Descriptions of Scientific Revolutions: Rorty's Failure at Redescribing Scientific Progress

Kyle Cavagnini

Abstract: The twentieth century saw extended development in the philosophy of science to incorporate contemporary expansions of scientific theory and investigation. Richard Rorty was a prominent and rather controversial thinker who maintained that all progress, from social change to scientific inquiry, was achieved through the redescription of existing vocabularies. However, this theory fails to describe revolutionary scientific progress. Thomas Kuhn's theories of paradigm change, as first described in his seminal work *The Structure of Scientific Revolutions*, better portray this process. I attempt to show this by applying Kuhn's and Rorty's views to examples of scientific progress and comparing the results.

Richard Rorty was arguably one of the most controversial thinkers of the latter twentieth century. His embrace of neo-pragmatism inspired a renewed interest in the pragmatic tradition of the philosophical community at large and precipitated countless debates in contemporary philosophical studies. Among his many problematic claims is his assertion that any type of progress is achieved through redescription of previous vocabularies. I will argue that this theory has dangerous implications when applied to revolutionary scientific advance. Redescription ultimately fails to account for the change that occurs during such periods in scientific practice, and is ultimately disingenuous towards that progress. Thomas Kuhn's theories, as they first appear in *The Structure of Scientific Revolutions* and as they evolve over the course of his life, provide an answer to this failure, and ultimately provide a more accurate means of describing revolutionary scientific progress.

The philosophical project of Thomas Kuhn was to provide a model of scientific progress that could account for the revolutionary spectrum of scientific practice. Kuhn, in his influential work *The Structure of Scientific Revolutions*, proposed that revolutionary science is the shifting from one paradigm to another. Kuhn described a paradigm as a set of theories, practices, and exemplars that define the conceptual mindset and occupation of science for a set period. Kuhn later suggests that the term "disciplinary matrix" might better serve his purpose. The disciplinary matrix is "the common possession of the practitioners of a professional discipline" that sets the conceptual foundation for the work done within that field.[1,2]

I. Rorty and Redescription

Richard Rorty believed that previous eras of philosophy focused on working within what he called their respective final vocabularies. These final vocabularies mediated the ways in which they "judged their actions, their beliefs, and their lives."[3] The concept of final vocabularies is not limited to philosophical inquiry, however, but extends out to every aspect and project of human existence. Any practice, action, idea, or statement is made within the bounds of one's own final vocabulary, the cultural and personal foundations in which one's beliefs, actions, and practices are constructed and described. Rorty argues that confining one's self to working within a single category leads to intellectual, cultural, and personal stagnation. To address this, Rorty introduces the concept of the ironist and ironic redescription.

---

[1] Thomas Kuhn, "Second Thoughts on Paradigms," in *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago, University of Chicago Press, 1977): 297.

[2] I shall use the term disciplinary matrix and paradigm interchangeably throughout this paper. We shall see that this system of paradigm change better models revolutionary scientific practice than does Rorty's concept of redescription.

[3] Richard Rorty, *Contingency, Irony, and Solidarity* (Cambridge: Cambridge University Press, 1989): 73.

An ironist is an individual who, in Rorty's words, "has radical and continuing doubts about the final vocabulary she currently uses" such that "she does not think her vocabulary is closer to reality than others."[4] To overcome these doubts and to reinvestigate the situation, the ironist uses redescription. Because previous explanations do not satisfy every need, the ironist recasts her vocabulary, changing and modifying it until it works for her current situation. This redescription changes the basis of one's final vocabulary, shifting those foundations in some way such that a change is made to address the inadequacies that arise within a given final vocabulary, and by extension within the situation of a culture and an individual. However, once the vocabulary is no longer able to describe the ironist's situation, she once again embarks on the path of redescription, entering into a never-ending cycle of redescription and "re-re-redescription."[5]

The ironist's project is not wholly private; it is instead a social phenomenon. The ironist redescribes in hopes of "inciting people to adopt and extend" their ideas and beliefs.[6] Through adding new meaning to old words and creating "neologistic jargon" the ironist essentially wishes to change the final vocabulary of the day by "[comparing] the results [of the redescription] with alternative redescriptions," and through this process incite some sort of personal, social, scientific, or cultural progress.[7,8]

While this process of redescription may seem to work for select circumstances, one falls drastically short when applying the concept of continual redescription to science. Within scientific progress, specifically in regards to revolutionary scientific progress, one cannot simply redescribe the current scientific theories and expect to have a new conceptual framework as a result. In addition, one must be able to make a statement that one scientific theory better describes observed phenomena than another, something for which redescription does not allow.

[4] Ibid.

[5] Ibid., 80.

[6] Ibid., 78.

[7] Ibid.

[8] Ibid., 80.

Consider the changes that have occurred in physics over the past two centuries. In Newtonian mechanics, concepts such as velocity, momentum, position, and energy were absolute. There were debates about how to come up with more accurate modifications to theories, but these modifications were always done with the classic work of Newton's *Principia* in mind. However, with Faraday's discovery of cathode rays in 1838 and the subsequent failure of Newtonian mechanics to account for the very small, it became apparent that a new theory was needed to account for radiation. This debate continued for the rest of the nineteenth century until, in 1900, Max Planck hypothesized that energy radiating from an atomic system could be described in terms of quanta, or discrete elements.[9] Out of this concept came Einstein's proof of the photoelectric effect, Heisenberg's Uncertainty Principle, the Bohr model of the atom, and a whole new era in physics. To make matters worse for Newton, Einstein also proposed his general and special theories of relativity during the first two decades of the twentieth century. These two theories showed that space and time are essentially relative, not absolute. The classic Newtonian definitions could no longer be accepted as wholly true, and Newtonian mechanics were essentially shown to apply only as a special case.

To give a further example of such revolutionary scientific progress, consider the discovery of DNA's structure by Watson, Crick, and Franklin. While the nineteenth century monk Gregor Mendel had, in his various pea studies, described measurable trait inheritance from one generation to the next, the exact biological mechanism of this phenomenon was still unknown. There was speculation in the first half of the twentieth century that proteins might play some role, yet specific theories always came up against some insurmountable hurtle. With the 1953 discovery of the double-helix structure of DNA, however, the answer to this mystery was immediately discerned. As Watson and Crick said in their seminal paper "it has not escaped our notice that the specific paring we have postulated immediately suggests a possible copying mechanism for the genetic material."[10] From the structure they discovered, a new biotechnology revolution has been occurring in the

[9] Werner Heisenberg, "The History of Quantum Theory," *Physics and Philosophy: The Revolution in Modern Science* (New York: Harper Perennial, 1958).

[10] J. Watson and F. Crick, "Molecular Structure of Nucleic Acids," *Nature* 171, no. 4356 (1953): 738.

biological sciences for the past six decades, with achievements ranging from being able to describe the molecular basis of genetic inheritance in all known life to the sequencing of the human genome.

If we were to apply redescription to these events, it would fall short. These scientific revolutions, these amazing bursts of insight and discovery, were not achieved through a redescription of previously existing concepts. Instead, they created their own theories that, while built off of a previous knowledge base, shattered the previously held models of the universe. Old theories were not redescribed, but were improved upon and, indeed, *surpassed*. Note the above passage where Rorty calls for an extension and adaptation of ideas through redescription. Revolutionary scientific progress does not extend out from a common basis in a discipline, but instead calls for that basis to be completely reformulated in a new paradigm. To apply this to the previous physics example, for quantum mechanics to come about, physics had to move beyond the traditional definitions of momentum and position, replacing them with probabilities for the very small. Similarly, special and general relativity needed concepts of space and time to change from fundamental constants to corresponding constructs. Redescription extends the previous paradigm outward, but it does not allow for a new disciplinary matrix in the full sense of Kuhn's theories.

Classical mechanics cannot be redescribed to give the conceptual framework of quantum mechanics. Again, in classical mechanics momentum and position were simply separate concepts that, while one could be used to predict the other, never infringed upon each other. However, in quantum mechanics, Heisenberg's Uncertainty Principle states that certain properties, such as position and momentum, have a relationship such that the more accurately one value is measured, the less accurately one will be able to determine the other. Such an interrelationship would never have been conceived in classical mechanics, much less taken to be a statement about our ability to describe the universe. The ironist's linguistic manipulations and language games cannot account for such revolutionary changes in prior conceptual frameworks. Words that were previously outside of the scientific vocabulary entered into it because they were needed to describe the new findings that the existing vocabulary could not accurately portray, not because

Planck, Einstein, or Crick were playing Rortian language games. As Rorty said, "ironists specialize in redescribing ranges of objects or events in partially neologistic jargon."[11] New words *do not* equal new scientific theories.

II. Kuhn and the Structure of Revolutionary Science

In Kuhn's theories, science preoccupies itself for the majority of the time in normal science. Normal science is any research, theorizing, or experimentation that is "firmly based upon one or more past scientific achievements" that are recognized as "foundational" for the current practice of that discipline.[12] In other words, normal science is the practice of a scientific community working to expand the purview of the current disciplinary matrix, teasing out all the areas to which the contemporary scientific theories can be applied.[13,14] To relate this to our previous example, prior to the quantum mechanical revolution, the Newtonian paradigm was used. The vast majority of physics during the seventeenth, eighteenth, and nineteenth centuries was concerned with the expansion of classical mechanics to describe various observed systems, such as gas behavior, chemical reactions, and thermodynamics. However, once those theories were seen to fall short in describing certain phenomena the new quantum mechanical paradigm was proposed as a counter to classical mechanics, and there is a latent possibility that a similar situation may arise within quantum physics at some point in the future.

Revolutionary scientific progress occurs when the current paradigm is unable to describe certain existing or newly observed phenomena. In fact, this is implicit within the concept of normal science; a disciplinary matrix, while it is able to explain many problems within that field, "need not, and in fact never does, explain

[11] Rorty, *Contingency, Irony, and Solidarity*, 78.

[12] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (Chicago: University of Chicago Press, 1996): 10.

[13] This is very similar to Rorty's concept of redescription, and it could be argued (perhaps accurately) that Rorty's structure for changing vocabularies encompasses what Kuhn calls "normal science." However, this breaks down when one looks at the special, and in many ways foundational, case of revolutionary scientific progress.

[14] For a specific account of a normal science process in the twentieth century (notably in the closing section "Philosophical Implications") see: Richard M. Pagni, "The origin and development of the acidity function," *Foundations of Chemistry: Philosophical, Historical, and Interdisciplinary Studies of Chemistry* 11, no. 1 (2009): 43-50.

all the facts with which it can be confronted."[15] This ever-present, essential tension in normal science is what eventually catalyzes scientific revolution. Scientific revolution can in many ways be viewed as the abnormality within scientific progress. Indeed, most scientists "[aim] to elucidate the… tradition in which [s]he was raised rather than to change it."[16] However, when there arises a problem such that it "[refuses] to be assimilated into existing paradigms," that "[calls] into question explicit and fundamental generalizations of the paradigm," science finds itself within a crisis.[17,18] The previous exemplars of a conceptual background cannot adequately be applied, and normal science no longer functions optimally. It is in this climate that revolutionary science will arise.[19] If a proposed theory is better able to explain the crisis-producing anomalies and provide a framework that can be utilized in researching other problems within the field, then the scientific community at large might accept the new paradigm. As Kuhn put it, this "transition to a new paradigm is scientific revolution."[20,21]

To once again return to our examples, the quantum revolution applies not only to the proposal of quantum mechanics to explain the failings of classical mechanics, but also to its propagation into the scientific community as more and more scientists began to use the quantum paradigm as their disciplinary matrix. This resulted in what could be viewed as a feud between adherents of the two schools, with the members of the quantum mechanical paradigm eventually becoming the predominant body of thought through their ability to better explain the experimental phenomena emerging in the early twentieth century. To reiterate the point, redescription could not have produced such an effect. Thomas Young's classic

---

[15] Kuhn, *The Essential Tension*, 234.

[16] Ibid.

[17] Ibid., 97.

[18] Ibid., 82.

[19] See: Paul Hoyningen-Huene, "Thomas Kuhn and the Chemical Revolution," *Foundations of Chemistry: Philosophical, Historical, and Interdisciplinary Studies of Chemistry* 10, no. 2 (2008): 101-115.

[20] Ibid., 90.

[21] It should be noted that Kuhn was interested in the theory only, and as such this paper is discussed within that limit. Recent developments in philosophy of science have put forth systems that incorporate experimentalism with the theoretical basis to better describe the everyday practice of science (the "normal" science). For such a development involving Kuhn's theories, see: James A. Marcum, "Horizon for Scientific Practice: Scientific Discovery and Progress." *International Studies In The Philosophy Of Science* 24, no. 2 (2010): 187-215.

double-slit experiment provides an excellent example of this. In 1801, Young devised an apparatus that passed light through two layers of material, the first having one slit through which the light could pass and the second having two. After passing through the slits the light was detected by a photometric plate. Young used the results obtained within the bounds of *classical mechanics* to explain the wave nature of light. However, the experiment was revisited by early quantum physicists and even used by Einstein as one confirmation of his theory of the photoelectric effect (for which he won the 1921 Nobel Prize in Physics).[22] The experiment was understood in light of a new disciplinary matrix; it was adopted as an extension of quantum, not classical, mechanics in that it showed the wave-particle duality of light.

This new understanding was not a redescription of terms or vocabularies used to describe the original conclusions of the experiment, but was a changing of the underlying conceptual basis used to interpret the results. Heisenberg said that Newtonian physics was a closed system of knowledge, and as such no further improvements could be made to the framework.[23,24] The vocabulary of that previous paradigm could in no way conceptualize the new concept of light as both wave and particle, and thus could not be redescribed into the emerging quantum theory.

However, the case is somewhat different with the discovery of DNA's structure. Instead of an argument around a previously held disciplinary matrix, the scientific community was more fluid about what was accepted as the molecular basis of inheritance. Out of this murk of various theories, the discovery of DNA's structure almost overnight revolutionized a field. In many ways, one could view the preceding decades, in which it was known that there was a yet unidentified molecular mechanism of inheritance, as an extended period of scientific crisis. The structure of DNA provided an answer to this crisis that was readily accepted by most, if not all, of the members of the field as the material from which a new disciplinary matrix could be built. The discovery of the molecular origins of inheritance, coupled with the ongoing biotechnology revolution that has lasted the past six decades and continues through today, has provided an environment in which members of the molecular biology

[22] Niels Bohr, "Discussions with Einstein on Epistemological Problems in Atomic Physics," *Atomic Physics and Human Knowledge* (New York, NY: Dover Publications, 2010): 32-66.

[23] Ian Hacking, "The Self-Vindication of the Laboratory Sciences," *Science as Practice and Culture*, ed. Andrew Pickering, (Chicago, IL: University of Chicago Press, 1992): 39.

[24] Alisa Bokulich, "Heisenberg Meets Kuhn: Closed Theories and Paradigms," *Philosophy of Science* 73 (2006): 90-107.

community have been readily able to solidify the paradigmatic basis of their field.[25]

III. Redescription's Ultimate Failure

Kuhn's work provided a new framework in philosophy of science that garnered much attention, leading some of his theories to be adopted outside of the natural sciences. Unfortunately, some of these adoptions have not been faithful to Kuhn's original theories, and at times just plain erroneous conclusions are drawn that use Kuhn as their justification. These misreadings not only detract from the power of Kuhn's argument, but also serve to add false support for theories that Kuhn was very much against; Rorty was one such individual. Rorty claimed that Kuhn was "one of [his] idols" who very much influenced his own thought.[26] Rorty claims that Kuhn's arguments provide support for his own theories of redescription by showing that any revolutionary change in theory is simply a matter of "changing the terminology in which truth candidates [are formulated]."[27] This view is considerably relativistic in that Rorty is justifying that "there is no single model for good work in an academic discipline, that the criteria for good work have changed throughout the course of history, and will continue to change."[28] Rorty describes the realization of this process across disciplines as "Kuhnianization."[29]

These claims and passages take liberties with Kuhn's theories that are neither justified nor accurate, particularly in the domain of the natural sciences. By using Kuhn's theories to explain his own relativistic ones, Rorty would like to place the same relativist label on Kuhn. By redescribing not only the vocabulary of a discipline, but also the foundations of a discipline itself, Rorty's theories posit that there is absolutely no way of saying one scientific theory is better than another (Later in life he tries to back away from this position and equate scientific progress with moral progress, but his argument ultimately falls back into the extensive

[25] The field of molecular biology leads nicely into the investigation of the interplay between paradigm and instrumentation, and the means by which changing instrumentation can result in changing paradigms. See Hacking (1992) for an extended discussion of this reciprocity.

[26] Richard Rorty, "Thomas Kuhn and the Laws of Physics," *Philosophy and Social Hope* (London: Penguin, 1999): 175.

[27] Ibid., 176.

[28] Ibid., 181.

[29] Ibid.

relativism that is one marker of its failure to apply to science). Kuhn distances himself from the relativism of Rorty, explicitly stating that his theories are "not a relativist's position."[30] He feels completely justified in saying "one scientific theory is not as good as another for doing what scientists normally do" in that some are better able to model and predict observed phenomena and puzzles.[31] Rorty gives this some slight acknowledgment, however it is clear that the overall message he takes from Kuhn is that because of the ineffectiveness of debating whether Aristotle's or Newton's physics was "more scientific," one is justified in taking a relativistic stance towards scientific paradigms.[32] This ignores the "shared and justifiable… standards that scientific communities use when choosing between theories," both within a paradigm and during a period of paradigm shift.[33]

Central to the ironist's concept of progress is the construction of narratives. The narrative is the way through which the ironist redescribes vocabularies and achieves some sort of progress. Let us consider the role of the narrative in science to see how Rorty's redescription again falls short. Central to the goals of science and scientific progress is the scientific narrative. In science, one approaches a problem with a set strategy to obtain as much data supporting a hypothesis as one can, given restraints of equipment, time, money, and materials. Science is a discipline of "puzzle-solvers," where the puzzles are along the lines of "what malfunctioning proteins cause cancer" or "what atmospheric conditions give rise to harmful oxidative reactions."[34] To solve the puzzle, the scientist must utilize her own previous knowledge to devise a way in which some effect can be measured that would provide supporting evidence for the occurrence or absence of a phenomenon. To present this data to other scientists, the investigating researcher integrates the evidence gathered to assemble a narrative of how the observed experimental results support the claim the scientist has put forth. The way in which the scientist constructs this narrative, down to the methods used to gather data, is invariably

---

[30] Kuhn, *The Structure of Scientific Revolutions,* 206. (emphasis added)

[31] Thomas S. Kuhn, James Conant, and John Haugeland, *The Road Since Structure: Philosophical Essays, 1970-1993, with an Autobiographical Interview* (Chicago: University of Chicago Press, 2000): 160.

[32] Rorty, "Thomas Kuhn and the Laws of Physics," 179-180.

[33] Kuhn *et al.*, *The Road Since Structures,* 76.

[34] Kuhn, *The Structure of Scientific Revolutions,* 205.

bound within the disciplinary matrix of the scientist. One purpose of The Structure of Scientific Revolutions was to show that science did not progress as one linear, unbroken line, but instead was characterized by periodization.[35] This periodization can be thought of as the progression from one paradigmatic narrative to another.[36]

In revolutionary scientific progress, the tension begins when the current paradigm is unable to account for a significant selection of observed phenomena. Consequently, the community of a discipline must eventually overcome this tension with a new paradigm, one that is better able to describe observations and properly explain the short-comings of the previous disciplinary matrix. Rorty's ironists, however, "are content with mere difference."[37] This lack of concern for the progression of accuracy is alarming when applied to science. When paradigms are compared there is more than mere difference, there is a direct comparison between results obtained. The goal is that one paradigm will provide the more accurate description/model of the problem(s) which caused the tension to arise within the discipline; one paradigm will provide an answer that better explains and incorporates the observed phenomena than the other. Thus, via comparisons across the results obtained by different paradigms, one is able to move beyond mere difference and make a distinct statement about progress, a step that the relativist Rorty does not allow.

Kim points out that for Rorty the goal of philosophy is not striving towards philosophical truth, as there is no such truth for Rorty.[38] Therefore, progress from vocabulary to vocabulary (what Kim calls the tension between edifying and systematic

---

[35] This bears an amusing yet accurate resemblance to the concept of Punctuated Equilibrium in evolutionary biology. This analogy has been criticized by some, but a refutation of such (erroneous) criticisms can be found in: Thomas A.C. Reydon and Paul Hoyningen-Huene, "Discussion: Kuhn's Evolutionary Analogy in *The Structure of Scientific Revolutions* and "The Road since Structure," *Philosophy of Science* 77 (2010): 468-476.

[36] This is not to be confused with the narratives of normal science.

[37] Rorty, *Contingency, Irony, and Solidarity*, 101.

[38] Jaegwon Kim, "Rorty on the Possibility of Philosophy," *The Journal of Philosophy* 77, no. 10 (1980): 588-597.

philosophy) is not searching for some sort of truth. Rather, it is a means of progressing a dialogue so that the boundaries of philosophical discussion may be pushed into different, (hopefully) novel directions.[39]

Rorty states "the liberal ironist does not think her vocabulary is closer to reality than others."[40] The failure to make a judgment between theories about reality essentially nullifies any claim redescription can hope to have on describing scientific progress, as science is essentially using experimental methods and observations to inform paradigms, and vice versa, towards elucidating details about the world. One is able to say that the physics of Heisenberg and Bohr is a better representation of reality than that found in Aristotle's *Physica vis-à-vis* experimental observation because "later scientific theories are better than earlier ones for solving puzzles... That is not a relativist's position, and it displays the sense in which [Kuhn is] a convinced believer in scientific progress."[41] In Kuhn, progress through paradigms is marked by the improvement of science as a "better instrument for discovering and solving puzzles."[42] It is precisely because we are able to say one theory is more effective (and accurate) at describing reality that we are able to have any kind of scientific progress at all.[43]

Kuhn was aware of the dangerously mistaken manner of approaching scientific progress expressed by Rorty. In discussing the nature of paradigm shifts and how they direct future research, he says that while a "restatement," or redescription of an old theory within a new theory could have some utility, it ultimately "could not suffice for the guidance of research" unless the concept has been fully

[39] For Rorty, this discussion involved moving beyond philosophical dialogue as pertaining to "philosophical problems" only, instead focusing on the role of philosophy in practice via interaction with select disciplines.

[40] Rorty, *Contingency, Irony, and Solidarity,* 73.

[41] Kuhn, *The Structure of Scientific Revolutions,* 206.

[42] Ibid.

[43] Whether or not what we have is a "true" representation is cultural interpretation, and that will change over time as theories improve and sentiments evolve. However, that does not mean the goal of finding that which maps onto observed phenomena is any less valid. We use the exemplars, the equations, and the theories that best explain the answer, as determined by the community of a scientific discipline. If we are to completely exclude the possibility of ever achieving a valid representation of reality, then we are to exclude the practice of science itself from our everyday lives in the sense that science strives to elucidate reality from the paradigm that it finds itself situated within historically.

incorporated into the new paradigm.[44] The languages between past and current paradigms are not equivalent, and thus redescription is simply an inescapable recycling of the current scientific descriptions. As Kuhn succinctly put it, "one cannot get from the old to the new simply by an addition to what was already known."[45] Redescription ultimately fails to provide a conceptual grounding for explaining revolutionary scientific progress because it claims that one *can* get to the new by addition to the old. Kuhn is able to account for this failure in that his theories for progress from paradigm to paradigm do not allow for simple addition of knowledge, but instead call for a questioning, revisiting, and reformulation of previously held notions within specific disciplines, and those underlying science as a cultural practice itself. In this one does not simply add new knowledge, but changes the very way in which we understand and interpret results in the world through the scientific narrative. ❖

[44] Kuhn, *The Structure of Scientific Revolutions,* 103.

[45] Kuhn *et al.*, *The Road Since Structures,* 15.