10. Sociology of Science

1. Mertonian Sociology of Science (Robert Merton 1940's)

Robert Merton
(1910-2003)

- Function of science is to produce knowledge.
- Accomplishes this by enforcing institutional *norms*.
  - *Norms* = Rules that a group uses to govern appropriate and inappropriate values, beliefs, attitudes and behaviors.

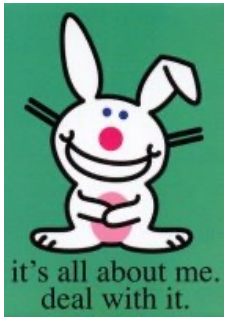
Key Concepts

(a) Scientific Norms

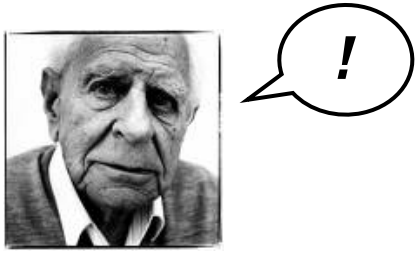
- *Universalism*: The criteria used to evaluate a scientific claim should not depend on the identity of the person making the claim. (Impersonality of laws of nature.)

- *Communalism*: Scientific knowledge should be communally owned.

- *Disinterestedness*: Scientists should disengage their interests from their actions and judgments.

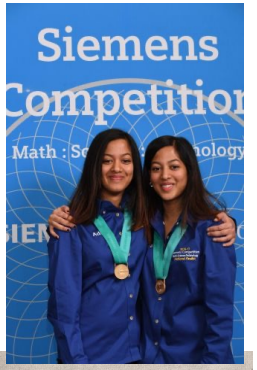


- *Organized Skepticism*: Scientific ideas should be subject to community-wide tests and challenges.



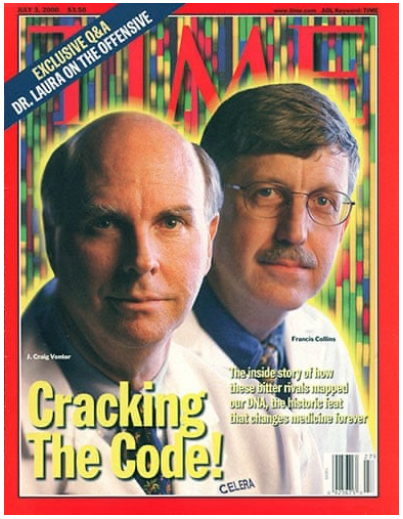
(b) Reward System

- Reward in science = *recognition*.
  - *Encourages original thinking and innovation.*



- One consequence: Priority disputes
  - *Newton vs. Leibniz over the calculus (1600's).*
  - *Joule vs. Mayer over mechanical equivalent of heat (1860's).*
  - *Celera Genomics vs. Human Genome Project (2001).*

NATIONAL ACADEMY
OF SCIENCES



(c) Deviant Behavior

- Fraud

  - Jan Hendrik Schön's organic molecular transistor.

    - Schön, Meng, Bao (2001) "Self assembled monlayer organic field-effect transistors", *Nature* **413**, 713.
    - Schön, Meng, Bao (2001) "Field-Effect Modulation of the Conductance of Single Molecules", *Science* **294**, 2138.
    - Schön, Kloc, Batlogg (2001) "Universal Crossover from Band to Hopping Conduction in Molecular Organic Semiconductors", *Phys. Rev. Lett*. **86**, 3843.

  - Irregularities found in noise data.

  - 2002: Schön fired from Bell Labs. Articles retracted from journals.

- The "Matthew Effect"

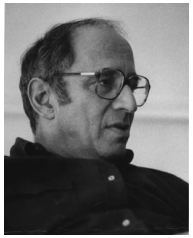
  - All things being equal, scientists with more initial recognition tend to receive more additional recognition than scientists with less initial recognition.

> *"For whosoever hath, to him shall be given, and he shall have more abundance: but whoseover hath not, from him shall be taken away even that he hath."*

Criticism

(i) *Are Merton's norms descriptive of actual scientific practice?*

- How prevalent is "deviant behavior"?
  - Is it an accidental or essential characteristic of scientific practice?
- How prevalent is organized skepticism?



Normal science is characterized by a balance between open-mindedness and dogmatism!

Harumph!

(ii) *Are Mertonian norms prescriptive of scientific practice?*

- Communalism, disinterestedness, and *entrepreneurial science*.
- Which venue best supports scientific research: industry or academia?

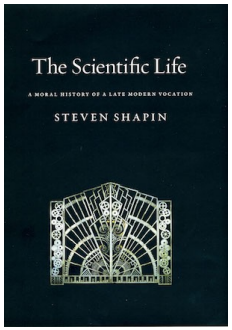
Industry:

Advantages:

- More resources.
- Chance to see ideas embodied in products.
- Compensation.
- Less individual competition.

Disadvantages:

- Less control over projects.
- Less individual freedom.
- More institutional competition.
- Less job security.



Shapin, S. (2008)
The Scientific Life

Academia:

Advantages:

- More control over projects.
- More individual freedom.
- Less institutional competition.
- More job security.

Disadvantages:

- Less resources.
- Less time for research (teaching, grant writing).
- Compensation.
- More individual competition.

2. The Strong Programme (1970's Univ. Edinburgh)


David Bloor


Barry Barnes


Donald MacKenzie

Concern: How does scientific knowledge arise in a social context?

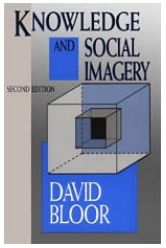
Four Tenets (Bloor 1976)

(i) *Causality*: Concerned with the causal conditions which bring about belief or states of knowledge.

(ii) *Impartiality* with respect to truth and falsity, rationality or irrationality, success or failure.

(iii) *Symmetry in Explanation*: All forms of belief and behavior should be approached using the same kinds of explanation.

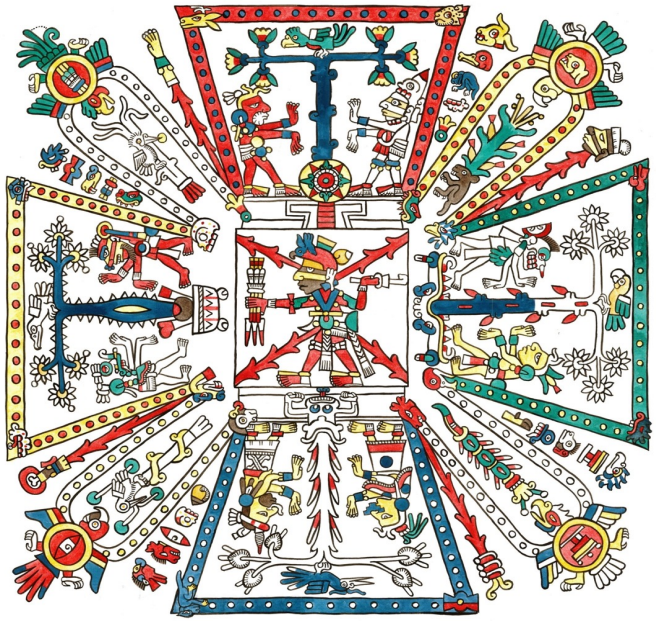
(iv) *Reflexivity*: Should be applicable to sociology itself.



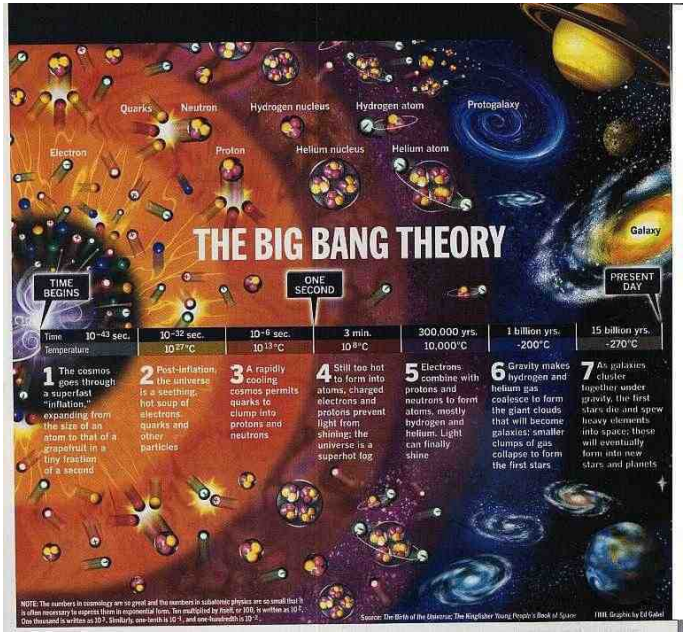
Bloor, D. (1976) *Knowledge and Social Imagery*

- *Idea*: Scientific beliefs are established and maintained by local social norms just like other types of beliefs.
- *In particular*: Scientific beliefs are on equal status with other types of beliefs.
  - *No reference to the "real world" should privilege scientific beliefs over others.*

Strong Claim: There is no single set of standards entitled to govern the justification of beliefs (*relativism of standards of justification*).



Aztec belief system



21st cent. scientific belief system

- Justification of a belief system is internal to that system, not external.

Social Constructivist Thesis

Science is a social phenomenon in two respects:

(1) The *manner* in which it produces results.

(2) The *results* themselves: *scientific facts are "socially constructed"*.

What does "socially constructed" mean?

Seven Possible Meanings

1. Social reality is socially constructed.

To construct X in the social world requires

- Knowledge of *X* encourages behaviors that increase or reduce other people's tendency to act as though *X* does or does not exist.
- There is reasonably common knowledge of *X*
- There is transmission of knowledge of *X*.

Exs: gender, baseball, *etc*.

2. Things and phenomena are socially constructed.

Ex: The artifacts of laboratories and experiments are non-natural constructs of social structures and organizations.

3. Material and social environments are scientifically and technologically constructed.

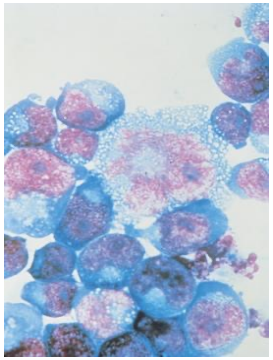
Ex: The development of gas-powered cars constructed suburbs and suburban culture and society.

4. Scientific theories are socially constructed.

Ex: The theoretical claims made by theories are typically underdetermined by evidence.

5. The simultaneous shaping of the material and social world (*heterogeneous construction*).

Ex: The development of the Pap smear test for uterine and cervical cancer (Casper & Clarke 1998).



6. Natural kinds are socially constructed (*nominalism*).

Ex: water, human, tiger, triangle, *etc*.

7. Nature is socially constructed.

How might we make sense of this?

Social Constructivist Thesis

Science is a social phenomenon in two respects:

(1) The *manner* in which it produces results.

(2) The *results* themselves: *scientific facts are "socially constructed"*.

- *Problem*: Risk of running Claims (1) & (2) together.

  - *This conflates a methodological claim with an ontological claim.*

(a) *Methodological claim*: The *methods* used by science are socially influenced (peer review, grant process, institutional politics, *etc.*)

(b) *Ontological claim*: The *products* of science (*i.e.*, facts) are social constructs.

- Claim (a) is not controversial.
- *But*: Evidence for Claim (a) is not evidence for Claim (b).

  - *To substantiate Claim* (b) *requires arguments based on ontological premises.*

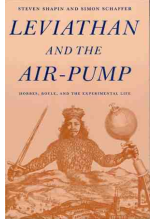
Option #1: (Empiricism) "Socially constructed" means "Explainable solely in terms of social parameters".

- Requires a theory of social causation.
  - *A causal account of how knowledge arises in which only social parameters occur.*
- *One possibililty*: Show that scientific facts supervene on social facts.
  - *For every scientific fact, there are social facts that are necessary and sufficient conditions for it.*

Option #2: (Neo-Kantian) "Socially constructed" means "Constructed in a Kantian sense".

- *Recall*: Kant maintained that the world of experience (the phenomenal world) is constructed by us.
- *And*: Kant maintained that the manner in which we construct the phenomenal world is fixed (everyone has the same built-in "filters").
- *Suppose*: The filters are not built-in, but determined by social factors.

Ex: *Leviathan and the Air Pump* (Shapin & Schaffer 1985)

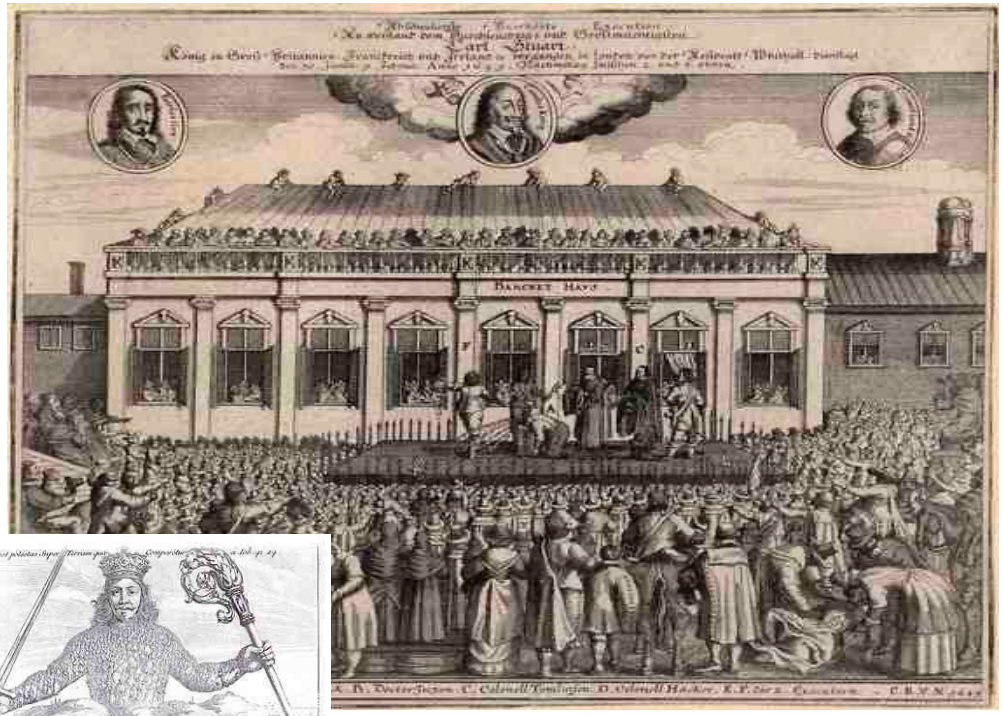



Steven Shapin

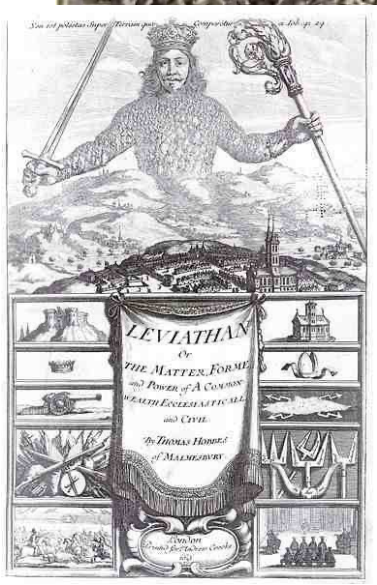

Simon Schaffer

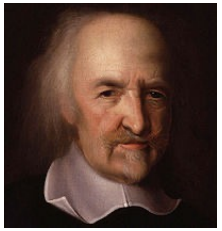
Claim: Scientific facts are not absolute but rather depend on cultural and political *contingencies*.

- 17th century Britain:
  - Civil war!
  - King Charles beheaded!
  - Chaos and Cromwell!



- Hobbes (1651) *Leviathan*.
  - Life in the state of nature is "solitary, poore, nasty, brutish, and short".
  - An absolute monarch is necessary to bind humans together in a society.

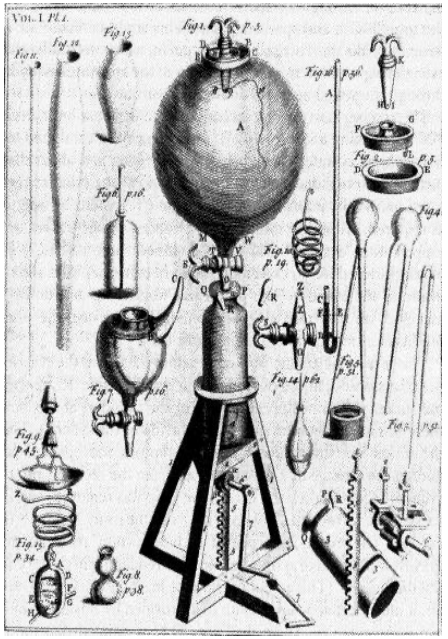


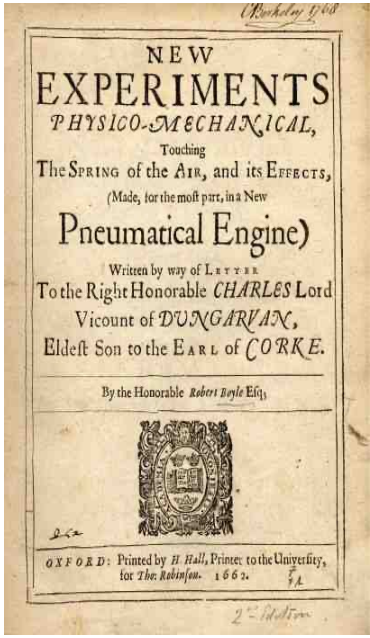

Thomas Hobbes
(1588-1679)

- Robert Boyle
  - Founding member of the Royal Society (1660).
  - To maintain social order, make a division between:
    - *Public sphere*: The *experimental investigations* of matters of fact, which should be public and cooperative.
    - *Private sphere*: The construction of *theoretical explanations* of matters of fact, which can be done in private.

Robert Boyle
(1627-1691)

- <u>*Example*</u>: Boyle's experiments on the vacuum.
  - Hobbes (Aristotlian physics): a vacuum is a metaphysical impossibility.
  - Boyle's response: The question is not "Can an absolutely pure vacuum exist?", but rather "Can we approximate a vacuum in a given piece of experimental equipment?"





- Boyle rephrases questions to separate *public* experimental investigations from *private* metaphysics and theology.

Wittgensteinian concepts

- *Form of life*: Basic set of practices, behaviors, principles (no external justification).
- *Language game*: Pattern of linguistic habits associated with a form of life.
- *Use theory of meaning*:
  - Language does not represent; rather, it is used by communities to communicate.
  - Terms do not gain meaning by what they represent; rather, they gain meaning by how they are used.

- Boyle set up a new language game for the form of life of experimental science.

"The form of life in which we make our scientific knowledge will stand or fall with the way we order our affairs in the state."

"... it is ourselves and not reality that is responsible for what we know. Knowledge, as much as the state, is the product of human actions."