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.

Different perspectives

We look at some different perspectives one can have of science. They will contrast with each other. Such a subdivision is sometimes called a dichotomy.

Engineering - Science

Engineering

We find solutions to certain classes of problems.

Science

We find theorems and general laws that apply to a large class of situations.

Rationalism - Empiricism

Rationalism

In order to do science you just have to do logical reasoning.

Empiricism

In order to do science you must do experiments and observations.

Francis Bacon

He thought that you should observe nature and try to recognize patterns and formulate scientific laws.

René Descartes

He thought that you should use your own logical reasoning to understand the laws of nature.

Explanation - Prediction

Explanation

The goal of science is to give explanations for phenomena.

Prediction

The goal of science is to make predictions of what will happen.

Supernaturalism- Mechanism

Supernaturalism

Our understanding of the world must be partly based on knowledge of a supernatural unseen reality.

Mechanism

Our understanding of the world is based on basic "mechanical" processes.

Discovery - Verification

Discovery

The most important goal in science is to find new hypothesis and theorems.

Verification

The most important goal in science is to verify hypothesis.

Naturalism- Positivism

Naturalism

You must first study separate sciences in order to understand philosophy of science.

Positivism

There is a philosophy of science that can guide you in all separate sciences.

Realism - Instrumentalism

Realism

Science describes reality as it is.

Instrumentalism

Science is just a tool for us to handle the world.

Objectivism - Relativism

Objectivism

There is an objective truth and the goal of science is to find it.

Relativism

What truth is depends on the context.

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.*

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

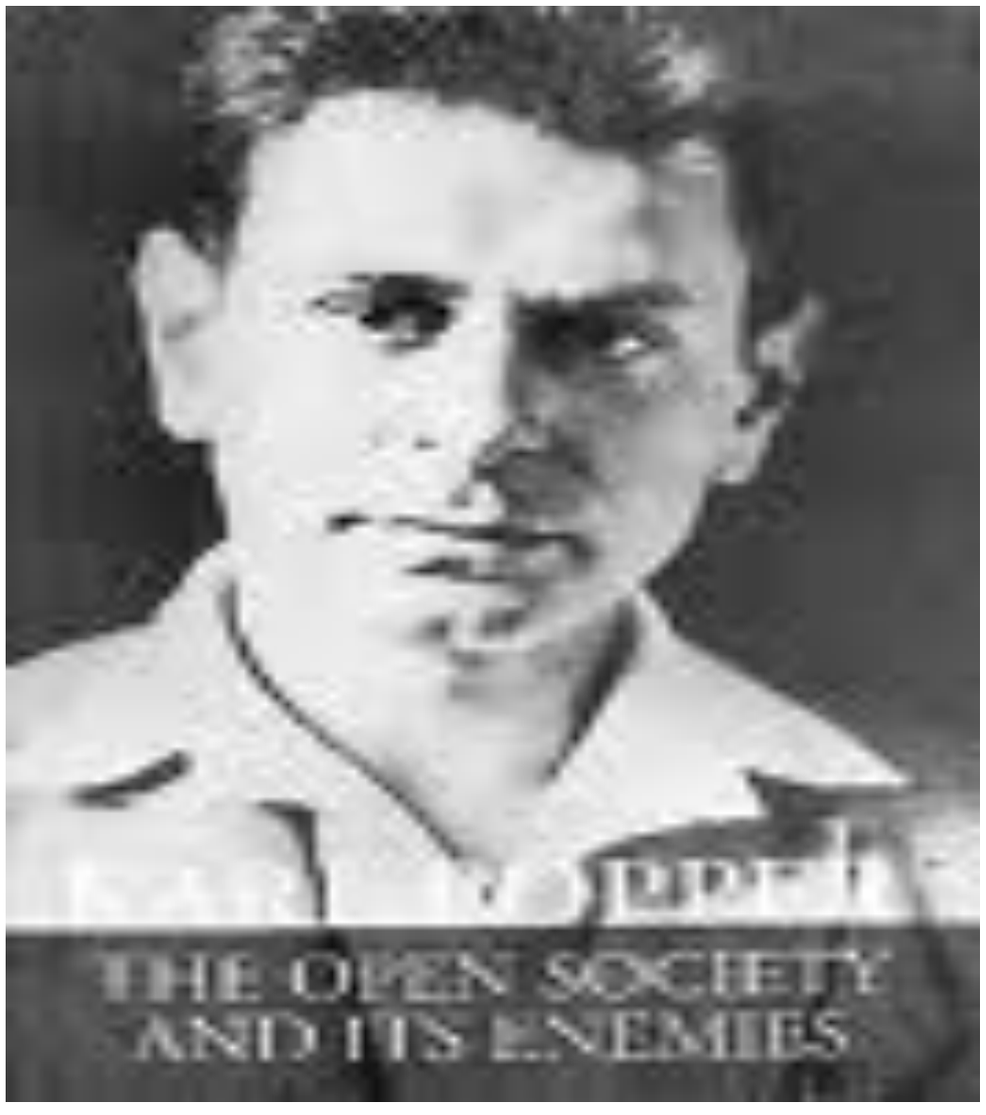
Course contents contd.

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

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.