Modern epistemology

Nothing in science makes sense except in the light of statistics

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And what I see, do and write

echoes only faintly the world

I have learnt from my family and my home village.

Asko Mäki-Tanila, 1982

Summary

Two lines of argument

Induction-deduction history

Hypothetico-deduction

The true nature of things

Probabilistic

Induction-deduction history

What is this thing called knowledge?

Epistemology or theory of knowledge is the branch of philosophy that studies the nature, methods, limitations, and validity of knowledge and belief.

The term "epistemology" is based on the Greek words "episteme" (knowledge or science) and "logos" (reason).

How do we acquire new knowledge?

Plato's Allegory of the Cave: Republic 29 (514a-521b)

[**Socrates**] And now, I said, let me show in a figure how far our nature is enlightened or unenlightened: --Behold! Human beings living in a underground cave, which has a mouth open towards the light and reaching all along the cave; here they have been from their childhood, and have their legs and necks chained so that they cannot move, and can only see before them, being prevented by the chains from turning round their heads. Above and behind them a fire is blazing at a distance, and between the fire and the prisoners there is a raised way; and you will see, if you look, a low wall built along the way, like the screen which marionette players have in front of them, over which they show the puppets.

[**Glaucon**] I see.

Plato's Allegory of the Cave: Republic 29 (514a-521b)

[**Socrates**] And do you see, I said, men passing along the wall carrying all sorts of vessels, and statues and figures of animals made of wood and stone and various materials, which appear over the wall? Some of them are talking, others silent.

[**Glaucon**] You have shown me a strange image, and they are strange prisoners.

[**Socrates**] Like ourselves, I replied; and they see only their own shadows, or the shadows of one another, which the fire throws on the opposite wall of the cave?

[**Glaucon**] True, he said; how could they see anything but the shadows if they were never allowed to move their heads?

Plato's Allegory of the Cave: Republic 29 (514a-521b)

[**Socrates**] And of the objects which are being carried in like manner they would only see the shadows?

[**Glaucon**] Yes, he said.

[**Socrates**] And if they were able to converse with one another, would they not suppose that they were naming what was actually before them?

[**Glaucon**] Very true.

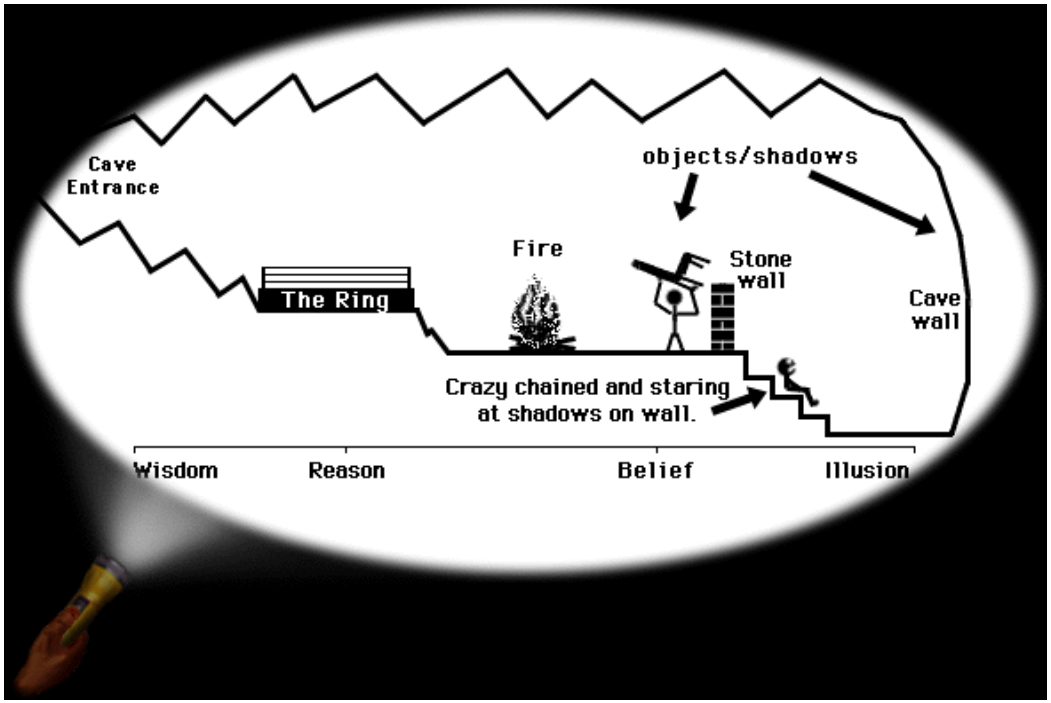
Plato's Allegory of the Cave: Republic 29 (514a-521b)

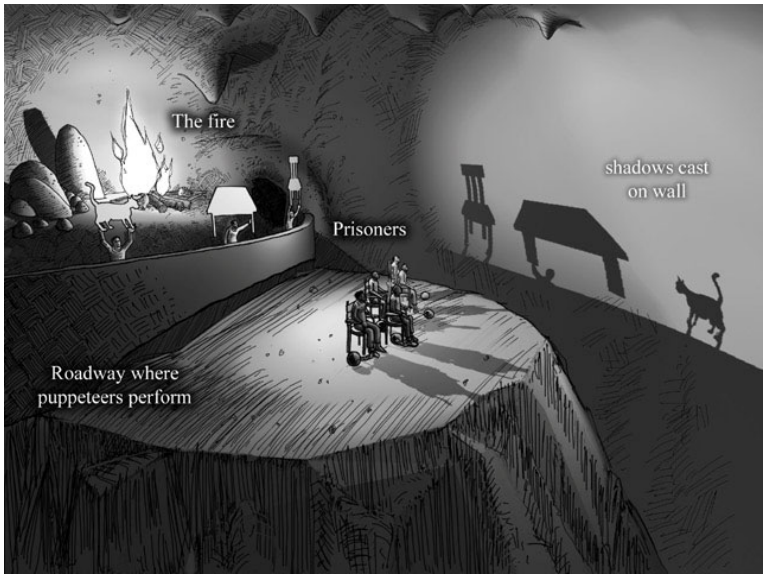
[**Socrates**] And suppose further that the prison had an echo which came from the other side, would they not be sure to fancy when one of the passers-by spoke that the voice which they heard came from the passing shadow?

[**Glaucon**] No question, he replied.

[**Socrates**] To them, I said, the truth would be literally nothing but the shadows of the images.

[**Glaucon**] That is certain.





Induction-deduction history

Two interpretation of the allegory of the cave:

Every phenomena has a true type (archetype=idea).

The archetype can manifest itself in many forms.

Every phenomena has an essence.

Essence will be known by examining many observations.

Induction

Induction or inductive reasoning, sometimes called inductive logic, is the process of reasoning in which the premises of an argument are believed to support the conclusion

All observed swans are white.

Therefore, all swans are white.

Deduction

Deductive reasoning is the kind of reasoning where the conclusion is necessitated by previously known premises. If the premises are true then the conclusion must be true.

Deductive reasoning is the following:

- All men are mortal (major premise),
- Socrates is a man (minor premise),
- Therefore Socrates is mortal.

Aristotelian deductive system (1)

1) There is a finite number of basic propositions which are postulated without proofs.
2) A proposition that is not basic may be asserted if and only if it has been derived from the basic propositions by logical inference.
3) The inferences always proceed by means of syllogisms. An example of a syllogism:

   All b are c.

   All a are b.

   Hence: All a are c.

Aristotelian deductive system (2)

4) The basic propositions are true and necessary.
5) The basic proposition have an absolute certainty or self-evidence.
6) The basic propositions of a demonstrative science are indemonstrable, i.e. no further reasons for them can be adduced.
7) The basic propositions of a demonstrative science are objects of knowledge, and further propositions become known as they are inferred from the basic ones.

Summary of the Aristotelian deduction

The most important epistemological requirements of a deductive science:

The basic propositions are:

- True;
- Self-evident;
- Cognitively prior to the theorems inferred; and
- Unprovable.

Transformation of Aristotelian deduction

Change "**basic propositions**" in the above statements with any of the following:

God
Bible
Pope
Church

Aristotle & Christianity

Saint Augustine of Hippo

Saint Thomas of Aquino

Saint Anselm of Canterbury

Down with the (Catholic) church

Martin Luther	1483-1546
Copernicus	1473-1543
Bacon	1561-1626
Galileo	1564-1642
Kepler	1571-1630
Descartes	1596-1650
Pascal	1623-1662

Down with Aristotle, down with deduction

Origins of modern science

Francis Bacon (1561-1626)
1st Baron Verulam and Viscount Saint Albans

1584	House of Commons
1603	Knighthood
1613	Attorney General
1616	Lord Chancellor

No more induction

Hume 1739-1740 (A Treatise of Human Nature)

All observed swans are white.
Therefore,
All swans are white.

Cook 1770 European discovery of AUS & black swan

?

The true nature of things

Causality

Causality or causation denotes the relationship between
one event (called cause) and
another event (called effect)
which is the consequence (result) of the first.

Causality

Causality postulates that there are laws by which the occurrence of an entity B of a certain class depends on the occurrence of an entity A of another class, where the word entity means any physical object, phenomenon, situation, or event. A is called the cause, B the effect.

Antecedence postulates that the cause must be prior to, or at least simultaneous with, the effect.

Contiguity postulates that cause and effect must be in spatial contact or connected by a chain of intermediate things in contact.

Aristotelian causality

The material cause	Proximate cause
The formal cause	
The efficient cause	
The final cause	Ultimate cause

Determinism

Determinism is the philosophical proposition that every event, including human cognition and behavior, decision and action, is causally determined by an unbroken chain of prior occurrences.

Determinism may also be defined as the thesis that there is at any instant exactly one physically possible future.

Philosophical determinism (1)

The universe
is nothing but a vast ocean of particles in motion ...

... no more than
a chain of events following one after another
according to the law of cause and effect.

Philosophical determinism (2)

Imagine an entity
that knows all facts about the past and the present, and
knows all natural laws that govern the universe.

Such an entity might, under certain circumstances,
be able to use this knowledge
to foresee the future, down to the smallest detail

Newtonian determinism

The "billiard ball" hypothesis argues that once the initial conditions of the universe have been established the rest of the history of the universe follows inevitably. In this sense, the basic particles of the universe operate in the same fashion as the rolling balls on a billiard table, moving and striking each other in predictable ways to produce predictable results.

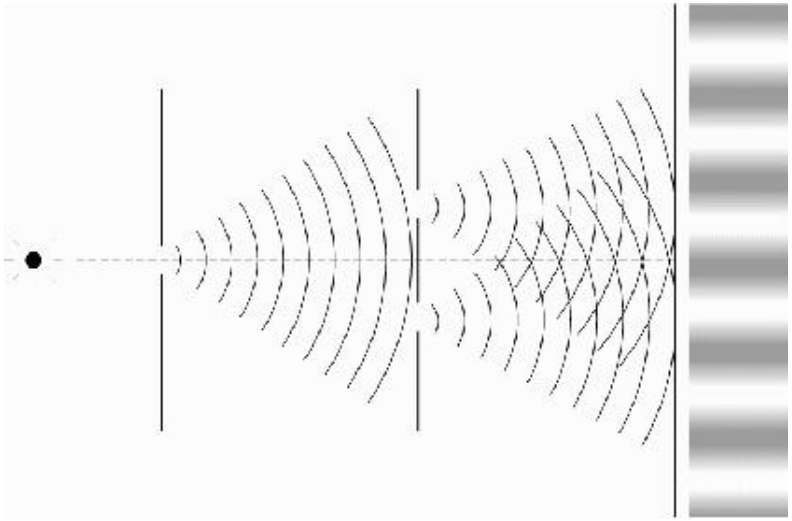
You can't handle the truth.

Col. Nathan R. Jessep

Nature of the things

Max Planck	(1858-1947)
Albert Einstein	(1879-1955)
Werner Heisenberg	(1901-1976)

Wave-particle duality of light

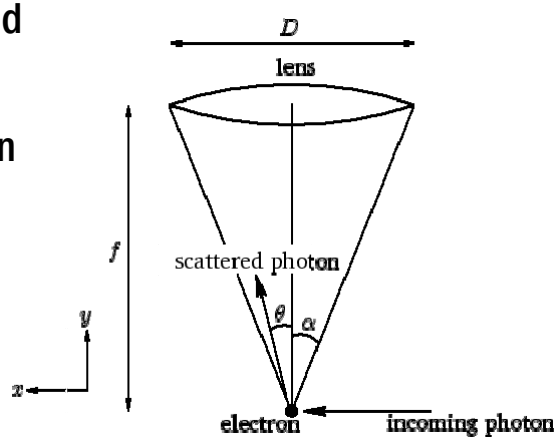


Relativity

Do I need to spell it out?

Uncertainty principle & Observer's effect

Measurements of position and momentum taken in several identical copies of a system in a given state will each vary according to a probability distribution characteristic of the system's state.



The philosophical milieu

Karl. R. Popper (1902-1994)

Thomas Kuhn (1922-1996)

Hypothetico-deductive method

An investigator makes use of the HDM if he/she

1) Formulates and studies deductive systems of greater or smaller scope;
2) Embraces a particular system only as long as the consequences deduced from it are found to hold good under empirical testing;
3) As long as he/she does embrace a system. He/she does not ascribe certainty to it, but merely a probability which depends essentially on the number and kind of consequences that have been found to hold good under empirical testing.

Hypothetico-deductive method

The aim of science is not

TRUTH

but

PROBABILITY

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