Macalester Journal of Philosophy

Volume 8
Issue 1 *Spring 1998*

Article 12

3-25-2011

Kuhn's Predicament

Ryan Long
Macalester College

Kuhn's Predicament

Ryan Long

Introduction

This paper is an explication of Thomas Kuhn's position on science in the context of W. V. Quine, whose philosophy shares a strong similarity with Kuhn's views, and of Donald Davidson, who claims that the notion of "conceptual schemes" is erroneous. I will attempt to show that Davidson's critique must be answered by Kuhn's position, and that to retain the notion of paradigm shift, one must either adopt a position on language and truth similar to Richard Rorty's or admit that paradigm shifts are more related to psychological and methodological changes than the "change of worlds" idea initially suggests.

Science and Paradigm Shifts

Kuhn's *The Structure of Scientific Revolutions* attempts to undermine the notion that science is a constellation of facts about the world which scientists add onto. This traditional conception leaves the historian of science with two tasks: to chronicle discoveries which have added to science, and to describe errors which have impeded accumulation. These two tasks, however, leave science trapped; either science itself produces errors and myths, or, if the errors of the past are truly science, then the scientific tradition includes beliefs incompatible with current beliefs. Kuhn states that we must choose the latter and recognize that the out-of-date past is not unscientific—but that this admission also forces the conclusion that science is not merely an accumulation of facts in correspondence with the world (Kuhn, 5).

Kuhn goes on to describe, in three sections, what he considers the activity "science" to include. First is the pre-paradigmatic time; a period of intense competition where scientists in a given field are not yet united by a conceptual framework. Their research is highly individualized and haphazard. Without a paradigm (a notion which I will develop shortly) it is difficult to organize facts into a hierarchy, and the forming science must borrow a theoretical and methodological framework from an external source, e.g., metaphysics or another science. Gradually, the second stage will occur as a paradigm which can provide a high degree of structure in the explanation of facts and can suggest what problems are worth experimenting takes control, erasing the earlier divergences of opinion and establishing a set of core principles which will now go unquestioned.

These paradigms are not universal or infallible, but rather, gain power by virtue of the fact that they provide help in solving particularly acute problems. The second stage of science, "normal science," actualizes the promise of the paradigm by performing experiments to "force nature into the paradigm." That is, normal science does not look for novelty: it looks for experimental results which correspond to the paradigm's predicted results, or for results which can resolve ambiguities and previously unsolvable problems within the paradigm. The first applies the paradigm, the second further articulates it (e.g., defining constants or quantitative laws—though these are often guessed correctly through the paradigm before being determined experimentally). Therefore, paradigms allow for minutely detailed investigation in spite of the fact that they are not universal and will someday be replaced. Indeed, paradigms are absolutely necessary for normal science, since experimental measurements can not come from an a-theoretical framework; what we choose to measure is guided by our paradigmatic assumptions. For example, Boyle could not have performed his experiments without working under the framework which recognized that air was an elastic fluid to which hydrostatic concepts could be applied.

Normal science does not aim for novelty. Any serious experimental deviation from the predicted result is likely to be dismissed as a research failure. The motivation for normal science is not to uncover a new fact which can replace old errors, but rather, to successfully navigate the puzzle of attaining the predicted result. Working under theoretical rules which limit the methods allowed and the acceptable answers, and working within the technical boundaries of the lab, the scientist aims to solve a puzzle which will extend the understanding of the precision with which the world is ordered.

These rules derive from the paradigm. Paradigms take priority over rules (you can have normal science without rules so long as there is a paradigm and the previous solutions are accepted), and two scientific communities sharing a paradigm do not necessarily share rules. Scientific rules display a Wittgensteinian family resemblance. Scientists are not taught the rules, but rather, pick them up through doing science. This is a persistent theme; while scientists are quite competent at solving puzzles, they are not experts in the foundation of their field, its rules, methods, or set of legitimate problems. These issues are also never debated by scientists; any knowledge they have of the rules is displayed by simply doing research. Only when paradigms break down do rules become a focus of concern.

We will now turn our focus to this process of breakdown. If normal science does not seek irregularity, how do paradigms change? There are two possibilities (though, as we shall see, their division is quite artificial): change comes about from a discovery of fact or from an invention of theory.

The discovery process first becomes aware of anomaly, then explores the anomaly, and finally adjusts the paradigm until the anomaly becomes expected. Until this final step, anomalous "facts" are not scientific. This three-step process of discovery shows why the history of science should not be seen as asking questions such as "When was oxygen discovered?" Discovery is not a single act which one can equate with seeing. Nor is it performed by one person at a singular instant in time. First, discovery must recognize *that* something is, then it must discern *what* it is. That is, fact must be assimilated with theory. Once the discovery process is complete, the value of the new phenomena is equated with the degree to which it violates paradigmatic expectation. This process only occurs with difficulty and resistance; our theoretical and methodological guidelines obscure perception, novelty which is assimilated often negates prior research, and further, shifts the paradigmatic framework which many scientists refuse to relinquish. This resistance, too, has a function—it is a guarantee that science will not fall to petty distraction. Only anomalies which shock the existing knowledge heavily will lead to paradigm change.

The invention of theory also leads to paradigm shift. New theories are generally consequent to severe insecurity that the current paradigm is failing to solve important puzzles. For example, the Ptolemaic system was accurate, but the most accurate observations could not be predicted. That is, the system provided a coherent way to predict astronomical events, but the current methods of observation offered a greater precision than could be predicted. Ptolemaic astronomy underwent countless changes and revisions to account for this, but soon its complexity outweighed its usefulness. As discrepancies were accounted for by a revision in one area, the error would often shift to a new location, leaving a futile race to revise the theory in the face of endless divergence. Ptolemaic astronomy was in shambles before Copernicus did anything. (The inverse of this phenomenon also occurs. Leibniz, in a sense, predicted relativity theory, but since he had no application for it and there were no relevant experimental techniques, he did not create a conflict.)

Novel theory is a response to crisis. In this, it is not simply a rejection of the status quo, or even a falsification of the current theory through comparison with nature. For the current paradigm to be rejected, there must be a new theory waiting to take its place. The response period always involves comparison between nature and more than one competing paradigm. That is, the choice of a paradigm is not simply a matter of which corresponds most accurately with nature, but which paradigm can solve problems considered particularly important and which paradigm opens research possibilities into problems considered particularly interesting. The process of choosing between paradigms is not simply an appeal to facts; *ad hoc* theories will always be created to deal with conflicting facts and retain the current theory. (However, if the new paradigm is adopted,

these "new facts" generally become core tautologies of the new framework.) Since all puzzles must be approached as though they have a pre defined solution, and that only a lack of ingenuity can cause them to defy description under the current paradigm, anomaly does not create strong response. There must be more present to incur crisis. When *ad hoc* theories appear, the anomaly must persist. This loosens the rules of research, and divergent answers to puzzles appear. This leads to disagreement over the state of the paradigm and a questioning of previous solutions. Science reverts to traits it displayed in the pre-paradigmatic phase: speculation, competition, haphazard experimentation, sometimes even philosophical analysis.

Thus commences the revolutionary period. Existing institutions are now insufficient to answer the very problems they have allowed to emerge. The power of these institutions is undermined, leaving scientific activity in a relative state of disorder. Since the competing factions do not recognize a higher authority (there is only the paradigm), choosing between them is not merely a logical comparison. That is, the proponents of various paradigms do not have recourse only to "scientific" means; persuasion and force become salient tools. Since each faction is necessarily working at cross-purposes and using incommensurate vocabularies, there is not a wholly logical field of contact between the two paradigms. There is a necessary antagonism, since the paradigm which can account for anomaly must make different predictions from its predecessor. (This antagonism is not cumulative. The problems created by Einstein, for example, are much more related to Newton's predecessors than his followers.)

The revolution is, in fact, a change in world view. The core substances (e.g., concepts such as mass, motion, gravity) are now re-ordered, and the view of science itself (what problems are now scientific) changes. Where Galileo saw a pendulum which almost attained infinite motion, Aristotle saw a stone's attempt to fall being restricted by string. Each scientist is descriptively accurate, but each work in a different world. To move from a vision of swinging stones to one of pendulums is to experience a Gestalt switch.

Unlike Descartes' notion of an absolute reality which can be interpreted in various ways, Kuhn maintains that data is not stable. A swinging stone is not a pendulum. This is not a new interpretation, it is a new way of seeing. Interpretation is paradigm-governed and can only articulate, never cause change. Aristotle's concern over weight, height, and time lapse to rest period could never have led to Galileo's laws—only a period of crisis reconciled by a Gestalt switch could do this.

Implicit in this is a rejection of the notion that there can be a neutral language which can describe our fixed and neutral sense experiences. For Kuhn, perception is always through a paradigm, and is not a piecemeal operation but

rather something which defines huge portions of our experience. This paradigm interference in our perception is itself antecedent to the search for a neutral language. Consider this in light of the fact that, after a revolution, many relics carry over. Instruments, language, and methods are retained, but their relation to the paradigm and results they obtain are different. The world the scientist works in has changed—the categories into which the world is divided, the unspoken assumptions, and the core problems are all new.

The problem of how revolutions are resolved has not been fully answered. Some have claimed that we compare paradigms with nature. For Kuhn, this probabilistic theory of verification is misguided and ahistorical. As stated earlier, "facts" are not a sufficient criteria for adopting a paradigm. Kuhn also rejects Karl Popper's theory that science progresses through change by means of necessary rejection. Failure is not cause to reject a theory; rather, it is failure which creates the puzzles that normal science must solve.

In the end, the adoption of a new paradigm cannot come through any "proof." Persuasive claims that a new paradigm can solve the problem which created the crisis, or predict phenomenon which was previously unexpected, are helpful but insufficient. There must be a sense that the new paradigm is "appropriate" or "aesthetic." Often a new paradigm is trapped in the admission that it has no answers to what should be scientific problems. A new paradigm is always relatively incomplete and rough. Since they do become accepted, however, the notion that a relative comparison of solutions can account for change must be rejected (though this is how science itself often speaks of the process).

The core issue often becomes, "Which paradigm should guide research on problems neither can solve?" In this, the emphasis is on the paradigm's promise, not achievement; that is, the resolution of crisis falls back on faith. For a paradigm to emerge, it needs initial adherents to further develop the framework, articulate arguments, and incur faith in others. Gradually, a successful paradigm creates a shift in the distribution of alliance, either through conversion or the mortality of the old guard.

A Philosopher's Defense

It is perhaps fair to describe the traditional notion of science which Kuhn attacks as reductionist. Science is understood as a fact-collecting process, conflict as a phenomenon in which current positions negate or falsify their predecessors because they were not in correspondence with the way the world truly is. Further, a (scientific) statement *in isolation* can be confirmed or denied.

Quine, too, rejects this notion, claiming that statements about the world "face the tribunal of sense not individually, but as a corporate body." Not simply isolated statements, but the conceptual scheme as a whole answers to experience.

For Quine, traditional empiricism involves two essentially similar dogmas: the analytic/synthetic distinction and reductionism. These dogmas are practically identical, insofar as the notion of verifying isolated statements inevitably coincides with speaking of "vacuously confirmed" analytic statements. Simply stated, this traditional notion rests on a division of "factual" and "linguistic" truth.

In contrast, Quine holds that although science depends both on language and experience, science only answers to experience as a *whole* conceptual scheme. Claiming that "all knowledge and belief is a man-made fabric which impinges on experience only along the edges," Quine portrays knowledge as a sphere surrounded by experience. When an experience contradicts something we hold to be true, we must change a part of the scheme. Yet, the majority of "truths" held up to this form of contradiction reside in the periphery and are related to simple, physical objects. For example, a statement about there being ten brick houses on Elm Street can easily be refuted by experience. (Here, we are not forced to abandon the statement if there are not ten houses, but it would not be worth the effort to hold on to such an extreme denial of experience.)

As we move into the sphere of knowledge, historical truths or beliefs are more sheltered from experience. If some sense perception denies a core belief, we will reject the perception rather than the belief. Our knowledge is interrelated, and when experience contradicts us, there are numerous ways to make the system correspond. We almost always choose the simplest. Therefore, since the schema can be modified, Quine must hold that any statement can be true, and conversely, no statements are immune to revision. All depends on the state of the system.

Quine presents us with a relativist theory, and thus holds that the primary elements of the current system (e.g., the physical objects of natural science) are not essentially different from primary elements of other conceptual systems (e.g., Homer's gods). We merely see physical objects as a better myth in that they structure experience in a more useful way. Herein we see Quine's pragmatism at its fullest. Pragmatist science is not the process of verifying; its goal is to predict the future from knowledge of the past.

The question of truth is no longer one of rigid correspondence, but rather, of usefulness and simplicity. The issue of correspondence is radically revised; since we can modify the conceptual scheme, we are not slaves to experience. The periphery of the schema must coherently, not exactly, correspond to experience. The interior of the system is only truly concerned with creating and preserving a system of useful and simple laws. This difference between periphery and interior, however, is only a matter of degree. All hypotheses are aimed at choosing a convenient schema or framework. Thus, even at the periphery, where experience seems to wield great power, pragmatism is the motivating force; it still chooses what parts of the schema to adjust.

A Philosopher's Attack

Donald Davidson claims that the notion of conceptual schemes is a doctrine which sheds its initial excitement under closer scrutiny. Similar to Kuhn's notion of a paradigm, Davidson defines a conceptual scheme as a "system of categories that give form to the data of sensation." Conceptual relativism is the doctrine that reality is relative to a conceptual scheme. Yet, in order to make any sense of the notion of different schemes (or points of view), one must understand all schemes as existing within a common co-ordinate system. That is, to speak of schemes as being different, there must be a common entity in relation to which they differ.

Davidson's criteria for difference of scheme is that they are untranslatable. That is, its claims about the world cannot be stated in the language of another scheme. This is a fair description of a paradigm shift. Since Donaldson maintains that successful communication is related to describing or understanding a speaker's beliefs and intentions, there is a strong relation between translation and being able to deduce a speaker's mental state.

There are two systems for making sense of conceptual relativism. Davidson is not as strongly opposed to Strawson's conception of schemes; a constant world and one point of view which may have varying truth values. However, Davidson finds Kuhn's notion of conceptual relativism more problematic. Here the world is a constant and different observers possess incommensurate schemes for describing it. Davidson defines this as a "scheme/content distinction," the idea that language can be separated from the world. This form of relativism abandons the analytic/synthetic distinction, thus blurring the distinction between "theory" and "language." Thus, one's theory or scheme affects (or contaminates) the meaning and truth of various statements about the world.

To change schemes, or undergo a paradigm shift, changes the truth value of various statements. However, this is not simply a matter of realizing that we were wrong about how we evaluated various statements; the *meanings* of the words have changed—the speaker is using a new language. Davidson objects to this form of change by claiming that if you accept that meanings can undergo a revolution, there really is no way to ascertain whether a speaker is using the new or old conception. For example, if we were to somehow force a "materialist language" upon everyone, there would be no way to tell if these new words are not simply being used to represent the old emotive concepts.

Davidson rejects the notion of a "scheme-content distinction" as the "third dogma" of empiricism. If we abandon the distinction between analytic and synthetic, we create a dualism of conceptual scheme and empirical content (the "organizer" and the "organized"). This assumes an entity outside of all

conceptual schemes, yet an entity which is not the "subject matter," for if it were, schemes would be translatable. Schemes are, rather, related to experience in that they allegedly "organize" or "fit" sense data.

Davidson refutes the notion of organization by claiming that to organize something is to assume that the entities organized all exist *within* something. For example, it makes sense to say you will "organize your closet" if by that you mean you will organize the contents of the closet; if you use "closet" as the primary unit, it does not make sense to say you will organize it. The implication is that it is nonsensical to speak of organization if the entities are not individuated by familiar principles.

As for "fitting," Davidson claims that the criteria for fitting is that sense experience provides evidence for accepting a statement as viable. That is, to fit is to be true. Conceptual relativism purports to show that different schemes are untranslatable; they each individually face experience *as a whole system*, and if coherent, are each largely true. This idea is untenable if, as Davidson maintains, the criteria for truth is divorced from translation.

This is due to the fact that there is no ground from which comparison of schemes can occur. Neither a fixed stock of meanings, nor a theory-neutral reality can allow us to speak sensibly of various schemes—these conclusions all stem from the erroneous metaphor of a single space within which every conceptual scheme has a position and provides a relative point of view to reality.

For Davidson, a translation theory which someone like Kuhn or Quine supports would not be able to make assumptions about shared meanings, concepts, or beliefs. However, making these assumptions is an integral part of language—in his words, "charity is forced on us." The only way to allow for meaningful disagreement between speakers is by sharing a common foundation. His reasoning is that to understand "meaning," one must interpret belief and intention. You must understand what a speaker intends to convey, and what belief about its truth or falsity she holds. If a translation theory can only get at truth values of various statements, it is going to fail. One must know about a speaker's beliefs, which is only possible through interpretation of speech and the assumption of general agreement on beliefs. It is only through this that we can make a sensible attempt at translation, and further, to make sense of the notion of disagreement.

Kuhn's Predicament

I cannot see how Kuhn's general thesis can be upheld in light of Davidson's criticism. The notion of conceptual schemes organizing the world loses meaning when you assume a distinction between language and a neutral reality (that is, when you try to organize the closet itself). Neither will fitting be an adequate concept, since fitting is essentially equal to truth and thus forces a

regression to the traditional notion of science, that of a "constellation of facts about the world which scientists add onto."

There are two evident changes that can now be made in Kuhn's theory if he is to survive Davidson's criticism. One is to take his relativism further and adopt a position similar to Richard Rorty's. The other is to make the notions of paradigms more relevant to methodological and psychological, and not only epistemological, issues in science.

The first option involves a use of the notion of language games. While Wittgenstein spoke of specific language games (e.g., telling a joke, giving a report), Rorty historicizes language games (e.g., Athenian politics, Newtonian physics). For Rorty, language is not a timeless medium for describing reality or expressing the self—the language games we use are historical contingencies. Further, it does not make sense to speak of truth outside the boundary of a particular language game, for there is no logical "neutral ground" from which to make such judgements. One can speak of truth only within a language game by appeal to cohesiveness or pragmatic considerations. The underlying argument here is that only human statements are considered truth value candidates, and since statements are a human convention, truth is a human convention. That is, Rorty rejects the idea that there is inherent truth in reality which science and philosophy must uncover. Rather than speaking of paradigm shifts, Rorty deals with the genesis of new language games. This process is started through the creation of a new metaphor, which is a statement that is not a truth value candidate in any language game. A truly new and creative metaphor, then, is outside the space of language games. If people choose to begin employing this metaphor, then a language game will form. (Note the similarity to the process of forming a new paradigm—the first adherents accept it on faith and develop it further.)

It would seem that this route could be a way around Davidson, for now to speak of "fitting" without being relative to a language game (paradigm) is nonsensical. Davidson's problem was with the notion that there can be a single space in which truly different points of view can exist. By making language contingent, and introducing the primacy of language games, the problem is turned on its head; there is no space from which to judge different points of view (even if you consider these points of view to be imaginary, as Davidson does) as being a better fit, or more true, or even saying that they are translatable and not different. If a language game exists and people speak it, it certainly is a unique point of view—though like all others, equidistant from the imaginary notion of Truth.

The other method for preserving Kuhn is to downplay the relation of paradigms to reality, and to speak more of methodological and psychological concerns. Kuhn states that paradigm shifts do not come through interpretation,

which can only ever support a paradigm. The implication is similar to Rorty's notion of the creation of language games—the new metaphor is not yet a truth value candidate (is not yet scientific, but rather, a "research failure"), it springs forth out of a combination of crisis, creativity, and chance. Once a scientist enters a new language game, she is working in a different world than before.

For example, Aristotle and Newton worked in different worlds, though Kuhn makes an appeal to a more conservative notion—the world itself has not changed, it is the world that they work in. (To paraphrase John Searle, "I've been to England, and I've been to Greece, and I can guarantee that Newton and Aristotle lived in the same world.") What, then, is the significance of restricting the change to the world of scientific *work*? Though it is unclear whether Kuhn intended this, it seems difficult not to deduce that scientists exist in both scientific and non-scientific worlds. The paradigm shift may only change the scientific world of work, that of the lab. What are the conditions of the lab? As Kuhn stated, the goal of natural science is to "force nature into a paradigm."

Is it not then sufficient to say that this world has changed since the entire activity performed within it has changed? Paradigm shifts do not merely change what research is done, but change the way basic scientific concepts are used (i.e., their meaning changes), the core tautologies, the key problems, the unspoken assumptions.

One could surely object that these changes reflect upon the world as a whole, because science does nothing if not, as Kuhn states, "aim to solve puzzles which will extend the understanding of the precision with which the world is ordered." The radical interpretation is, of course, that Kuhn's theory indicates that paradigm shifts create a new external world, a new order or structure of reality. Yet, if we can make the puzzle-solving mentality and the affects of paradigm shifts more of a psychological issue, the problem of "fitting" as truth may perhaps disappear, thus giving new sense to the notion of a different world.

Quine again provides the support. He claims that his notion of science is "supported in part by coherence and simplicity, and external information (sensory stimulation)." External information enters scientific discourse through observation sentences such as "It is raining" or "That is a dog." He claims, "Always the situation that makes an observation sentence true will be a situation that is present when and where the sentence is truly uttered. Always, moreover, it will be intersubjectively observable; that is, it will be the sort of situation to which multiple witnesses could, if present, attest" (Quine, 1970, 15).

One could make a claim for relativism by stating that there will be a divergence of opinion on whether or not a statement deserves assent. This, however, is overcome either by appeal to the community of specialists or by reducing statements to "novice level" so that all people can learn to give the correct assent through ostensive training. The true claim for relativity is through

appeal to the individual's implicit standard of similarity. When someone is trained or conditioned to learn which observational sentences are "true," this is not through appeal to a unique sensory experience. Conditioning is done by relating statements to a class of similar phenomena. To learn when to assent to a given observational sentence, the subject must share an agreement on what counts as similarity. This is the "irreducible kernel of relativism," the notion that "all sense evidence as reflected in observational sentences is relative to the neural organization that determines what different triggerings of nerve endings will favor the same response" (Quine 1984, 293).[1]

Could revolution not be understood as a general change in a scientific community in how and when similar responses are elicited? Can we salvage Quine's notion of a sphere of knowledge bounded by experience, and claim that the paradigm is the vehicle for deciding which sensory data is similar, and further, which data is too contradictory and should be rejected? The notion of fitting, or of being true, is now psychologized and made relative. Where Aristotle saw a stone's fall impeded by a string, Galileo saw a pendulum. Yet, it is not as though the world has changed, that the configuration of matter which was a string and stone became a pendulum; rather, the psychological disposition of the scientist has changed, what observation sentences about this identical phenomena can be assented to are different. That is to say, the change of world really is a change of interpretation. As Kuhn stated, paradigms are not adopted piecemeal; the theory defines large parts of how you deal with sense data. This appeal to interpretation is a way to account for the inability of Aristotle's method and perception to ever have discerned Galileo's laws: his mode of interpretation is holistic, and what he is willing to assent to defines what problems he will attack and what conclusions he can draw. The ultimate conclusion is that, since the effect of paradigms hinges on a psychological disposition, the world of the scientist has changed. One cannot enter into a new paradigm, assent to its "true" observational sentences, accept its assumptions, and be committed to its problems only to, at the end of the day, leave the psychology of scientific activity in the lab. It must be brought out into the world as well.

Kuhn's appeal to paradigm changes as "gestalt switches" is conducive to this reading. This, however, begs the question of whether or not science still aims to "extend the understanding of the precision with which the world is ordered." I think that the notion of paradigm shifts can perhaps be saved from

---

[1] It could be argued, simply, that some "neural organizations" are true, and some false. This, however, I must hide from, as I must restrict the scope of my topic. I would assume you would defend the doctrine by simply claiming that there is no guarantee that the individual judging the various dispositions of similarity has any right to authority; what is so special about her neural organization?

Davidson's critique if science is understood at aiming solely at extending the cohesiveness with which our conceptual scheme is ordered. As Quine proposed, science can be understood as having no obligation to recognize a given sensory experience as true; conceptual schemes strive for cohesiveness and simplicity, and always choose whether to accept or reject empirical evidence. The empirical world is out on the boundary of the scheme, and science is not a slave to empirical evidence. The goal is not simply to attain a unifying theory which can account for all the phenomenon of external reality, but rather, to articulate a conceptual scheme which latches onto experience as it sees fit. Motivated by the puzzle-solving mentality and the pragmatic use of predicting sensory events, normal science moves forward until our disposition towards various problems, solutions, and notions of similarity change. Science then revolts, re-organizing our mental hierarchy and the meaning of our concepts and problems, changing our criteria for similarity, and establishing a new fit with empirical reality, balancing the predictions of its new core beliefs with the desire for cohesiveness and simplicity.

Bibliography

Davidson, Donald, "On the Very Idea of a Conceptual Scheme," in *Inquiries into Truth and Interpretation*. New York: Oxford University Press, 1984, 183-198.

Kuhn, Thomas, *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962.

Quine, W.V., *The Web of Belief*. New York: Random House, 1970.

----------, "The Two Dogmas of Empiricism," in *The Philosophy of Language*, ed. A. P. Martinich. New York: Oxford University Press, 1985.

----------, "Relativism and Absolutism," *The Monist* 67, 3 (1984), 293.

Rorty, Richard, *Contingency, Irony and Solidarity*. New York: Cambridge University Press, 1989.