Scientific Revolutions

Preliminary Remarks

- Last week: Inference to the Best Explanation
- IBE can help solve questions of theory choice.
- Next two weeks: Actual theory choice in the history of science.

Philosophy of Science in the 20th Century

- Prior to 20's: History and Philosophy of Science went hand in hand. [Duhem and Poincaré].
- 20's to 50's: Logical positivists, the dominant force, largely ignored historical considerations.

  Tacit assumption: Science is guided by an identifiable set of rules, i.e. the scientific method, that lead to the accumulation of knowledge and progress towards truth.
- 60's and 70's: Kuhn and Feyerabend resuscitate historicism in the philosophy of science, using it to independently argue against the above assumption.

Scientific Revolutions (1)

- Paradigm: A paradigm consists of one or more theories, auxiliary hypotheses, heuristic models, ontological assumptions, methodological principles, techniques, standards, instruments, training methods, etc.
- The history of mature science can be understood as periods of stable growth punctuated by revisionary revolutions.

  Normal science: science as practiced most of the time, i.e. when one paradigm rules with a broad consensus.

  Revolutionary Science: A period of conceptual upheaval sparked off by an increase in anomalies that the current paradigm cannot solve. Paradigms clash but are incommensurable. The old paradigm is eventually overthrown.

Scientific Revolutions (2)

- Two versions of incommensurability:
  1) Standards of comparison and evaluation are paradigm-relative, so no common standards upon which to judge competing theories or paradigms.
  2) Meaning and referent variance between old and new concepts implies incomparability between their respective theories or paradigms.
- Incommensurability often tied to theory-ladenness:

  Both *can* be used to argue that there is no common, i.e. independent, ground upon which to judge rival theories or paradigms.

Scientific Revolutions (3)

- Scientific revolutions bring about paradigm shifts *just like* political revolutions bring about regime change.

- Science NOT dictated by: An identifiable set of rules, i.e. the scientific method, that leads to the accumulation of scientific knowledge and progress towards truth.

- Relativism: Standards of 'rationality' relative to a paradigm. We cannot say we are better off *now*.

Scientific Revolutions: Examples

(1) Copernican

- FROM geocentric TO heliocentric system.

(2) Newtonian

- FROM terrestrial and celestial phenomena governed by different laws TO one unified set of laws.

(3) Darwinian

- FROM habit and behaviour being inheritable TO genes, natural selection and mutation.

(4) Quantum

- FROM particles possessing any energy *and* changing energy in a continuous way TO possessing discrete energies *and* changing in a discontinuous way.

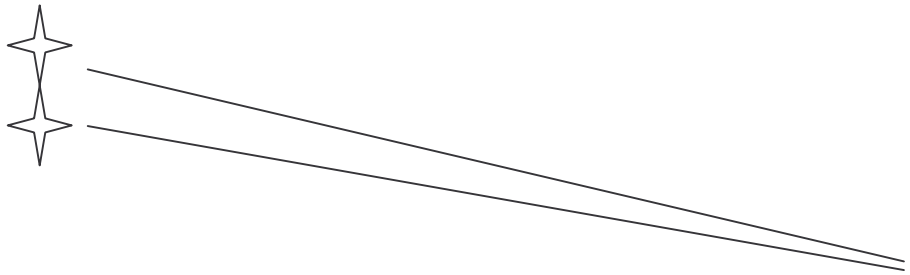
Commensurability (1)

- If incommensurability is as debilitating as Kuhn and Feyerabend argue, does this mean that science is merely a struggle between different groups of people and their ideals?

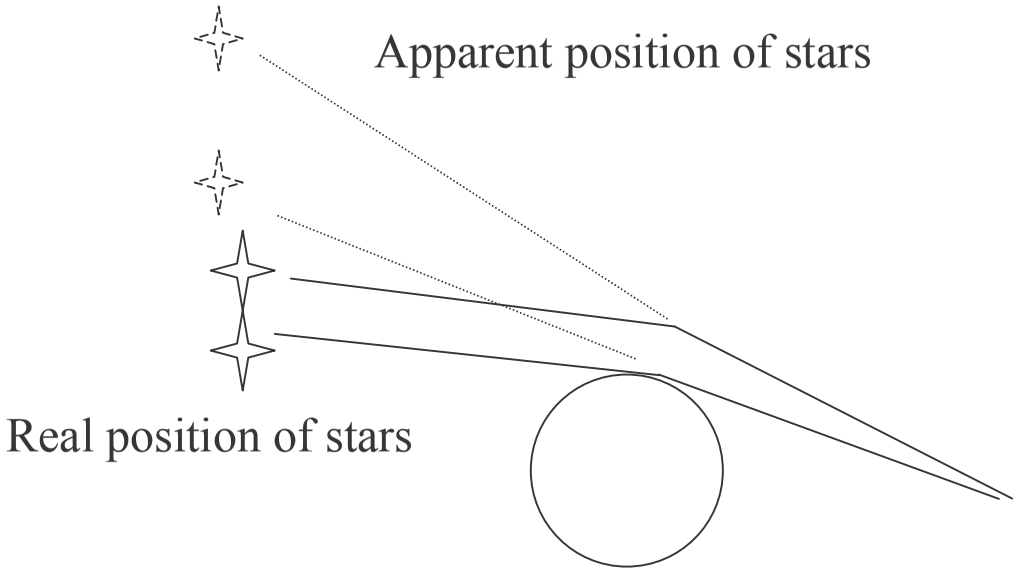
- Surely evidence in the form of observation sentences must be able to act as common ground upon which to judge competing paradigms or theories.

Example

- Einstein's GTR tested by Eddington's expedition.



Stars at night



Stars during day (eclipse)

Commensurability (2)

- Kuhn and Feyerabend assume that their opponents are descriptivist theorists.

  Descriptivist account of reference:

  A theoretical term *t* refers to an entity *a* if and only if *a* satisfies the theoretical (i.e. descriptive) claims made by the scientific theory employing *t*.

- Many philosophers opt for other accounts; one popular account is the causal-descriptivist.
- Others accept reference failure but deny that meaning need be completely divergent.

Commensurability (3)

- *Partial Holism*: Kuhn unreasonably assumes that the meaning of a concept depends on the whole theory.
- Latter Kuhn: Some common ground upon which to judge paradigms, namely five values: (a) accuracy, (b) consistency (internal and external), (c) broad scope, (d) simplicity, and (e) fruitfulness.
- Latter Feyerabend: In *Against Method* he advocates epistemological and methodological anarchism.

  Best Rule: 'Anything goes'

Food for Thought

- Suppose that some things survive scientific revolutions. What would this mean for the cumulativity of knowledge and progress towards truth?

Reading

- Bird, A. (1998) Philosophy of Science, ch.8, pp. 275-285.