Scientific Revolutions II

Preliminary Remarks

- Last week: Scientific Revolutions and, in particular, *incommensurability*.

- Question arises: What effect do scientific revolutions have on our account of scientific knowledge?

- This week: Scientific Realism and the *Pessimistic Meta-Induction*.

Scientific Realism Debate (1)

- Central question: What kind of knowledge, if any, science gives us?
- Answers fall under these two broad categories:
  - (Scientific) Realism
  - (Scientific) Anti-Realism
- Realism: Science aims (and succeeds) to produce true, or at least approximately true, statements about the observable and unobservable world.

Scientific Realism Debate (2)

- Additional claims (not espoused by all realists):

  (1) Mature scientific theories approx. true.

  (2) More recent theories closer to truth.

  (3) Terms in mature theories genuinely refer.

  (4) New theories retain certain parts of old.

  (5) New theories explain any success of old.

- Main Support: No Miracles Argument

  Scientific realism is the only view that does not make the success of science a miracle.

Scientific Realism Debate (3)

- Anti-Realism: We cannot know whether any of the statements made by scientific theories are true or approximately true.
- Anti-realists typically deny one or more of the aforementioned realist claims.
- Main Support:
  - Underdetermination Argument
  - Pessimistic Meta-Induction Argument

Underdetermination: Any given body of evidence is insufficient to uniquely determine the truth of a theory.

Pessimistic Meta-Induction (1)

- Laudan (1977) and Putnam (1978) independently provide a more sophisticated argument against the cumulativity of scientific knowledge.

  In a nutshell: The evidence from the history of science (inductively) counts against NMA inferences.

  Explanatory and *predictive success*

  ∴ *Approximate truth* and *successful reference*

  NB: The inference is obviously invalid. The real issue is whether it is reliable.

Pessimistic Meta-Induction (2)

- Some examples (from Laudan's list) of 'successful' theories that were later abandoned:

  - The humoral theory of medicine
  - The effluvial theory of static electricity
  - The phlogiston theory of combustion
  - The caloric theory of heat
  - The vital forces theories of physiology
  - The electromagnetic ether theory

- Understood *inductively*, it is argued that there is good reason to believe that current or even future theories will succumb to the same fate.

Realist Reaction

- Main Reaction: The historical record can be reconciled with scientific realism.
- Strategy: Essential vs. Idle Theoretical components

  Only some theoretical components are abandoned. These, however, are *inessential* for the explanatory and predictive success enjoyed by their theories. Thus, their abandonment is inconsequential for the realist.
- Main Advocates: John Worrall, Philip Kitcher, and Stathis Psillos.

Essential vs. Idle Components

- Different manifestations of the distinction:
  - Kitcher: working vs. presuppositional posits
  - Psillos: essential vs. inessential components
  - Worrall: structure vs. nature
- Central question: How do we tell the essential from the idle components in advance of a scientific revolution?
- We will now look at one answer to this question, viz. the structural realist answer.

Structural Realism (1)

- Structural Realism: Our epistemic access to the external (physical) world is restricted to its structural features.
- *Structure* is understood, roughly speaking, as the mathematical postulates of the theory as opposed to the ontological postulates.
- Historical claim: Despite scientific revolutions, there is preservation of structure.
- Examples: Fresnel's equations and 'Caloric' equations
- Main Advocates: Russell, Poincaré, Worrall.

Structural Realism (2)

- Problem: These two cases are atypical. More often equations of an older theory reappear only as limiting cases of equations in a newer theory.
- Reply: The correspondence principle: "any acceptable new theory *L* should account for its predecessor *S* by 'degenerating' into that theory under those conditions under which *S* has been well confirmed by tests" (Heinz Post).
- *The Structural Continuity Challenge*: Sufficient historical evidence must be amassed to establish structural continuity. It must be shown that the correspondence is not trivially satisfiable.

Food for Thought

- Suppose that some theoretical components do survive scientific revolutions. Does this mean that they have latched on to the world?

- Suppose that some theoretical components have latched on to the world. Does this mean that they will survive scientific revolutions?

Reading

- Laudan, L. (1981) ‘A Confutation of Convergent Realism’, in Curd and Cover, pp. 1114-1135

- Psillos, S. (1999) Scientific Realism: How Science Tracks Truth, ch.5, London: Routledge.