Is the Reticulational Model of Scientific Change Based on a Misunderstanding?

Revisiting the Laudan-Kuhn Debate

**Abstract: In this article, I explain the motivations behind, content, and goals of Larry Laudan’s reticulational model of scientific change, especially as they relate to his critique of the model of scientific change given by Thomas Kuhn’s *The Structure of Scientific Revolutions*. After outlining each model, I show that Laudan’s critique misconstrues Kuhn’s model on several important points—most severely, Laudan misunderstands Kuhn’s notion of a paradigm. Thus, to the degree that Laudan’s model was a response to failures in Kuhn’s, it was not objectively motivated.**

KEYWORDS: RETICULATIONAL MODEL; PARADIGM; RATIONALITY; VALUES; SCIENTIFIC REVOLUTIONS.

# 1 Introduction

Since Thomas Kuhn’s *The Structure of Scientific Revolutions* first appeared in 1962, the model of scientific change presented therein has played a dominant role in the philosophical literature on the topic. In it, Kuhn proposed a model of scientific change based on *paradigms*, and argued that what makes a scientific research program progressive is a sociological commitment on the part of the scientists to certain core values and aims central to that branch of science within which they operate. Kuhn draws several important corollaries from this claim: first, that research programs are encapsulated wholes, and cannot be easily separated from their surrounding framework; second, that science is not the meticulous rational enterprise that it is depicted as in the popular imagination, but that its directives and results are just as much the product of irrational passions as they are of detached calculation; third, that progressiveness within a paradigm is equivalent to cumulativity; lastly and most controversially, that one cannot categorically state that science as a whole, with its vicissitudes and reformations, is objectively progressive—particularly, the shift from one scientific paradigm to another (what Kuhn calls a ‘scientific revolution’) cannot be thought of as progressive.

In *Science and Values*, Larry Laudan sets forth an alternative to Kuhn’s paradigm-based model of scientific change. Laudan’s reticulational model is characterized by three principle claims: first, that paradigm shifts are not as wholesale and drastic as Kuhn thinks; second, that it is possible to rationally adjudicate between rival paradigms via an appeal to common ground between the theories; third, that an individual paradigm is able to sow the seeds for its own replacement via a gradual replacement of its separate parts.

In what follows, I explain the motivations behind, content, and goals of Laudan’s reticulational model of scientific change. This is followed by an outline of Kuhn’s own model. In the third section, I show that Laudan misconstrues Kuhn’s model on several important points—most severely, Laudan misunderstands Kuhn’s notion of a paradigm. Thus, to the degree that that model was a response to failures in Kuhn’s, it was not objectively motivated. In the final section, I identify several treated by Kuhn’s model that, on account of the distinct concerns that motivated Laudan’s model, remained unaccounted for by it.

# 2 Laudan’s Reticulational Model

Laudan’s complaint against Kuhn is twofold: his main complaint is that Kuhn’s model jettisons the rationality of science, and that therefore, “scientific decision making is” for Kuhn, “fundamentally capricious” (Laudan 143); his secondary complaint is that Kuhn’s model does not even accurately describe the historical record. Against this background, Laudan puts forth his reticulational model as an attempt both to accurately describe the historical record and to safeguard the possibility of rational consensus in science.

Laudan critiques Kuhn by pointing out an ambiguity in Kuhn’s use of the word “paradigm”. According to Laudan, Kuhn’s use of the word paradigm has three central meanings. First, a Kuhnian paradigm provides the practicing scientist with an *ontology*: it “specifies in a generic way the sorts of entities which are thought to populate a certain domain of experience and it sketches out how those entities generally interact” (ibid, 140). Second, a Kuhnian paradigm specifies certain *methodologies* for working with that paradigm's ontology. Lastly, a Kuhnian paradigm comes with a definite and exclusive set of ideals, or *axiology*, that determines standards of evidence and directions of research, and ultimately attempt to answer the question, “What are we attempting to achieve here?”

According to Kuhn, these factors are bound together “in an inextricable mixture” (Kuhn, 100): to learn a paradigm just *is* to learn this inextricable mixture of parts. Laudan by contrast argues that this inextricability of parts is precisely what is wrong with Kuhn’s model. Accordingly, the crux of Laudan’s solution is to “loosen up” the way in which the various parts of a paradigm hang together. For Laudan, the individual parts of a paradigm can (and often do) change without causing serious damage to the whole thing. Laudan argues that if one can ensure, both theoretically and empirically, that paradigms can and do change in a much more piecemeal fashion than Kuhn suggests, and if one can ensure that the individual steps are rational, then one can prove that the scientific enterprise as a whole is a rational undertaking.

Another important aspect of Laudan’s model, in contrast to Kuhn’s, is that while Kuhn seemingly only allows for one type of paradigm shift, Laudan allows for two. For Kuhn, paradigm shifts only happen when there are two rival paradigms, and a significant portion of the scientific community ‘jumps ship’ from one paradigm to the other. Examples that Kuhn himself uses include the Copernican revolution and the switch from a Newtonian to an Einsteinian understanding of space. Laudan refers to such shifts as *multitraditional* paradigm shifts. For Laudan, however, this is not the only—or even the dominant—type of paradigm shift. Laudan also argues that there is such a thing as a *unitraditional* paradigm shift. Within a unitraditional paradigm, the individual parts of a paradigm are replaced in a piecemeal fashion, peacefully and so smoothly that nature of such a shift as a scientific revolution would nearly go unnoticed were it not for the fact that we can “zoom out” on these historical shifts and notice not only the changes in their individual parts over a small course of time but also their final destination in the course of several years or even decades. Examples of unitraditional paradigm shift include, for Laudan, the adoption of Newtonian principles by Cartesian physicists, the shift from the inductive to the hypothetico-deductive method, and science’s abandonment of the quest for apodictic certainty. Laudan claims that unitraditional paradigm shifts are the standard cases of scientific change, and that multitraditional paradigm shifts are “nothing more than a degenerate instance of unitraditional change” (150). Furthermore, Laudan thinks that the inability of Kuhn’s model to account for certain drastic, unitraditional instances of scientific change—especially his inability to account for the specific cases of the introduction of the hypothetico-deductive model and the scientific abandonment of the quest for certainty—marks a strong case against that model and in favor of Laudan’s own model, which does account for these instances.

Now the mechanism of the reticulational model is best described as follows. A paradigm can be divided into three constituent parts: its axiology, its ontology, and its methodology. Each of these three parts stand in a complex relationship in which any two of those parts will either justify or, in cases where change is necessary, point to the inadequacy of, the third part of the triad. So for instance, axiological goals of a paradigm will support a particular scientific methodology, which will, in turn, justify a particular ontology. This methodology will lead to new discoveries in ontology that will also validate the goals of the program. The ontology will both exemplify the goals and constrain the methodology. Through the process of paradigm articulation, it may come to be the case that one realizes that either: 1) the goals and methodologies lead to new ontological discoveries, or even the replacement of old theories with better ones; 2) the goals of the theory may, in light of new theories, promote a new and improved methodology, or 3) the ontology and methodology may, in fact, *not* exemplify the intended axiology and, upon reflection, call for a shift in the goals of this science. When these individual changes occur, two of the three factors (axiology, ontology, and methodology) are used to determine a necessary modification of the third factor. Because the two factors are able to rationally adjudicate, the process can be seen as reasonable; and because large-scale scientific changes are basically amalgamations of these smaller decisions, science as a whole can be thought of as rational. This is the basic structure of Laudan’s reticulational model of scientific change.

# 3 Kuhn’s Hierarchical model

In order to form a proper contrast between Laudan’s model and Kuhn’s, it is necessary to sketch a rough outline of the intricacies of Kuhn’s model. We should begin by saying something about the central, though frequently misunderstood, Kuhnian notion of a *paradigm*.

First, Kuhnian paradigms are vague. Kuhn writes that “we must not […] seek a sharp or decisive [demarcation criterion]” (14) for distinguishing science from other enterprises; and throughout both *The Structure of Scientific Revolutions* and his later work, he prefers to illustrate the meaning of the term ‘paradigm’ by ostension and example rather than by logical definition. Kuhn even suggests that it is not so much his idea of paradigm as it is the paradigms *themselves* that have blurred boundaries, citing the closeness of science to philosophy on the one hand and engineering on the other (111). Paradigms frequently overlap in important ways, and in some cases, some paradigms are themselves sub-paradigms of other paradigms. For instance, both astronomy and radiation theory are important sub-paradigms of the larger paradigm of science in general.

Second, Kuhnian paradigms are holistic. Adjustments in basic theory are ultimately bound to lead to adjustments both in methodology and in the respective weight given to different cognitive values. Hence Kuhn states, “In learning a paradigm, the scientist acquires theory, methods, and standards together, usually in an inextricable mixture” (100).

Third, Kuhnian paradigms are defined primarily in terms of two aspects: 1) their central or core theory, and 2) their ability to promote a puzzle solving tradition. These two aspects do not, however, exhaust the total content of a given paradigm.

Kuhn makes it clear that a paradigm’s core theory is to be identified with its ontology: he uses the word ‘theory’ both as synonym for a paradigm’s ontology and as a designation for the paradigm itself;[[1]](#footnote-1) and he explicitly states that the content of the paradigm flows out of its core theory.[[2]](#footnote-2)

Kuhn alludes to the second main function that paradigms serve, providing useful puzzles, when he states, “Through the theories they embody, paradigms prove to be constitutive of the research activity” (100). Kuhn stresses the central importance of this role in his argument against Karl Popper when he states that research programs are both productive and scientific only insofar as they promote new and useful puzzles. Kuhn uses the example of ancient astrologers as a negative confirmation of this rule: “Though they had rules to apply, they had no puzzles to solve and therefore no science to practice” (16).

Another important part of Kuhn’s thesis is his distinction between theory and hypothesis. Hypotheses can be, and frequently are, rejected and/or revised. Core theory, by contrast, is not able to be revised short of rejection of the entire paradigm. Hence, Kuhn writes that “When engaged with a normal research problem, the scientist must *premise* current theory as the rules of the game” (12).

This quote brings us to the important distinction within Kuhn’s system between normal science and revolutionary science. Normal science “depends upon commitment to a paradigm” (Kuhn 93). This means that normal science is committed to certain core theories, has particular methodologies and goals, and develops in a progressive manner over time. Revolutionary science, however, does not operate under these conditions. Scientific revolutions tend to arise when anomalies in data stubbornly refuse, for projected periods of time, even under the analysis of the most adept experts of the field, to be rendered law-like within the context of the traditional paradigm. During periods of scientific revolution, fundamental ontological commitments are subjected to scrutiny and occasionally rejected; a traditional paradigm is usually forced to coexist in enmity with a rival program, or perhaps the solutions to puzzles within the traditional paradigm have themselves led to unintuitive results. During periods of scientific upheaval, there are no universally shared standards of methodology, and the shift from one paradigm to another is not progressive. Instead, the paradigm shift usually involves important trade-offs between different, mutually exclusive benefits that each of the different paradigms provide.

But scientific revolutions, just like political revolutions, are not necessarily revolutions for everyone. Kuhn insists that scientific revolutions, like political revolutions, are always revolutions for a certain group. He writes:

Scientific revolutions […] need seem revolutionary only to those whose paradigms are affected by them. To outsiders they may, like the Balkan revolutions of the early twentieth century, seem normal parts of the developmental process. Astronomers, for example, could accept X-rays as a mere addition to knowledge, for their paradigms were unaffected by the existence of the new radiation. But for men like Kelvin, Crookes, and Roentgen, whose research dealt with radiation theory or with cathode ray tubes, the emergence of X-rays necessarily violated one paradigm as it created another (Kuhn 86-87).

This means that a revolution may, for example, take place within the field of astronomy that has little or no impact on the practice of organic chemists.

One final but important aspect of Kuhn’s thesis is the ascription he gives to the relationship between science and values. According to Kuhn, “the criteria or values deployed in theory choice are fixed once and for all, unaffected by their participation in transitions from one theory to another” (114). A natural consequence of this is that values, since they are often shared by proponents of different paradigms, are unable of themselves to demarcate those paradigms from each other. Kuhn does, however, think that it can be, and often is the case that shifts in paradigms lead to corresponding shifts in the stresses that are given to different values. “Value change is ordinarily a belated and largely unconscious concomitant of theory choice” (115).

Although the above description of Kuhn’s tenets is by no means complete, I think it adequately covers the most important aspects of his general thesis on the nature of science and scientific revolutions. Let us return, then, to Laudan’s model.

# 4 Laudan’s Critique

In the following I show that Laudan’s critique of Kuhn misconstrues Kuhn on several key points. Specifically, it misconstrues Kuhn’s ideas on i) rationality, ii) the nature of paradigms, iii) their axiology, and iv) the character of paradigm shifts.

First, Laudan mistakenly claims that Kuhn claims that theory is unable to influence methodology. He writes, “[Kuhn’s] hierarchical model […] does not permit our beliefs at the level of theories to shape our views as to permissible methods, since justification in the hierarchical model is entirely downward from methods to theories” (148). But the truth is that in Kuhn’s model, just the opposite is true: the methods and values of a paradigm flow from its theories. What Laudan thinks Kuhn holds to be the least significant part of a paradigm is actually what Kuhn holds to be most central to it.

Second, Laudan misconstrues Kuhn’s notion of rationality. In discussing Kuhn’s treatment of the debate between Priestly and Dalton, Laudan writes, “Kuhn asserted that it was perfectly reasonable for Priestley to hold onto phlogiston theory, just as it was fully rational for most of his contemporaries to be converting to the oxygen theory of Lavoisier” (143). However, in the very comment to which Laudan refers, Kuhn states, that ““Though the historian can always find men—Priestly, for instance—who were *unreasonable* to resist for as long as they did, he will not find a point at which resistance becomes illogical or unscientific” (102). Kuhn explicitly states that Priestly was being *un*reasonable, but without being illogical. At a later point in his essay, Laudan expresses perplexity at the distinction between the two notions and gives what he believes to be a charitable interpretation of Kuhn. He writes, “Kuhn seemed to be saying that a scientist could always interpret the applicable standards of appraisal, whatever they might be, so as to “rationalize” his own paradigmatic preferences, whatever they might be” (157). But there is a much easier and more charitable way to understand Kuhn’s point here. Kuhn is merely stating that, while Priestly may have been being stubborn, and recalcitrant in holding so strongly to his paradigm and the values and problems that it emphasized, it was nevertheless impossible that he should be swayed from his values *by the laws of logic alone*. Such a claim is not particularly strange, and Laudan himself makes a distinction when he distinguishes between rationality and what he calls ‘ampliative rationality’.

Laudan’s appropriation of the central Kuhnian concept of ‘paradigm’ is also confused. Laudan is particularly unclear about what constitutes the most central portion of a paradigm. In some quotes, he describes Kuhn as identifying the ‘hard core’, of a paradigm with its core ontology. This vantage point is evident, for instance, when Laudan states, ““the core ontology of a world view or paradigm, along with its methodology and axiology, comes on a take-it-or-leave-it basis” (144). On other occasions, however, Laudan associates the core of a paradigm with its values. This is evident, for instance, when he states, “Indeed, to accept a paradigm is, for Kuhn, to subscribe to a complex of cognitive values which the proponents of no other paradigm accept fully” (141). This is also evident when, after explicating his own model, he claims that “Value changes do not always accompany, nor are they always accompanied by, changes in scientific paradigm” (153). Thus, insofar as his reticulational model is put forth as an alternative to explain how value change can happen without the upheaval of a whole paradigm, Laudan’s argument is simply an *ignoratio*.

Fourth, Laudan is also unclear about what constitutes a paradigm’s axiology. Specifically, it is unclear whether Laudan means to include the puzzle-solving aims of a paradigm under this banner as well. This confusion is evident when Laudan states, ““Although the partisans of two paradigms may (and usually do) share some aims in common, Kuhn insists that the goals are not fully overlapping between followers of rival paradigms” (141). Now if Laudan’s use of the word ‘aims’ here is meant to correspond to what Kuhn refers to as the *values* of science, then Laudan’s claim is simply false. If, on the other hand, it is meant to refer to the lesser aims of a paradigm—the particular puzzles that it seeks to solve—then it is irrelevant to the reticulational model’s goal of showing that a paradigm’s axiology can change independently of its other parts.

One last problem with Laudan’s use of terms is that he frequently conflates the terms “change” and “paradigm shift”. For instance, Laudan claims that Kuhn holds that “individual paradigms have an integral and static character […] changes take place only between, rather than within, paradigms” (142). This statement is simply false. Kuhn admits that paradigms change over time: they grow as they accumulate more auxiliary hypotheses to sublimate recalcitrant data to the central theory of that paradigm; and hypotheses outside of the core theory are adopted or junked. If Laudan’s statement is revised so as to be more indicative of one of Kuhn’s actual claims—that scientific revolutions only take place when one must choose between *rival* paradigms—then it again shows one of the main theses of the reticulational model—its insistence that there can be unitraditional paradigm shifts—to be an *ignoratio*. If the goals of the unitraditional paradigm shift are merely to account for intra-paradigmatic change, then Kuhnian paradigms already serve this purpose, and it is unclear how Laudan’s model differs here from Kuhn’s on this point.

# 5 What the Reticulational Model Ignores

In this last part of my essay I intend to focus on several important aspects of Kuhn’s theory that Laudan’s theory ignores.

First, Laudan neglects the importance of puzzle solving for Kuhnian paradigms, and Laudan’s own model says virtually nothing about puzzle solving. This omission would not be so problematic if it were not the case that puzzle solving is so central to Kuhn’s model that Kuhn had already nominated it for the role of a demarcation criterion in his earlier arguments against Popper. Such an omission is conspicuous, especially when Laudan’s own model does not replace Kuhn’s model with anything on this point.

Second, Laudan’s model lacks a clear distinction between normal and revolutionary science. This is especially evident in Laudan’s claim that one can use any two “legs” of the reticulational model, in the face of recalcitrant data, to rationally mandate a replacement in the area occupied by the third leg. The only way that Laudan can make this claim, however, is if he holds that the weight of any one of the main three components can never exceed the combined weight of the other two. But this issue of weighting is just what Kuhn’s own model rightly called attention to against the Bayesian and positivistic currents of his own day. Laudan’s model never sufficiently addresses issues of weighting—be it in the mechanisms of the reticulational model, the distinction between theory and hypothesis, or the nature and possibility of so-called unitraditional paradigm shifts.

Third, Laudan is inattentive to Kuhn’s insistence on the intentional character of scientific revolutions, in particular in two instances. First, Laudan cites the case of Cartesian physicists slowly capitulating to Newtonian principles as one example of a paradigm shift for which Kuhn’s model is unable to account. But this seems to be a case not of Kuhn’s model being unable to account for a revolution, but of Laudan’s model seeing a revolution where there is none. The adoption of these principles by the mechanists cannot be called a revolution, but is rather the dross of the revolution that had already begun and passed. It is reasonable to surmise that the run-of-the-mill mechanistic scientists were not necessarily any more dogmatically committed to the mechanistic cause than the employees of a given company are actively committed to furthering the goals of their employers. A revolution is only a revolution for those who are both 1) conscious of it and 2) concerned. In spite of their general higher level of erudition than the rest of society, there seems to be no innate reason to presume that Cartesian physicists were experiencing a crisis; and for those that were of a noble enough mind to envision the high consequences of Newton’s discoveries, and nevertheless capitulated, such a case can easily be accounted for by Kuhn’s model: either they genuinely converted to the Newtonian cause, or they may have surrendered under the pressure of the tide—perhaps in fear of some external pressure, financial, social, or otherwise. The question then becomes a question not of which paradigm accounts for the facts; rather, the question becomes “whose provides a more intuitively and well-reasoned explanation of the phenomena?” And on this question, logical considerations alone do not provide an unequivocal answer in favor of one or the other.

The second instance in which Laudan actually neglects this important aspect of scientific revolutions is in one of his main critiques of Kuhn—that Kuhn comes to his thesis on the nature of these scientific revolutions simply because he paints with too wide of a temporal brush. According to Laudan, Kuhnian revolutions seem non-rational merely because Kuhn portrays decades of intense scientific and philosophical activity as if they happened in an instant. But I suggest that the problem is not so much that Kuhn is engaging in a type of tunnel vision regarding the temporal dimension of these revolutions as it is that Laudan’s himself overlooks the intensely personal character of these revolutions. In this respect, Kuhn grasps a central psychological and sociological insight that Laudan misses. While revolutions are not revolutions for everybody, they certainly are for those who are most effected by them; they certainly are for the Leibnizes, Newtons, Einsteins, and Lorentzes of the scientific world. For the average American, the invention of the telegraph was a great improvement for the times and a wonderful new convenience; but when Samuel Morse sent the first message across the wire, containing the words “what hath God wrought”, he presumably understood the strange and awesome weight of the invention that had come forth from his hands. Hume’s writings were widely enough read in their own day, and yet many read them without having any more of a disturbance than the ill taste in one’s mouth after a bad drink; yet for Kant, the piercing words on Hume’s page were enough to wake him from his dogmatic slumber. Scientific revolutions are only apt to be most touching to those of a deep philosophical bent upon whose concerns they have a deep impact.

# 6 Conclusion

In conclusion, Laudan’s argument against Kuhn misunderstands Kuhn’s model in important ways. Laudan misunderstands Kuhn’s idea of rationality, even though Laudan himself employs a similar idea in his own work elsewhere. He misconstrues the basic structure of a Kuhnian paradigm. His construal of the axiology of a Kuhnian paradigm is vague. As a result, Laudan directs his reticulational model towards solving the problem of how value change is possible without shifts in every part of a paradigm—a problem which, given that Kuhn thinks that the values of science are trans-paradigmatic, is non-existent for Kuhn’s model. Ironically, the very fact of this misunderstanding seems to provide confirmation of *Kuhn’s* view: the concerns motivating Laudan’s model are weighted very differently from those that motivated Kuhn’s, and to the degree that this was the case, the participants of *this* debate seem to have been talking past each other.

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1. For instance, he does this when he writes, “When [crucial experiments] occur, they are generally called forth either by a prior crisis in the relevant field […] or by the existence of a theory which competes with the existing canons of research” (13). Laudan follows him in this respect. Cf. Laudan, 140. [↑](#footnote-ref-1)
2. Hence, Kuhn states, “Paradigms provide all phenomena except anomalies with a theory-determined place in the scientist’s field of vision” (90). [↑](#footnote-ref-2)