Handout #13

<u>Kuhn's *The Structure of Scientific Revolutions* (1)</u>

This "landmark in intellectual history" appeared in 1962 and provoked a storm of critical discussion, much of which continues today. Kuhn denied both (a) that the driving force behind scientific change is rationality, and (b) that a scientific theory is, in general, a more faithful or accurate representation of the world than the theory it replaces. His views have a descriptive side, to the effect that here is how science evolves, and a philosophical side saying that given the history, science is not so objective as we may have thought.

<u>Descriptive Claims</u>

There are two kinds of science: *normal* and *revolutionary*. Normal science is "research firmly based upon one or more scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its future practice" (p. 10).

Normal science is organized around *paradigms*. A paradigm is a theory together with a set of experimental techniques and ways of applying the theory which has "attract[ed] an enduring group of adherents away from competing modes of scientific activity" and which is "sufficiently open-ended to leave all sorts of problems for the...group of practitioners to solve" (p. 10).

Examples of paradigms are: Ptolemaic astronomy, corpuscular optics, Aristotelian dynamics, Newtonian mechanics, and so forth. (NB: Kuhn is, by his own admission, not at all clear exactly what "paradigms" are supposed to be.) Whenever we have a widely accepted paradigm, we have a period of normal science.

Normal science consists in "puzzle-solving", solving problems that arise once a particular paradigm is accepted (e.g. determining the wavelengths of visible light, a problem which arises only if wave optics is the accepted paradigm). However, sooner or later *anomalies* occur. Examples of anomalies:

(a) Phlogiston theory and the fact that many bodies gain in weight when burned. The theory says that burning “liberates” phlogiston that had been bonded with “ash”; the remaining ash ought to weigh less then. The view nowadays is that rather than something being subtracted by burning, oxygen is added.

(b) Ether theory and the Michelson-Morley experiment. The theory says that light waves propagate in a stationary medium known as ether. But then (oversimplifying mightily) the velocity of light should be less when it is flying into the (ether) wind, more when there’s a headwind. It turns out that its velocity is the same in all directions.

When the anomalies become sufficiently numerous and/or acute, science enters a period of "crisis": "the persistent failure of the puzzles of normal science to come out as they should" (p. 68).

"The early attacks upon the resistant problem will have followed the paradigm rules quite closely. But with continuing resistance, more and more of the attacks upon it will have involved some minor or not so minor articulations of the paradigm, no two of them quite alike, each partially successful, but none sufficiently so to be accepted as paradigm by the group (p. 83)." An example is Lorentz's hypothesis in defense of ether theory that objects contract in the direction of their motion by a factor of Ö$(1-v^2/c^2)$, where c is the speed of light. "Through this proliferation of divergent articulations (more and more frequently they will come to be described as *ad hoc* adjustments), the rules of normal science become increasingly blurred. Though there is still a paradigm, few practitioners prove to be entirely agreed about what it is. Even formerly standard solutions of solved problems are called in question" (p. 83).

"The resulting transition to a new paradigm is scientific revolution" (p. 90), such as the transition to special relativity in the early part of this century. The crisis is `"terminated, not by deliberation and interpretation, but by a relatively sudden and unstructured event like the gestalt switch [e.g. the change from seeing an illustration as a rabbit to seeing it as a duck]. Scientists then often speak of the `scales falling from the eyes' or of the `lightning flash' that `inundates' a previously obscure puzzle, enabling its components to be seen in a new way that for the first time permits its solution" (p. 122).

Philosophical Claims

Debates about paradigms are characterized by "incompleteness of logical contact" (p. 110): "schools guided by different paradigms are always slightly at cross purposes" (p. 112). Three aspects to this lack of contact.

Different Reasons: "the proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards … are not the same" (p. 148). There are no objectively cogent reasons, recognizable by both sides, for preferring new paradigm to old.

Question: Does anything like this happen outside of science? Try to think of two groups that are at cross purposes because different things count as reasons for them. ("Can't you see that abstention from all forms of pleasure will make people unhappy?" "Who ever said the goal of life was to be happy?" Etc.)

Different Meanings: "[W]ithin the new paradigm, old terms, concepts, and experiments fall into new relationships one with the other" (p. 149). "[T]he physical referents of [the Einsteinian concepts of space, time, and mass] are by no means identical to the Newtonian concepts that bear the same name" (p. 102). Hence "[c]ommunication across the revolutionary divide is inevitably partial" (p. 149).

Question: Does anything like this happen outside of science? Try to think of two groups that are in danger of talking past each other because they mean different things by their words.

DIFFERENT “WORLDS”: "The proponents of competing paradigms practice their trades in different worlds" (p. 150). "Lavoisier…saw oxygen when Priestley had seen dephlogisticated air and where others had seen nothing at all...At the very least, as a result of discovering oxygen, Lavoisier saw nature differently. And in the absence of some recourse to that hypothetical fixed nature that he `saw differently', the principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world" (p. 118).

Question: Does this happen outside of science? X sees one thing, Y another, though they are looking at what is in some sense the same scene.

That competing paradigms differ in these ways is summed up by saying that they are *incommensurable*. The question is, *to what extent is incommensurability at odds with conventional notions of scientific progress*? Kuhn is maddeningly unclear about this. What answer(s) do you find in the following passage:

"Later scientific theories are better than earlier ones for solving puzzles in the often quite different environments to which they are applied. That is not a relativist's position, and it displays the sense in which I am a convinced believer in scientific progress. Compared with the notion of progress most prevalent among both philosophers of science and laymen, however, this position lacks an essential element. A scientific theory is usually felt to be better than its predecessors not only in the sense that it is a better instrument for discovering and solving puzzles but also because it is somehow a better representation of what nature is really like. One often hears that successive theories grow ever closer to, or approximate more and more closely to, the truth......There is, I think, no theory-independent way to reconstruct phrases like `really there': the notion of a match between the ontology of a theory [the things a theory says exist] and its "real" counterpart in nature now seems to me illusive in principle. Besides, as a historian, I am impressed with the implausibility of the view. I do not doubt, for example, that Newton's mechanics improves on Aristotle's and that Einstein's improves on Newton's as instruments for puzzle solving. But I can see in their succession no coherent direction of ontological development" (Postscript--1969, p. 206).