Introduction

Christian Wüthrich

http://www.wuthrich.net/

Introduction to the history and philosophy of science
Faculté des sciences, Université de Genève

Plan

1. Introduction to the course
   - What is (history and) philosophy of science?
   - Three approaches to science
2. Terminology and distinctions
   - Terminology: statements, propositions
   - Some distinctions

What is (history and) philosophy of science?

What is (history and) philosophy of science?

- Philosophy of science: analyses the foundations of scientific knowledge
- History and philosophy of science (HPS): studies examples in the history of science with an eye to philosophical problems, particularly concerning the development of science and its epistemological consequences
- There are multiple conceptions of the relationship between philosophy of science and its adjacent disciplines (like history and sociology of science).

What is (history and) philosophy of science?

- Attention concerning 'épistémologie': in the francophone tradition, this term means history and philosophy of science!
- Today, the term 'epistemology' (and 'épistémologie') is reserved for philosophy of knowledge in general (at least in the anglophone tradition).

What is (history and) philosophy of science?

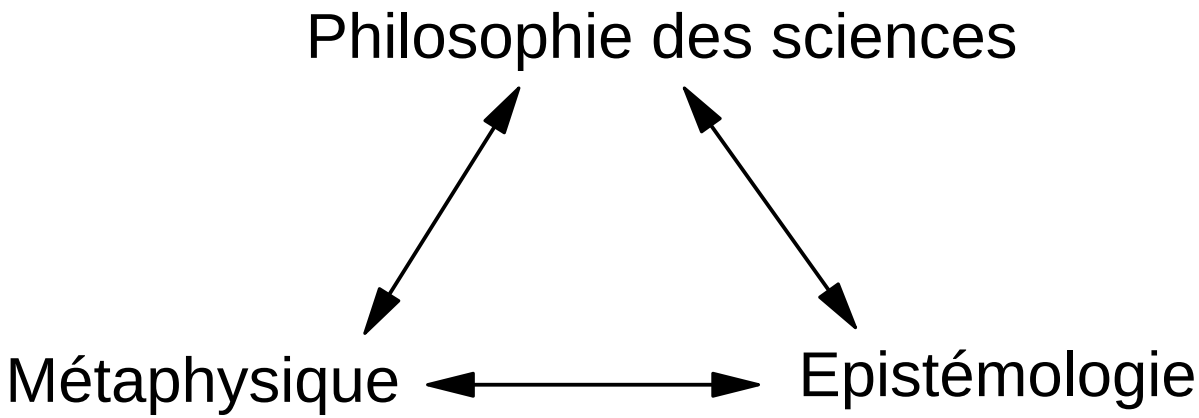
- Originally, 'science' meant the natural science. Today, philosophers of science are also very interested in the social sciences.
- In the classical texts, the paradigmatic sciences are astronomy and physics.
- 'Special sciences': chemistry, geology, biology, psychology, sociology, economics...
- In this course, we will be primarily interested in the natural sciences.

Other disciplines

- Contemporary history of science is principally concerned with the development of science and its relationship to the public in its historical, political, and cultural context.
- Sociology of science is interested in the social conditions of the production of scientific knowledge.
- Science studies: history, philosophy and sociology of science

Relevant questions in philosophy of science

- What is science and is it distinct from 'pseudoscience'?
- What is the 'scientific method', if there is one, and on what basis does it justify its claim that its results are objective?
- How does science explain our observations and our experiments?
- Does scientific knowledge grow in a progressive and linear manner, or is its evolution dominated by radical revolutions?
- Are the grounds on which a scientist rejects an old idea and replaces it with a new theory completely rational and logically reconstructible? Or are they substantially influenced by irrational factors?
- Do scientific theories deliver a conception of the world which is literally true? Or should we consider even the most developed and best confirmed theory as a simple instrument just built to systematise the results of our experiments?


Philosophie des sciences
Métaphysique
Epistémologie

The scope of the investigation

Godfrey-Smith (2021,6)

However we choose to use the word 'science', in the end we should try to develop both:

1. *a general understanding of how humans gain knowledge of the world around them, and*
2. *an understanding of what makes the work descended from the Scientific Revolution—if it really is different—from other kinds of investigation of the world.*

Peter Godfrey-Smith (2021). *Theory and Reality: An Introduction to the Philosophy of Science*. University of Chicago Press. Second edition.

Three approaches to understanding how science works

(1) Empiricism and science

Godfrey-Smith (2021,12)

Empiricism and Science: Scientific thinking and investigation have the same pattern as everyday thinking and investigation. In each case, the only source of knowledge about the world is experience. But science is especially successful because it is organized, systematic, and particularly responsive to experience.

Three approaches to understanding how science works

(1) Examples from the history of medicine: (a) Semmelweis

- Of two Vienna maternity clinics in the 1840s, one had an average maternal mortality rate of about 10% due to puerperal (or childbed) fever, the other less than 4% (similar to if women gave birth in the streets!). Why the difference?
- Ignaz Semmelweis (1818-1865): eliminating all possible differences, he identified 'cadaveric contamination' as the cause when doctors and students moved from doing autopsies on corpses to assisting in childbirth.
- Semmelweis proposed that doctor wash their hands between autopsies and delivering babies, which greatly reduced the problem.

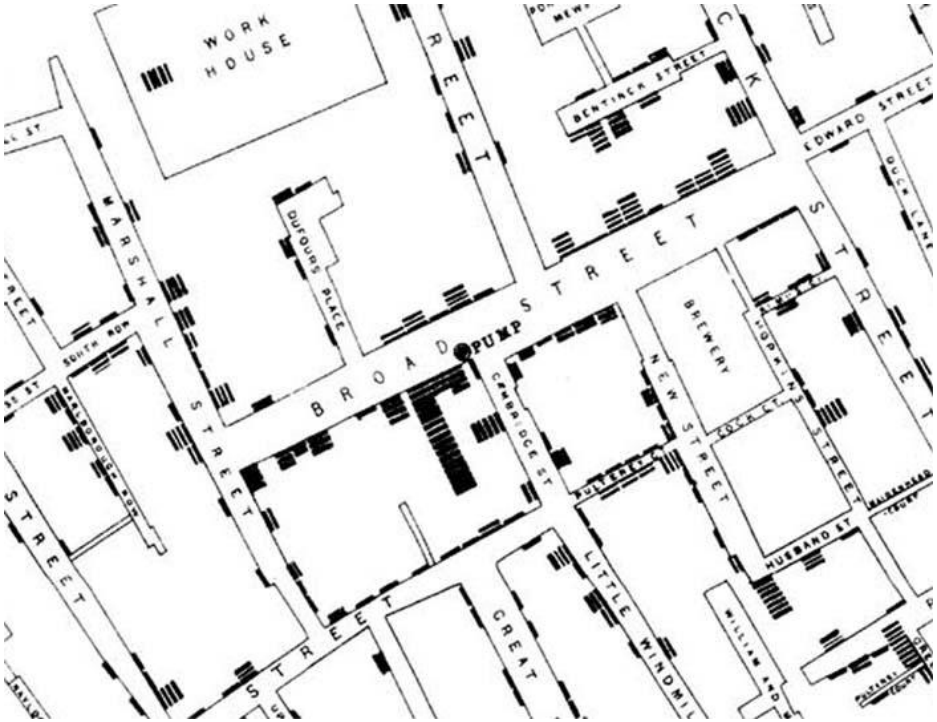
Three approaches to understanding how science works

(1) Examples from the history of medicine: (b) Death at the pump

- great cholera epidemics in London 1848-9 and 1853-4
- Question: how can cholera be stopped?
- Assumption at the time: contagious cholera agent air-borne
- John Snow (1813-1858), a London doctor, solved the problem: infection was through fecal-oral transmission of a specific pathogenic agent in contaminated water

Three approaches to understanding how science works

(1) Examples from the history of medicine: (b) Mapping the disease



- 'disease map' of the cholera epidemic in Soho in 1854, showing cholera deaths as stacked black lines drawn at the street address of the deceased
- Note the large number of deaths in households near the Broad Street pump.

Three approaches to understanding how science works

(1) Examples from the history of medicine: (b) John Snow's findings

- Snow showed that the use of water from the small hand-operated pump that served up drinking water from a shallow well was a common factor in (almost) all of the cholera deaths.
- Also, the nonuse of that water was characteristic of two groups that were little affected (workhouse residents and brewery workers).

$\Rightarrow$ pioneer of germ theory, 'father of modern epidemiology'

- But: really he only found a correlation; philosophers are interested in identifying and analyzing causation

Three approaches to understanding how science works

(1) Examples from the history of medicine: (c) Max Pettenkofer

- Several decades later, Robert Koch and Louis Pasteur developed the theory that diseases like cholera are caused by microorganisms, Koch identifying the bacterium responsible for cholera.
- Max Pettenkofer was unconvinced and to prove Koch wrong, he drank a soup containing the alleged cholera germs.
- He suffered few ill effects, claiming that he disproved Koch's theory—but he was just lucky!

$\Rightarrow$ empirical tests alone are no guarantee of success

Three approaches to understanding how science works

(2) Mathematics and science

Godfrey-Smith (2021,14)

> *Mathematics and Science: What makes science different from other kinds of investigation, and especially successful, is its attempt to understand the natural world using mathematical concepts and tools.*

- No doubt mathematics provides extremely powerful tools for scientific investigations, but not all successful science (think e.g. Darwin) is mathematical, and mathematics can be used for non-scientific purposes.

Three approaches to understanding how science works

(3) Social structure and science

Godfrey-Smith (2021,14)

> *Social Structure and Science: What makes science different from other kinds of investigation, and especially successful, is its unique social structure.*

- We will address this approach particularly in the module on Kuhn, but we will not go as deep as Godfrey-Smith.

On the importance of philosophy of science

Einstein to Robert A. Thornton, 7 December 1944, EA 61-574

I fully agree with you about the significance and educational value of methodology as well as history and philosophy of science. So many people today—and even professional scientists—seem to me like somebody who has seen thousands of trees but has never seen a forest. A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is—in my opinion—the mark of distinction between a mere artisan or specialist and a real seeker after truth.

Some terminology: statements

Définition (Statement)

A statement is the result of the act of speaking or writing a declarative sentence (in a natural language) on a given occasion.

Examples

(1) Socrates is wise.

(2) Snow is white.

(3) It rains or it does not rain.

(4) The professor said on Thursday he would take a pop quiz.

Some terminology: propositions

Définition (Proposition)

A proposition is the thought or content of a meaningful statement (which is thus common to the statement and its translations). Propositions are carriers of truth values and are therefore either 'true' or 'false'. Typically, if a proposition is true, it expresses facts about the world. So facts are the things that make propositions true or false.

Some reasons to think that propositions are distinct from statements:

1. The statements 'Snow is white', 'La neige est blanche', 'Der Schnee ist weiss' all express the same proposition, viz., that the snow is white.
2. Some statements are ambiguous and express more than one proposition (e.g. «I vitelli dei romani sono belli», «Les jumelles grossissent»).
3. Grammatically well-formed statements such as 'Green ideas sleep furiously' express no proposition.

Analytic vs synthetic

- introduced by Immanuel Kant (1724-1804)
- Kant: a 'judgment' is composed of a subject and a predicate.
- An analytic proposition is true or false by virtue of the meaning of its parts (the concept of the predicate is 'contained' in the concept of the subject), independently of the state of the world ('All bachelors are unmarried').
- The truth of a synthetic proposition depends on the state of the world ('All bachelors are bald').
- *a priori* vs. *a posteriori*: 'before' or 'after' experience

A priori vs a posteriori

- Kant: mathematical and metaphysical propositions may be *a priori* and synthetic.
- Logical positivism: logic and mathematics are *a priori* and analytic, empirical science is *a posteriori* and synthetic.

		analytic	synthetic
Kant:	*a priori*	✓	✓
	a posteriori	×	✓

		analytic	synthetic
Logical positivism:	*a priori*	✓	×
	a posteriori	×	✓

Got it right? A priori or a posteriori?

- Molecular biology?
- A posteriori.
- Formal logic?
- A priori.
- Arithmetic?
- A priori.
- Geometry?
- A priori, but... it's an empirical fact which geometry best describes our world.
- String theory?
- A posteriori, but particular status of 'mathematical physics'.
- Astrology?
- Trap! It's not a science—but it's presumably a posteriori.

Descriptive vs normative

- distinction at the level of theories (of science)
- A descriptive theory attempts to describes what is the case regarding its domain of application. It states the relevant (general) facts, without making value judgments.
- A normative theory does make such value judgments. It states norms or rules for behaviour, a departure from which makes the offender liable to some kind of censure.