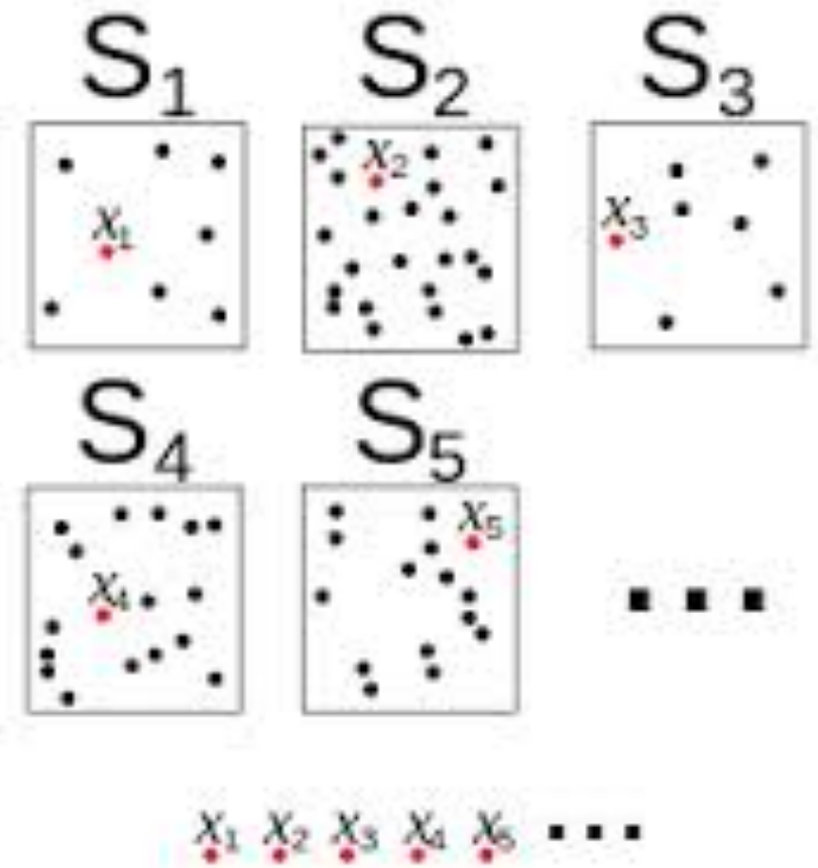


Fiction or not?

- There are actually two forms of anti-realism:
- We can say that theories, such as those concerning atoms, are pure fictions.
- We can say that theories, such as those concerning atoms, might be able to describe reality in a way. But we can never know if they are true. This approach is called agnosticism.
- The latter type of anti-realism is probably the most common.

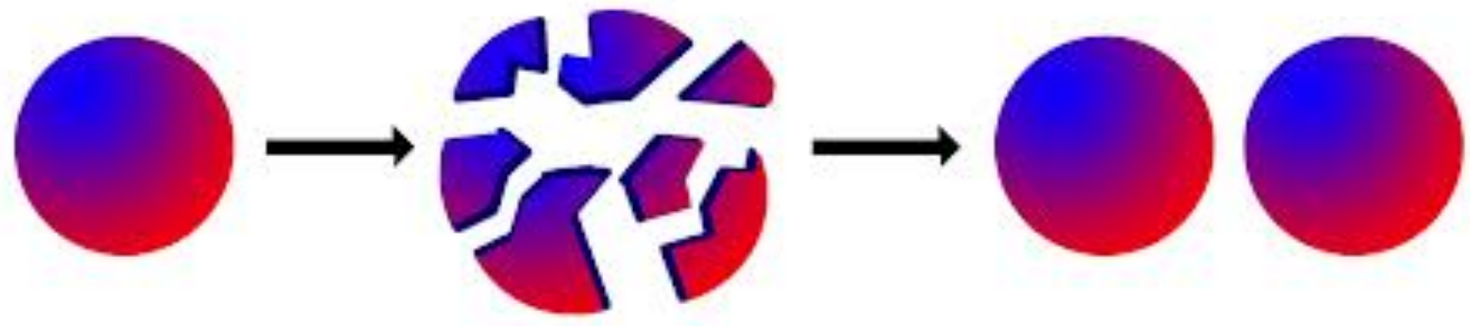
Realism in Mathematics

- The Axiom of choice says that if we have an arbitrary family of sets, we can choose an element from each set in the family.
- The selection is a function from the family of sets. The Axiom of choice says that this function always exists.
- The problem is that it doesn't have to be any explicit way of describing the function.



The status of The Axiom of Choice

- The axiom of choice is accepted by most mathematicians.
- It has many useful and important consequences.
- However, it has some strange consequences such as The Banach-Tarski Paradox.
- The paradox says that it is possible to divide a sphere with volume 1 into a number of parts and put the parts together and form two spheres which both have volume 1!
- The paradox "works" because we can it divide the sphere into parts that do not have measurable volumes.



Is the axiom contradictory?

- There are axiom schemes like The Zermelo–Fraenkel Set system (ZF) that seems to describe the basic math correctly.
- Gödel showed that the axiom of choice can be added to ZF without contradiction.
- Cohen showed that the negation of the axiom of choice can be added to ZF without contradiction.
- The conclusion is that using ZF we can neither prove or disprove the axiom of choice.

What do we do then?

- There are at least three approaches:
- We can believe that there is an objective answer to the question about the axiom of choice is true or not. We must try to understand the mathematical reality better. This approach is called realism.
- We choose to only deal with such mathematics can be proved constructively. We cannot know if The axiom of choice is true. This approach is known as constructivism.
- We can choose to accept the axiom of choice as true or false, depending on what we want. Have it your way! This approach is called formalism.

More details

- Realism: there is a mathematical reality that exists independently of us. Mathematicians are exploring this reality. Also called Platonism.
- Constructivism: the mathematics are designed by us. Only what is constructed or potentially possible to construct is real. This view (or a variant of it) is also known as Intuitionism.
- Formalism: Mathematics is just a sort of game with symbols. Mathematicians examine the consequences of the different rules of the game. Everything that does not lead to a contradiction is allowed. This view is a form of anti-realism.

Strength and weakness of anti-realism

- Gives a certain intellectual sanitation.
- Is quite natural. The reality can never be exactly what we imagine it to be.
- At the same time, it seems that an anti-realist position can limit our ability to speak about things.

Realism vs. anti-realism

- A summary of the positions:
- Realists believe that science is an accurate description of reality, even those parts of it that cannot be observed directly.
- Anti-realists believe that science can only describe the observable parts of reality and that the theories often are only fictions or models about which we cannot say that they are true or false.
- What are the reasons for the different positions?

The "No miracles" – Argument

- This is an argument for realism.
- There are scientific theories that manages to describe the observable part of the reality very well.
- They do so by describing a model for a non-observable reality and explain how this is projecting on the observable reality.
- How do you explain the "miracle" that this description of the non-observable reality works so well?
- No miracle! It works because it is true!

Counter-arguments

- In the history of science, there are many examples of theories that explains observable data very well but still proved to be incorrect.
- One such example is The Phlogistone Theory. (It was observable data that ultimately led to the rejection.)
- A critical example is theories of light nature.

The argument from observability

- This is also an argument against anti-realism.
- Anti-realism is based on the supposed fact that we can divide the world into observable and non observable parts.
- But can we really do that in a consistent way?
- There are, for example. a gradual transition from observability with the eye to observability with electron microscopes. It is the first one a genuine observability but not the other one?

Counter-arguments

- That type of argument really just shows that observability is a vague concept. It does not necessarily mean that it is a meaningless concept.
- We can see that there are clear cases of what is observable and clear cases of things that are not. That's enough for anti-realism.

The argument from under-determination

- This is an argument for anti-realism.
- We imagine that we have a set of observed data. We want to find a theory that explains the data.
- It is possible to realize that there is always a variety of theories that may explain these data. The theories are being under-determined.
- If you are using a theory to explain the data, it is just an arbitrary tool for the explanation.
- That's exactly what anti-realists believe about theories.

Counter-arguments

- Although there are different theories that could explain the measured data, they are not all equivalent.
- It seems natural that there is some kind of selection criterion, for example, choosing the simplest theory.
- It also seems to be a lack of historically interesting examples of under-determination.

Laws

- What is a scientific law?
- It seems natural to interpret it as a regularity in nature.
- But there is a problem: The law of gravity specifies a rule for how bodies fall. It is not literarily true, however, due to air resistance. How can it then be a law?
- Laws should perhaps be interpreted as a tendency? They strike through, depending on strength.

The mystery of laws

- Why does nature follow laws?
- Does it do that?
- Newton's laws seems to be very successful.
- But is not the concept of force just *defined* in a way that makes it work?
- We may just see the laws that work?

Computer Science

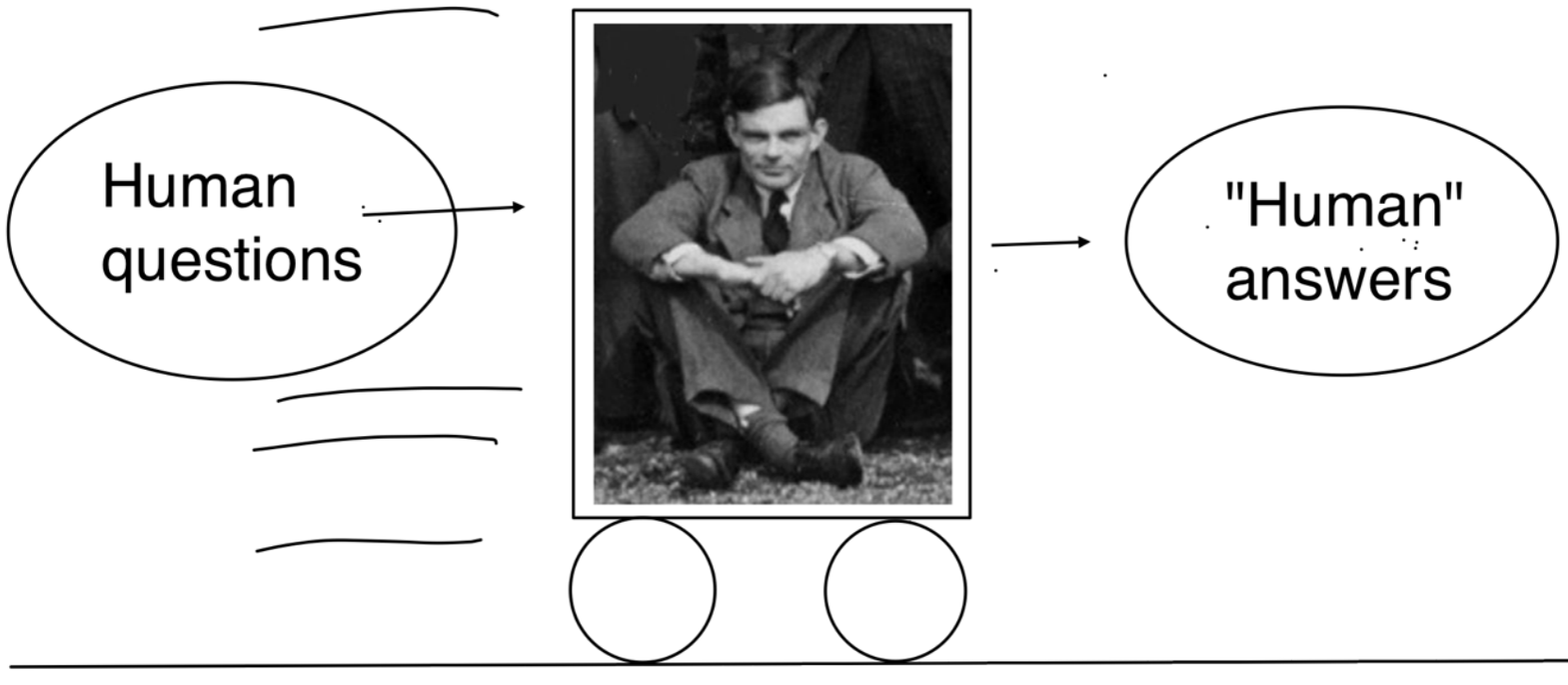
- What are the Computer Science problems relating to realism and anti-realism?
- The problems seems to be the same as in mathematics. But computer science works primarily with discrete mathematics that usually use finite methods. (Not so much of ontological problems.)
- Does the NP-question have to be decidable?
- Maybe the problem of consciousness is an example of the realism / anti-realism character?

The Turing Test

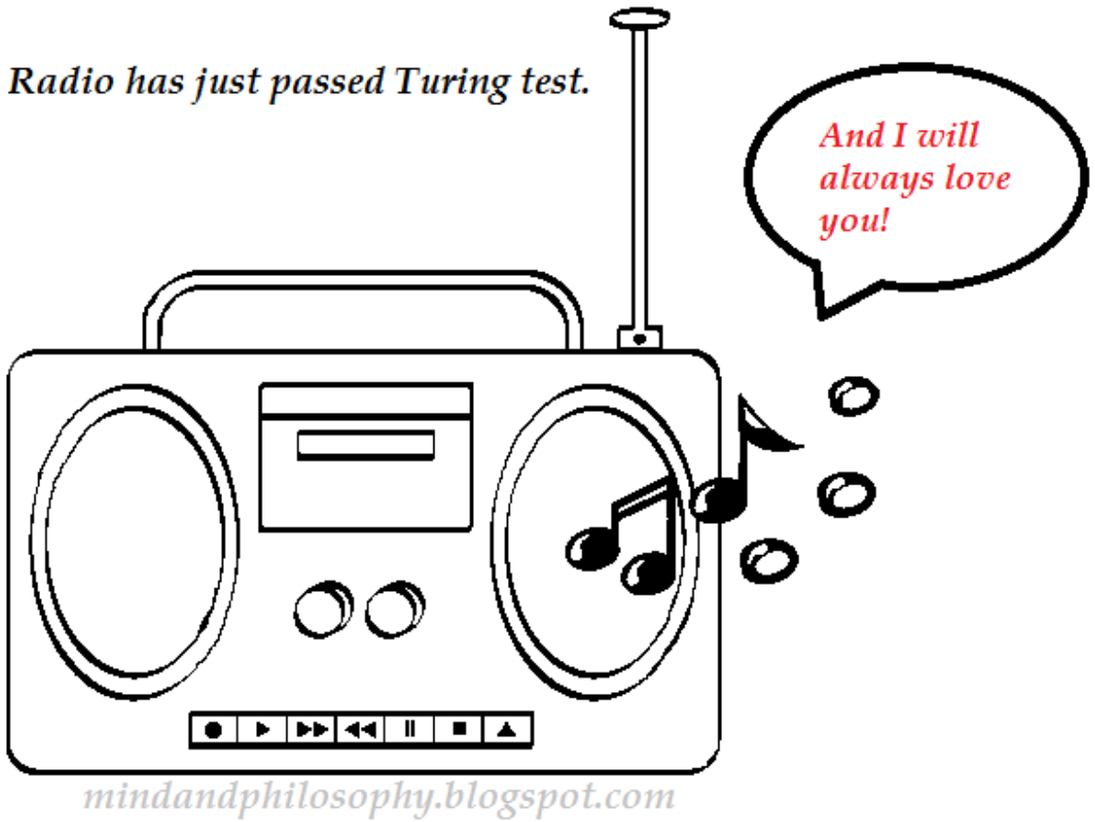
A machine passes the Turing test if it convinces you that it is human.

In that case:

- Is it "like" a human?
- Is it equivalent to a human?
- Is it human?

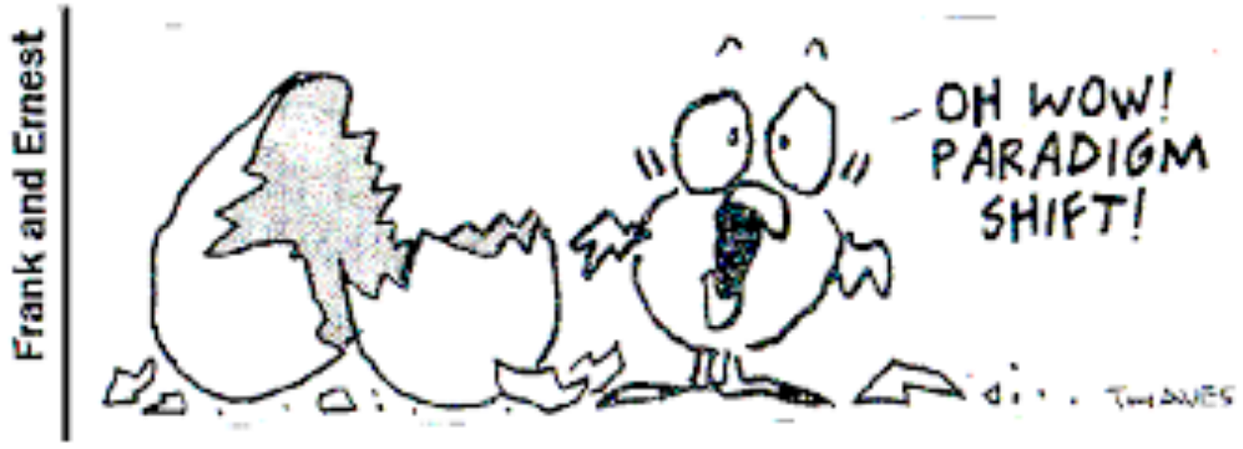


What is human consciousness?

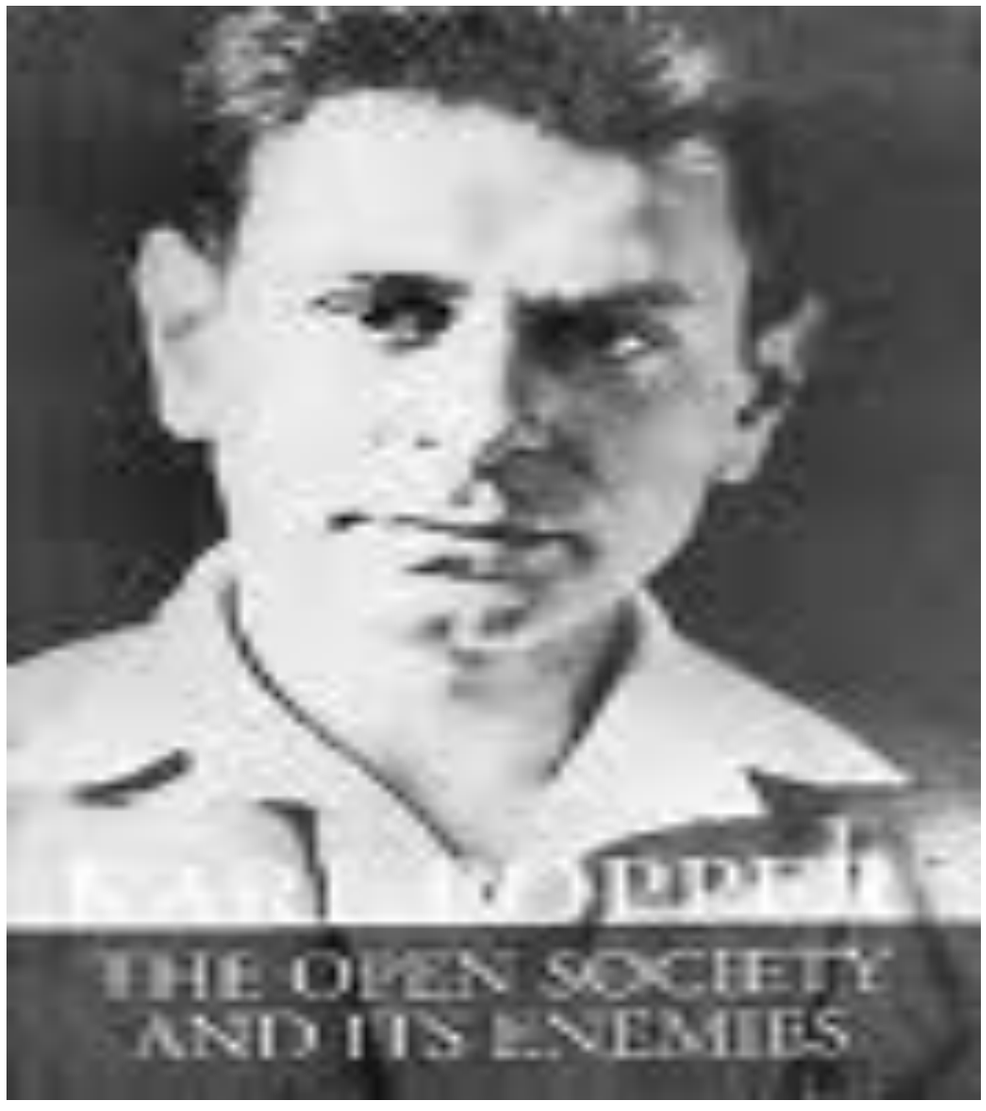


- Can a computer have feelings and consciousness?
- In the same way as humans have?
- Can a computer be you?
- Are you a computer?
- Perhaps consciousness is a convenient fiction?
- Many people think these are interesting and disturbing questions.
- And they are scientific questions (or?)

Popper and Kuhn



Karl Popper



Karl Popper 1902-1994

Some facts:

- Born in Austria.
- His most famous results origins in the twenties in Vienna.
- Of jewish heritage. After the Anschluss he emigrates to New Zealand.
- After the Second World War he moves to England.
- In 1965 he is knighted Sir Karl Popper by Queen Elisabeth.

Some steps in Popper's philosophy

- Popper lives in Vienna after the First World War.
- In 1919 there is an expedition for observing a solar eclips. The observation confirms Einstein's General Theory of Relativity.
- In Vienna there is much talk about Freud's psychoanalytical theory.
- And the same goes for Marx' political theory.
- Popper has the gut feeling that the first theory is real science.
- But not the other two.
- But what is the difference between them?
- Popper: Einstein's theory is *falsifiable* but the other theories are not.

Falisficationism

- The theory is first presented in *Logik der Forschung* 1934
- A theory should be alble to *falsify.*
- If we have a theory T, we try to find a testable consequence K of T.
- If K turns out t be false, then T is falsified.
- Then we must reject T.
- Only theories that are falsifiable in this manner can be considered scientific.

Falificationism II

- A theory that cannot be falisfied cannot predict anything.
- A scientist should always formulate theories in a way so that they can be falsified
- and the try to falsify the theory (!)
- We can never be certain that a theory is true. We can only know that it has not been falsified this far.
- The ”bigger risks” a theory takes, the better it is.

Criticism of falsificationism

- The theory doesn't seem to agree well with how science is done in real life.
- Scientist don't always (perhaps never) try to falsify their theories.
- Well established theories have more than once been temporarily falsified.
- But what are relevant falsifications of a theory?

Is there a universal scientifict method?

The question can be answered in two different ways:

- Normatively : *How science should be practised. Popper think in this fashion.*

- Descriptively: *How science is done in practice.*

Our next philosopher of science was more interested in the second mode of thinking.

Thomas Kuhn

Thomas Kuhn 1922-1996

- American. Doctor in physics at Harvard.
- Became more and more interested in the history and philosophy of science.
- In 1962 he published ”The Structure of Scientific Revolutions”. This is probably the most influential book on the philosophy of science ever published.
- The book introduced the phrase *paradigm shift.*

Kuhn's philosophy

- A paradigm consists of terms, methods, norms and ways of viewing thing. It defines our way of understanding the world (or at least a part of it).
- *Normal science* is science as it is done within the paradigm.
- In *revolutionary science* we reject the old paradigm and replaces it with a new one.

More details

- In normal science we don't put the paradigm on trial. All problems are handled within the paradigm.
- Within the paradigm we are doing ”puzzle-solving”. It is characteristic of real science that there is an established program for such problem solving.
- When a *crisis* occurs, it can lead to a paradigm shift.
- Such a shift is often done for *irrational* reasons.
- Two paradigms are *incommensurable* with each other.

Problems with Kuhn's philosophy

- Is it a recommendation for how science should be done?
- Yes, in a way. The philosophy focuses on the importance of stability in normal science.
- We would like to think that a paradigm shift always leads to a *better* paradigm. How can we tell if this is actually the case?
- Kuhn doesn't provide a clear answer to this question.