Philosophy of Science

Lecture 8: Kuhn and Normal Science

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Today's Agenda

- Goal: To understand a major turn in the philosophy of science – the historical turn – spearheaded by Thomas Kuhn in his book "The Structure of Scientific Revolutions".
  - Today we're going to focus on Kuhn's conception of "Normal Science."
  - Next time, we'll focus on "Revolutionary Science."

- Breakdown
  1. From Theory to Paradigm
  2. Normal Science
  3. The Conditions for Revolution

1. From Theory to Paradigm

Philosophy of Science Before Kuhn

- Since Aristotle, philosophers have been trying to account for the role of logic in Science.
  - Aristotle and Popper thought that deduction was all that science needed.
  - The logical empiricists (and many other philosophers, including Hume ironically enough) thought that both deduction and induction were needed for science.
- Logic is an abstract enterprise.
- Many *scientist-philosophers* were concerned with both the abstract logical questions as well as actual scientific practice and it's history.
- But *philosophers of science* typically focused especially hard on the logical questions, and only looked at small aspects of the actual practices of scientists in order to help inform their abstract logical inquiry.
  - The history of science was old hat, and largely irrelevant to the development of their logical reconstructions and analyses of science.

… Enter Thomas Kuhn

- This all changed when a group of logical empiricists published Thomas Kuhn's book, *the structure of scientific revolutions.*
- Kuhn's insights on scientific progress – theory development, selection and change -- significantly altered the way that philosophy of science is (and, many think, should be) done.
  - His work is said to have undermined the logical positivist/empiricist movement.
- Unlike anyone before him, Kuhn based his views on the nature of science, scientific progress, and theory change, on the *history of science*.
  - He more or less ignored the abstract logical issues that Popper, and the logical positivists/empiricists were so concerned with.

Theories and Paradigms

- Philosophers of Science were concerned with questions like:
  - What is a scientific theory and how is it different from a non-scientific theory?
  - What, if any, is the rational basis for theory change?
  - What is the basis for scientific progress?
- The most striking difference between he and Karl Popper is that, while Popper characterizes scientific progress in terms of “conjectures and refutations,” Kuhn characterizes it as a shift from “normal science” to “crisis science” to “revolutionary science” and back again.
- In general, the most striking difference between he and his predecessors is the shift from the idea that scientific “theories” are central to understanding the nature of science.
  - He replaces a concern for “scientific theories” with a concern for “scientific paradigms.”
  - The notion of a paradigm is central to his conception of “normal science” and scientific change.

2. Normal Science

What is a Paradigm?

- For Kuhn, a **paradigm** is MORE than a theory: it's a collection of…
  - agreements about fundamental assumptions about the world;
  - methods for acquiring and analyzing data;
  - indoctrinating students; and
  - instilling and exhibiting scientific habits…
- … that begin with a specific *achievement*.
  - The achievement serves as a model for inspiring and directing future research.
  - (e.g., Newtonian Mechanics; Einstein's inferences for special relativity; Skinner's behaviorism; Darwin's finches; Mendel's peas).

- PGS identifies two senses of 'paradigm' at work in Kuhn:
  - Broad sense: the collections found above.
    - A scientific *field* consists in those who adhere to (typically) a single paradigm at a given time.
  - Narrow sense: the achievement that kicks off the paradigm (in the broad sense)

Before the Paradigm begins…

- **Pre-Paradigm State:** The state of a “science” prior to the great achievement in which scientists are more or less flopping around aimlessly.

- After the great achievement, the methods are studied, assumptions are forged, and the paradigm begins.

- This kicks off the process known as “normal science.”

What is Normal Science?

- For Kuhn, the work that is done within (or adhering to) a paradigm is called "normal science."
  - It is very organized, and uses well-established methods
  - relies on fundamental assumptions which are *closed off* to skeptical questioning and testing.

- **Normal Science:** Is nothing more than a "puzzle solving" exercise.
  - *Puzzle Solving*: The activity of trying to get a new case/observation to fit nicely within the existing paradigm, using the well-established methods of the well-organized field, relying on the "closed off" fundamental assumptions of the paradigm.

- Unlike Popper, Kuhn thinks that it's a good thing for science that there are assumptions that are closed off for questioning.
  - Kuhn thinks that science needs these little dogmas in order to progress; otherwise, we're stuck trying to refute every idea we think up.

Scientific Progress within “Normal” Science

- Are Kuhn, Popper, and Logical Positivism/Empiricism completely incompatible?
  - Within normal science, scientists offer conjectures and test, and refute, them according to standard methods specified in the paradigm.
  - The “Neurath’s Boat” metaphor, if it applies at all within Kuhn, applies within “Normal science.”
    - Test one’s hypotheses that elaborate a paradigm; but don’t question what’s needed to “keep the boat/paradigm afloat”.
- The “Conject and refute” activity is simply part of the scientific game called “puzzle solving” that is characteristic of “normal science”.
  - Conjecture and refutation is used to see if a given solution to the puzzle actually works.

The End of Normal Science

- But major changes in science do not start with extremely creative ideas for Kuhn, as they do for Popper.
- Nor do they have anything to do with inter-theoretic reduction, as many logical empiricists claim.

- Rather, they start with an accumulation of stubborn problems… ***anomalies***.
  - *Puzzles:* are issues that seem to be solvable with a little bit of work.
  - *Problems:* are issues that are resistant to solution, and might seem to have no solution at all!

3. The Conditions for Revolution

The Resilience of Good Paradigms

- When such problems crop up, it's natural for the scientist to blame herself rather than question the fundamental assumptions of the paradigm.

- In this respect, anomalies ARE NOT considered refutations.
  - If they were, then nothing would ever get done since there are plenty of resilient puzzles that seem like problems until the moment that a breakthrough is discovered.

- In fact, Kuhn thinks this resilience is part of what makes science so successful.
  - A healthy science needs to strike a balance between being too resilient and being too quick to give up a paradigm.
    - Popper and Log. Empiricists would have scientists throw away good ideas too quickly.
    - But if paradigms are too resilient, then progress would grind to a halt.

Crisis Science

- But when the anomalies start to gather, they reach a critical threshold – a critical mass.
  - The threshold is not any set number of unsolvable problems;
  - The threshold is simply the number of problems that, in that scientific field, gets working scientists to doubt one or more of the fundamental assumptions of their paradigm.
  - But Kuhn thinks this is not a simple matter; he thinks paradigms are resilient. They are NOT refuted by failed predictions.

- **Crisis Science:** the period when the existing paradigm no longer inspires and guides scientists because those scientists (or their students) lose faith in the fundamental assumptions and methods of the paradigm.
  - And there is no alternative paradigm to take its place.

The Birth of a Revolution

- As soon as an alternative paradigm is developed (through a new great achievement), the field/science enters into a revolutionary period.

- **Revolutionary Science**: the period which springs from crisis science until a new paradigm appears.
  - All the rules of normal science break down; what counts as good argument and justification is unclear.

Kuhn's Characterization of Science and Scientific Progress (In short)

A. Starts in a period of pre-paradigm: scientists flop around aimlessly.
B. A great achievement is made that inspires others, that exhibits a form that can be developed, refined, and elaborated as a general method of doing science…
   - … insofar as one takes for granted certain fundamental assumptions about the achievement that permits it to be elaborated. Those assumptions are not "normally" questioned.
C. Normal Science begins: the field becomes obsessed with puzzle-solving; i.e., it begins to try to accommodate new data within confines of the paradigm's framework, thereby extending it and refining it.
D. Anomalies arise: Some puzzles become problems; the are resistant to solution. But the scientist blames himself; not the paradigm.
E. Crisis science emerges: the anomalies accumulate until they hit a critical mass, at which point faith is lost in the fundamental assumptions and methods of the paradigm.
F. Revolution begins when a new paradigm is forged.
   - The Revolutionary period is MUCH different than the period of normal science. We'll talk about it in the next lecture.

Problems for Kuhn (1)

- The Procrastination Problem: Is the Popperian refutation too quick to dismiss a paradigm?
  1. If rejecting a paradigm is actually inevitable, then the resilience of paradigms is simply putting off the inevitable..
  2. Rejecting a paradigm, according to Kuhn, is inevitable (it's just part of the natural course of science)
  3. So: The resilience of paradigms is simply delaying the inevitable.
  4. Science should not delay the inevitable: science would be better off rejecting the ideas that will ultimately fail sooner rather than later.
  5. If science would be better off rejecting ideas doomed to fail sooner rather than later, then we should not be Kuhnians, but rather be Popperians or Logical Empiricists.
     - i.e., we should not endorse the resilience of paradigms.
  6. Thus, we should not be Kuhnians, but rather Popperians or Logical Empiricists!

Problems for Kuhn (2)

- The Underachieving Science: there's no deep conceptual reason to think that a paradigm MUST be based on a great achievement.
  - E.g., ecology began without a great achievement; there was concern for the environment, and a mutual desire held by naturalists to explain certain features of species…. The "achievements" were mostly low-hanging branches that derive straight from common sense (food chains, describing soil types, noticing which trees grow where and other such natural patterns).
    - More complex ecosystems analyses came much later after the science started.

- Stated as an argument:
  1. Without an achievement, there is no paradigm.
  2. And so, if there's no conceptual reason to think that a paradigm must be based on an achievement, then our concept of science does not depend on a paradigm.
  3. Thus, Kuhn has not adequately described our concept of science.
     - He has no solution to the demarcation problem.

Problems for Kuhn (3)

- The commercial paradigm problem: Some “achievements” create paradigms that are hardly science-like.
  1. Myspace was an achievement in social networking, that created a paradigm which facebook refined and perfected. Linked-in, and academia.edu elaborated the paradigm.
  2. However, social networking websites are hardly paradigms in the Kuhnian sense.
  3. There is no “facebook science”.
  4. Thus, the existence and refinement of paradigms alone fails to characterize science (despite what seems to be suggested in Kuhn).

Discussion Questions

- In this lecture, we learned about the historical turn in the philosophy of science, originating with Thomas Kuhn's theory of the nature of science and scientific progress. We focused specifically on "normal science."

- Discussion Questions:
  1. Do you think that Kuhn's historical approach is superior to, inferior to, or on par with the logical/abstract approaches of Popper and the Logical Postitivist/Empiricists? Explain.
  2. Do you think that Kuhn's characterization of "normal" science as "puzzle solving" provides a way out of the problems raised by the Duhem-Quine thesis? Explain why someone might think so.
  3. How should Kuhn defend his view against the Procrastination Problem?
  4. How should Kuhn defend his view against the underachieving science problem?
  5. How should Kuhn defend his view against the commercial paradigm problem?