

Second Lecture on KUHN ON SCIENTIFIC REVOLUTIONS PHILOSOPHY 1 SPRING, 2006

Background: Conceptions of scientific theories.

Instrumentalism: A scientific theory is a device or tool for predicting observation statements. A theory rightly interpreted does not claim to be literally true. As Ayer says, a theory is a rule for anticipating experience. Suppose the theory posits unobservable entities such as subatomic particles like quarks. The theory does not say “there are quarks in the world.” Rather the theoretical claim involving quarks is better interpreted along these lines: Assume there are quarks, behaving as the theory says, and you will be enabled successfully to predict a specified range of observation statements. Or suppose an economic theory asserts a psychological law: Agents are fully informed and always act successfully to maximize their expected utility. One might object, but people are not really that rational—they make mistakes in integrating relevant information and adapting it to choice, they are not fully informed, they miscalculate, they do not know their own minds, they are ambivalent about what their preferences are, etc. If the theorist takes an instrumental view of theories, she will respond, Don’t worry. The theory says, it is as though people are perfectly informed and always act successfully to maximize their expected utility. With that assumption in place you can make predictions that will turn out to be correct.

Realism/Antirealism. The realist asserts (and the antirealist denies) that it can be the case that scientific theories make theoretical claims that are literally true; the theoretical claim made corresponds to the facts. A realist about unobservable entities holds that when a scientific theory asserts that say quarks exist the theory means that quarks exist independently of us or of our perceptions or ways of conceiving them. A realist interpretation of the economic theory claim “agents are fully informed and always act successfully to maximize their expected utility” would have it that the theorist asserting the claim is committed to its literal truth. We can in principle verify or disconfirm the theoretical claim directly, not just by checking to see if observation statements derived from it (in conjunction with other premises) are verified. Of course the realist does not claim every particular scientific theoretical claim ever made has proven to be literally true. But the realist typically believes that some are, and that some are approximately true or close to true. The realist may add another claim: that over time science progresses toward the complete truth; one theory is replaced by another, but the general direction is positive, so more recent theories are a better approximation to the truth than earlier theories.

The logical positivists tend to hold an instrumentalist view of scientific theories coupled with the idea that different theories entail different observation statements, so we can choose rationally among theories by confirming or disconfirming their observation statements. Observation statements provide a theory-neutral basis for deciding which empirical theories to accept. Ayer takes observation statements to be sense-datum reports, reports of sense-experience or how things appear to the observer that are non-committal as to whether what one seems to see or hears or touch exists outside the mind.

Kuhn rejects instrumentalism and realism. Consider what Kuhn calls “paradigms.” A paradigm is a scientific theory about some domain plus a striking successful application; a paradigm becomes the exemplar of how to carry on science in the field. Otherwise put, it functions as a framework that provides concepts, methods, standards of assessment, a way of carrying on science in the specific discipline. While a paradigm is established and dominant in a field, it guides a period of what Kuhn calls “normal science.” The paradigm is not put at risk in empirical experiments that rigorously seek to falsify it in the manner Popper recommends. Anyway

according to Kuhn it is not true that any scientific experiment directly tests a theory, if by theory you mean a scientific law or of set of laws. Consider Newton's theory of universal gravitation. Its laws do not entail any observation statements. To derive observation statements from the laws one needs to auxiliary hypotheses about the system one is trying to learn about, the orbits of the planets of the solar system, for example. So when one confronts this theory with an empirical test, if observations are disconfirming, what is disconfirmed? Clearly not the laws alone but the package of laws plus auxiliary hypotheses. An auxiliary hypothesis might stipulate that no forces except planetary gravitational forces are acting on the planets. Not to mention that the disconfirming observational statement itself might be doubted; perhaps the measurement was inaccurate or the equipment used was faulty, etc. The main point that no experiment ever decisively refutes a candidate scientific law; the most that is shown is that some element in the package that entailed the observation statement that does not agree with the experimental finding must be given up. If the theory being used has the status of a paradigm, it is treated as effectively unfalsifiable. Nor is this unreasonable. One should not give up an accepted theory that is central to a scientific field and has shown itself to be immensely fruitful just because some proposed explanation invoking the theory's laws does not pan out.

Example: When the observed orbit of the planet Uranus did not agree with the observation statements entailed by universal gravitation theory plus auxiliary hypotheses including the assumption that the already discovered planets were all the planets that existed, Newton's theory was not at risk. Scientists predicted there must be another planet, and in fact the planet Neptune was then discovered. Had the predicted further planet not shown up in observation, some other hypothesis would have been tried, then another and another. The problem, typical for normal science, is to explain the strange orbit of Uranus given Newton's accepted universal gravitation theory.

Kuhn on the transition from normal science to crisis and the emergence of a new paradigm.

According to Kuhn, there are always unsolved problems or puzzles in any ongoing normal science activity. At some point, the unsolved problems may become perceived as anomalies, difficulties that go to the heart of the existing paradigm theory. Scientists become unsure how to carry on. A period of crisis ensues, that may result in the emergence of a new fundamental theory or paradigm in the field.

Kuhn holds that the paradigm theory provides standards of rationality, successful explanation, valid scientific method, and so on. But when a period of crisis emerges and two or more contenders are vying for the status of paradigm, there is no neutral set of standards that can arbitrate the dispute. Each paradigm appeals to its own standards to show its superiority. There is no common yardstick for assessment. There reasons of various kinds to favor the emerging paradigm or to stand fast by the old one that is being challenged, but these reasons never dictate a unique rational choice. Reasons constrain but do not determine the choice.

A challenger paradigm that supplants an existing paradigm in a field resolves the crisis in the field. To do this it must solve most of the anomalies that plagued the existing paradigm and must also explain and match most of the empirical successes of the older theory. But this does not mean that reason dictates a choice for the new and against the old. Since the new paradigm never dominates the paradigm that is supplanted by matching all the older paradigm's successes plus adding some explanatory or predictive successes of its own. There is always loss as well as gain in the transition. But then the choice of one or another paradigm is always rationally optional and never rationally compelled.

Competing paradigms in time of crisis are incommensurable, Kuhn holds. One type of claimed incommensurability is **incommensurability of standards**. This goes along with differences as to what the aim of the theory in the field should be, what problems are most important to solve, which ones are peripheral, etc. A second type of incommensurability according to Kuhn is **incommensurability of meaning**. In explaining this idea Kuhn says that the advocates of different paradigm contenders, looking at the same situation, perceive different things and in some sense live in different worlds. Of the revolution in chemistry that resulted in the downfall of the phlogiston theory paradigm, Kuhn writes, page 118 “Lavoisier, we said, saw oxygen where Priestley had seen dephlogisticated air and 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.”

There are other passages to much the same effect in chapter 10, “Revolutions as Changes of World View,” in our reading from Kuhn. What is Kuhn saying? It helps to fill in some further background. Kuhn seems to operate with the idea that we never perceive nature directly, only through the concepts of one or another theory. Maybe there is nature herself looming somewhere behind the world as we perceive it through one or another conceptual framework. But this world beyond conceptual frameworks we can have no conception of; it is at most an “I-know-not-what.” We see the world only through the lens of one or another theory/language/conceptual scheme. But these worlds are then hermetically sealed off. Theory1 gives us access to the world as understood via theory1 concepts, Theory2 gives us access to the world as understood via theory2 concepts. But then the ideas of gradual progress to the truth through each successive paradigm change makes no sense according to Kuhn. One “world” supplants another, but there is no basis for saying one better than the other. (One response to the idea that we always have a choice of choosing one language or conceptual scheme and our truths will always be true-relative-to-a-conceptual-scheme is that ultimately there will be one correct set of concepts to use in scientific theory, the ones that allow the formulation of the scientific theory that ideally combines strength (being able to deduce what happens in the world) and simplicity (being able to deduce what happens from a few simple axioms).

Meaning holism and the description theory of reference for natural kind terms (the one that the Twin Earth story was supposed to call into question) lie in the background of Kuhn’s claims about incommensurability of meanings across different fundamental theories or candidate paradigms. Start with meaning holism for the terms in a scientific theory, a set of laws. It is plausible to think the meaning of Newtonian “mass” depends on all of the occurrences of the term in all of the laws—the function of the term in all of the laws, modified by the comparable meanings of all other terms that figure in the laws. The meaning of any scientific law term is then given locally holistically. The meaning of “mass” in Einsteinian theory is then systematically different from what meaning it had in Newtonian theory. Meaning holism extends. The meaning of ordinary terms for ordinary objects depends on the meanings of all of the other terms in the theory. Analogy: Suppose one has a box with many heavy objects inside it. Gravitational forces are acting by each object on all others. The force on any object then depends on the ensemble of forces acting on all of the objects in the box. Every object’s forces interact with every other object’s forces—and so it is with the meaning of terms.

It immediately follows that the positivist notion of a neutral observation base for competing theories is from this standpoint just described, defunct. The observation statements associated with theory T1 are tied to that theory and the observation statements associated with theory T2 are tied to that theory. Observation is infected with theory so cannot provide a theory neutral of deciding which of the contending theories it is best to accept.

If one denies meaning holism, this prop for Kuhn's claims is knocked away.

The descriptive theory of reference for theoretical/natural kind terms also is in the background of the account Kuhn gives. If the term "Newtonian mass" refers to something just in case most of the properties linked to the cluster of descriptions associated with the term hold for the something, then if Newtonian theory is given up, the term refers to nothing. Or one might say with Kuhn, Newtonian mass refers to items in the world as structured by Newtonian concepts. Again we do not get the picture of terms referring to items in one common world, about whose best theoretical description we are in the process of deciding as we evaluate competing fundamental theories. We instead get the picture of fundamental theories sealed from each other, each linked to a world-perceived-via-this-conceptual-framework.

On the causal theory of reference for theoretical/natural kind terms, we might get a different picture. Here one introduces a term by ostending or pointing to an exemplar of what one wants the term to refer to. One uses a description to point in the right direction toward the intended stuff, as when one points to a sample of water and says that the term *water* shall refer to the stuff like that, the stuff that fills lakes and rivers, is odorless and colorless, a liquid at normal temperatures, slakes thirst, etc. The stuff one is causally interacting with in apprehending the sample fixes the reference. If the surface descriptions used to point us toward the intended stuff are inaccurate, the process is unhappy, but reference still might succeed. Consider this example: At a party I say to you, see the woman with the brown hair in the corner who is flirting with the marine? These descriptions may be flat wrong—the person in the corner is a man, not a woman, and he is flirting with nobody. Yet may succeed in getting you to understand to whom I intend to refer, so the word-world link, reference, gets established. I then say, that person is going to Venezuela tomorrow. I can succeed here in referring to a particular person—the man I think is a woman, and saying something, maybe something true (the Venezuela claim) about that person. This could not happen according to the description theory of reference, if we extend that theory to this kind of case.

A simple example: two theories about witches. Consider two theories about witches. One is a witchcraft theory, which holds witches are women who consort with the devil, cause harm to people they dislike by casting spells, ride broomsticks, wear pointy hats, etc. The anthropological-historical account holds that witches are marginalized or eccentric women, women on the fringes of their societies in a certain historical period, who were falsely believed to have the attributes the witchcraft theory ascribes to them, and then were sometimes treated extremely harshly. On the description theory of reference for theoretical terms, since most of the descriptions in the cluster associated with witch on the first theory fail to apply, the term fails to refer to anything—there are no witches. The two witch theories will not then by referring to the same people and asserting conflicting things about them, which evidence might confirm or disconfirm. On the causal theory of reference, the situation is not so clear. Maybe the witchcraft theory, despite linking the term witch to properties no women possessed, did succeed in pointing our attention toward certain women—maybe the ones the supposed witchcraft experts of the time would have identified as witches. If so, then the two theories are talking about the same things, referring to the same entities—certain women who lived in England and Europe and the U.S. in a certain historical period. Of these women, the two theories make conflicting claims. On this view, there were witches after all. But maybe they did not satisfy most of the descriptions the witchcraft theory links them to. You see how on the causal theory of reference we get a picture different from Kuhn's—we are talking about the same women, denizens of the same world, and making competing claims about them. The theories do not on this account end up hermetically separated and talking each about its own conceptually created world.

Back to incommensurability of standards. So far we have not said anything about Kuhn's other argument for relativism regarding paradigm acceptance and paradigm correctness—this is incommensurability of standards. The relativism claim is that scientific standards are paradigm-relative. What is rational and explanatorily successful and true relative to one paradigm theory is not relative to a rival paradigm theory. What is true, explanatorily successful, and true, period? According to the relativist, this is not a well-formed question. Comparison: A moral relativist holds that questions like “Is this practice morally right or morally wrong” do not make sense. Proper questions about what is morally right and wrong are not freestanding in this way but instead are relative to a particular society and culture. So for example, infanticide of newborns and coercive “euthanasia” or killing of old people may be morally right relative to Eskimo (Inuit) culture circa 1910 whereas these same practices are morally wrong relative to California society circa 2006. Kuhn holds that reason cannot dictate a choice of one rival paradigm over another because each paradigm can reasonably claim to be best according to its own standards. Since standards of assessment are paradigm-relative, there are no standards to assess or guide choice of paradigms.

Another way to think of this is to see different paradigms as emphasizing different problems as important and affirming different goals as the ones a good theory should meet. If theory T1 solves anomalies A and B and C and theory T2 solves anomalies C and D, there is no decisive answer, maybe, as to which is better. If by paradigm Theory1's standards A and B solutions are more important and according to paradigm Theory T2's standards D solutions are very important, a choice of goals or values is needed to decide which way to go. This choice cannot be rationally compelled.

Kuhn in our reading, especially chapter 9, describes important episodes that he sees as crisis periods in which one paradigm gave way to another, seeking to show that incommensurability of standards and goals characterizes these episodes and the choice within them for one or another rival paradigm. Question: Why aren't there general standards of scientific method and scientific rationality, not tied to any contending paradigm theories, that enables rational choice among rivals? Kuhn's answer seems to be that even if there are such standards, they are more in the nature of slogans that can be claimed by any contending side, than rigorous clear standards that settle disputes. The overarching aims of science are too vague or general or unspecific to adjudicate any actual dispute.

What Kuhn says happens can happen, I would suppose. The issue between Kuhn and the optimistic scientific realist who sees historical progress through changes of paradigms perhaps centrally involves the interpretation of the pivotal episodes. After all, one might say the aim of science is to explain nature. Standards and methods do change over time, but in such a way that one has to see that we are gradually learning more about scientific method and scientific rationality—once the issue is understood, there are not two or more equally right answers, just a right solution. There is one right standard, about which we gradually become more cognizant over time as science develops. At this point one perhaps has to delve into specific episodes to see how plausible Kuhn's account is.

Back to Popper versus Kuhn. Popper might say, Kuhn is describing the scientific enterprise in history; I am affirming norms I say science should follow (and good science does follow). Kuhn might be right or wrong, or partly right and partly wrong, in his historical descriptions. But a factual claim does not automatically conflict with my evaluative, normative claim. Kuhn is asserting an “is” claim” and I am asserting an “ought” claim. The question arises, would this be an adequate response to Kuhn on behalf of Popper or not?

Popper might also propose that in his terms, Kuhn is propounding what looks like an empirical theory, a theory of the history of science. But really Kuhn has given us an unfalsifiable theory, like Freud's theory of mental illness. Kuhn's account of paradigm-normal science-crisis-revolutionary transformation to new paradigm just amounts to a language, a way of talking which one can use to describe whatever happens. If this is so, Kuhn is free to recommend his way of talking but I am free to reject it. Again, the question arises, whether this is an adequate reply on behalf of Popper to Kuhn.

Finally, another question about Kuhn's normal science/crisis/revolutionary science schema. Since there are always unsolved problems for any paradigm, maybe we should often not deeply entrench one paradigm in a field but develop more than one paradigm type theory at a time, so that normal science would be practiced in a way that shares some of the features of the Kuhn "crisis" mode. Granted that Kuhn is right that it is not useful to keep fretting about problems we can't solve now with the theoretical and conceptual tools at our disposal, so some potential anomalies at any given time should just be shelved and ignored because we can't make progress on them now, this does not dictate that we must always line up in loyalty to one dominant paradigm in order to make steady progress within a research tradition. Kuhn's example of a problem that it was reasonable for scientists to shelve: the philosophical objections against Newton's notion of absolute space on behalf of relative space, advanced by Leibniz while Newton was alive.