Lecture 1

What is philosophy of science?

Course data

- HEM1 - Seminars, 1,5 hp, grades: P, F. Attendance required.
- HEM2 - Essay, 1,5 hp, grades: P, F
- TEN1 - Exam, 3,0 hp, grades: A, B, C, D, E, FX, F. (By answering questions at the end of each lecture it is possible to get grade E without doing the exam.)

Semmelweis

Introduction to scientific thinking by an example

Semmelweis

Ignaz Semmelweis
(1818-1865).

In the years 1844-48 he worked at the main hospital in Vienna.

There he faced a strange problem.

The problem

- The hospital had two maternity wards . At that time it was not uncommon that the mothers died of childbed fever (puerperal fever).

- But there was a strange difference between the two clinics. The first one had a death rate of 8.2%. The second one had a death rate of 2.3%.

- Why the difference?

Looking for an explanation

- So what is an explanation?
- Can everything be explained?
- We will talk more about this later in the course.

Methods for explaining

- We can form a hypothesis and see if it is correct.

- We can observe differences between the clinics and try to find an explantion.

- In science, we normally try to form a hypothesis first. Then we know how to look for relevant differences.

Some possible relevant differences

- We have to remember that at this time the medical knowledge was quite low.
- Something with the air. There was a concept called miasms that was believed to exist.
- Different types of patients.
- Different treatments.
- Psychological factors.

Experiments

- Semmelweis couldn't see any differences between the clinics.
- He started to experiment by introducing differences.
- One example of a possible psychological difference was that the patients could be scared by priests going through the room on their way to dying patients. (Or at least one thought it was possible.)
- These experiments actually raise an ethical question? Why?

A relevant difference

- Semmelweis found a difference that was more promising.
- He found that the patients in clinic one was visited by doctors going a round. Their previous stop had been for autopsy of corpses.
- This was not the case in the second clinic.

Forming a hypothesis

- An important clue for Semmelweis was that a friend of his had died after accidentally cutting himself in a finger during autopsy.

- Semmelweis framed the hypothesis that it was some "stuff" from the corpses that caused the fever.

- Remember that germs were unknown at this time.

Doing an experiment

- He told the doctors to wash their hands with calcium hypochlorite before going to clinic one.

- And the death rate was soon reduced to the same level as the one in clinic two.

- But the medical expertise was extremely skeptical about this mysterious "stuff".

- Semmelweis died some twenty years later, considered a quack by many.

The importance of Semmelweis

- Semmelweis experimenting is know considered one of the most beautiful examples of scientific reasoning.

- He started with a hypothesis and then did experiment to confirm it.

- He found a good explanation for the differences between the clinics.

- But why calcium hypochlorite helped remained a mystery until around 1870.

Two components in the course

- Theory of science
- Scientific method

We will describe both subjects.

Why should we study philosophy of science? Some possible answers.

- General cultural knowledge in science. To get a wider perspective.
- To learn effective methods for doing science.
- To get to know the limits of science.
- To understand the *value* of science.

Three important questions

- Why is science so successful?
- Why does it seem as if nature obeys scientific laws?
- What is the difference between science and pseudo science?

Two sides of science

- Theoretical deductions.
- Observation of measurements.

Theoretical deductions can be said to be the original form of science.

Observation of measurements was a later development.

Obs: People are often bad at making correct observations.

A very short overview of the history of science

- The Pre-Socratics *Theories about what matter the world consists of.*
- Plato and Aristotle *Mathematics, physics and biology.*
- Copernicus and Kepler *A new view of the universe.*
- Galilei and Newton *Mathematics and physics united. The birth of modern science.*
- Darwin *A second scientific revolution.*
- Einstein, Schrödinger and Heissenberg *Relativity theory and quantum mechanics. A third scientific revolution.*

What is science?

A provisional answer:

Science as a method for är ett sätt att

- Investigation of an objective reality
- In a systematic way
- Which gives answers in forms of general laws.

Some questions the philosophy of science tries to find answers to

- Is there a general scientific method?
- Is there some test to tell if something is science and not pseudo science?
- Are there any limits for what questions science can answer?
- Ethical questions.

Philosophy is mostly about the limits of what we can understand.

Course contents

- Introduction
- Some history of science
- Positivistic theories and problems
- Scientific method
- Deductive methods

Course contents contd.

- Computer science as science
- Scientific methods in sociology
- Ethics in science
- Pseudo science
- The role of science in the society

Some famous thinkers about science

- Aristoteles - explanations
- Bacon – induction
- Galilei - experiments
- Descartes – deduction and rationalism

The first real philosophy of science

Starts at the end of the 19th century.

There is a lot of scientific theories.

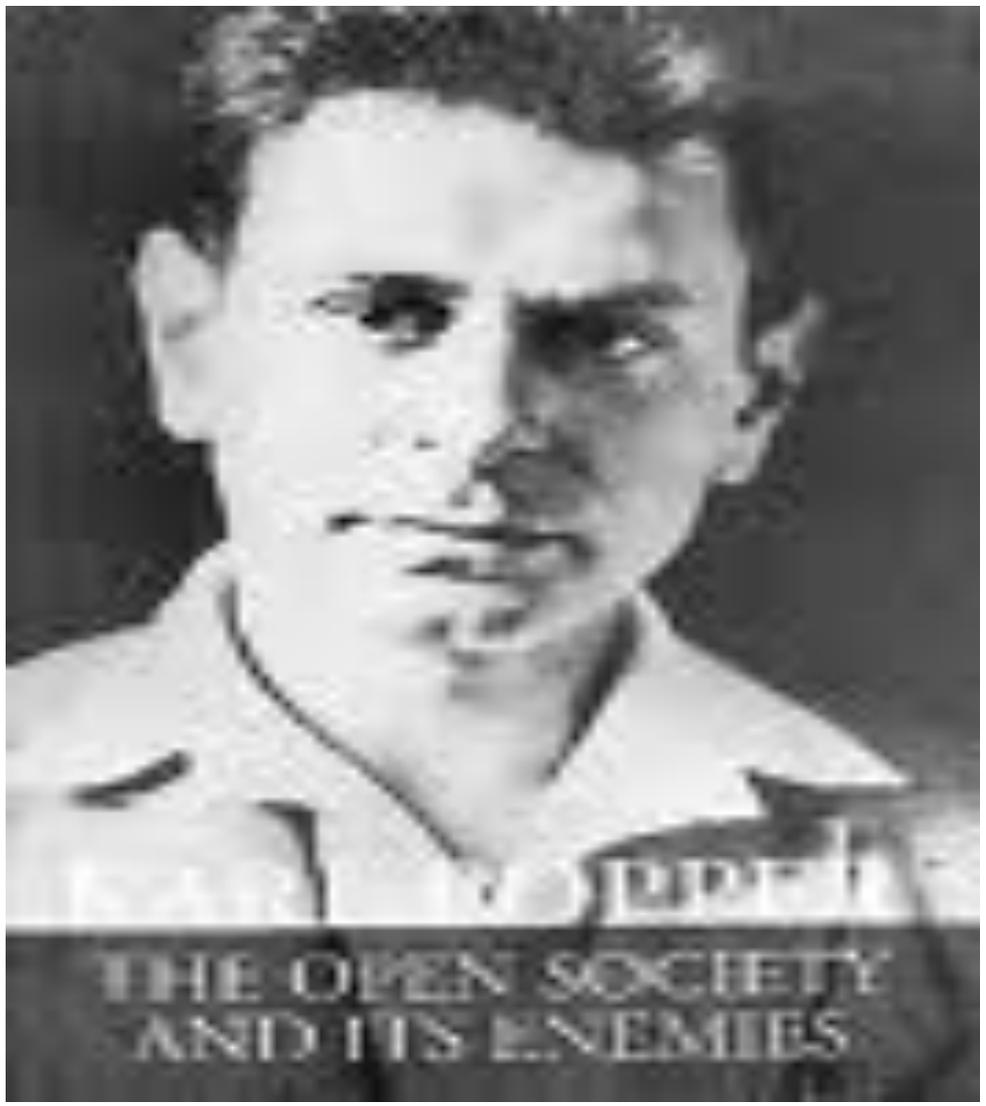
The question is what we can say about them.

Are they all good?

What method should a scientist use?

Are there any general principles?

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 eachother.

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.