

## Science and the Problem of Demarcation

The term ‘science’ [1] refers to any system of objective knowledge, in particular knowledge based on the scientific method [2], as well as an organized body of knowledge gained through research [3].

There are essentially three categories of sciences, namely:

- formal sciences (mathematics),
- natural sciences (physics, chemistry, biology)
- social sciences

In natural sciences one has to distinguish between

- a theory:  
a logically self-consistent framework for describing the behavior of certain natural phenomena based on fundamental principles;
- a model:  
a similar but weaker concept than a theory, describing only certain aspects of natural phenomena typically based on some simplified working hypothesis;
- a law of nature [4]:  
a scientific generalization based on a sufficiently large number of empirical observations that it is taken as fully verified;
- a hypothesis:  
a contention that has been neither proved nor yet ruled out by experiment or falsified by contradiction to established laws of nature.

A consensus, exactly speaking a consensus about a hypothesis, is a notion which lies outside natural science, since it is completely irrelevant for objective truth of a physical law: ‘scientific consensus’ is scientific nonsense.

The problem of demarcation [5] is how and where to draw lines around science, i.e., to distinguish science from religion, from pseudoscience, i.e., fraudulent systems that are dressed up as science, and non-science in general.

In the philosophy of science several approaches to the definition of science are discussed [1]:

- empirism (Vienna Circle [6]), also logical positivism or verificationism:  
only statements of empirical observations are meaningful, i.e. if a theory is verifiable, then it will be scientific;
- falsificationism (Popper [7]):  
if a theory is falsifiable, then it will be scientific;
- paradigm shift (Kuhn [8]):  
within the process of normal science anomalies are created which lead eventually to a crisis finally creating a new paradigm; the acceptance of a new

paradigm by the scientific community indicates a new demarcation between science and pseudoscience;

- democratic and anarchist approach to science (Feyerabend [9]): science is not an autonomous form of reasoning, it is inseparable from the larger body of human thought and inquiry: “Anything goes”.

It is highly questionable whether this last point fits into the frame of physics. Svozil [10] remarked that Feyerabend’s understanding of physics was superficial. Svozil emphasizes:

*“Quite generally, partly due to the complexity of the formalism and the new challenges of their findings, which left philosophy proper at a loss, physicists have attempted to develop their own meaning of their subject.”*

Physics provides a fundament for engineering and, hence, for production and modern economics. Thus the citizen is left with the alternative (in the sense of a choice between two options):

- a) either to accept the derivation of political and economical decisions from an anarchic standpoint, which eventually claims that there is a connection to experiment and observation, and, hence, the real world, when there is no such connection;
- b) or to call in the derivation of political and economical decisions from verifiable research results within the frame of physics, where there is a connection to experiment and observation, and hence, the real world.

Evidently, the option b) defines a pragmatic approach to science, defining a minimum of common features, such that engineers, managers and policymakers have something to rely on. Within the frame of exact sciences a theory should:

- 1) be logically consistent;
- 2) be consistent with observations;
- 3) have a grounding in empirical evidence;
- 4) be economical in the number of assumptions;
- 5) explain the phenomena;
- 6) be able to make predictions;
- 7) be falsifiable and testable;
- 8) be reproducible, at least for the colleagues;
- 9) be correctable;
- 10) be refinable;
- 11) be tentative;
- 12) be understandable by other scientists.

**References:**

- [1] Anonymous: *Science*, Wikipedia,  
<<http://en.wikipedia.org/wiki/Science>>
- [2] Anonymous: *Scientific Method*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Scientific\\_method](http://en.wikipedia.org/wiki/Scientific_method)>
- [3] Anonymous: *Research*, Wikipedia,  
<<http://en.wikipedia.org/wiki/Research>>
- [4] Anonymous: *Physical law*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Physical\\_law](http://en.wikipedia.org/wiki/Physical_law)>
- [5] Anonymous: *Demarkation Problem*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Demarcation\\_problem](http://en.wikipedia.org/wiki/Demarcation_problem)>
- [6] Anonymous: *Vienna Circle*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Vienna\\_Circle](http://en.wikipedia.org/wiki/Vienna_Circle)>
- [7] Anonymous: *Karl Popper*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Karl\\_Popper](http://en.wikipedia.org/wiki/Karl_Popper)>
- [8] Anonymous: *Thomas Kuhn*, Wikipedia,  
<[http://en.wikipedia.org/wiki/Thomas\\_Kuhn](http://en.wikipedia.org/wiki/Thomas_Kuhn)>
- [9] Feyerabend, P. K.: *Killing time*, The University of Chicago Press, Chicago and London, 1995  
see also: <[http://en.wikipedia.org/wiki/Paul\\_K\\_Feyerabend](http://en.wikipedia.org/wiki/Paul_K_Feyerabend)>
- [10] Svozil, K.: *Feyerabend and physics*, arXiv, 2004,  
<<http://arxiv.org/abs/physics/0406079>>