Science as Paradigmatic: A Critical Analysis of Thomas S. Kuhn's View of Normal Science

O Timothy, keep that which is committed to thy trust,
avoiding …oppositions of science falsely so called (1Tim. 6:20, KJV)

INTRODUCTION

What is science? How does science work? With the advent of the postmodern era, questions and answers regarding science have also begun to change.[1] In this paper, I would like to look at philosopher of science Thomas S. Kuhn' view regarding science or what he calls 'normal science', and critically engage it in light of its implications and imports for the Christian faith.

HISTORICAL BACKGROUND

The time we live in is the time of science. Science it seems has delivered on its promises. From antibiotics to treat various bacterial infections to putting Man on the moon, the ability of Science to better our lives validates it to the masses, such that whatever scientists say take on the air of authority in our contemporary society.

Yet despite the many benefits we have enjoyed from the scientific research by scientists, there is no unanimous definition of what "science" is, besides the circular description of 'what scientists do'.[2] C. John Collins gives us one definition of science which he was taught—that science is "the collection of data from observations of the world, and then the organizing of those observations in a way that leads to a generalization called a 'law.' "[3] In my own learning, science was taught to be an objective way of gaining true information of the world by rigorous

[1] In this paper, I am using the term "science" not in the older idea covered by the German word *Wissenschaft* which refers to any learning of knowledge, but in its contemporary English usage and scope in popular culture, with particular emphases on the mathematical, physical, chemical and biological sciences.
[2] C. John Collins, *Science and Faith: Friends or Foes?* (Wheaton, IL: Crossway, 2003), 29
[3] *Ibid.*, 30. This definition is in line with that of classical Baconian inductivism. See Del Ratzsch, *The Battle of Beginnings: Why Neither Side is Winning the Creation-Evolution Debate* (Downers Grove, IL: IVP, 1996), 106-8.

employment of the 'scientific method'—the hypothetico-deductive methodology.[4] Both of these seem to limit science to the explanation of experimentally testable phenomena. We are taught that through scientific research, true knowledge of the world and how it functions can be obtained in ever increasing quantity to give us scientific progress or the growth of knowledge.

However, is that how science actually works? Since the beginning of the twentieth century, criticisms of traditional theories of science have proliferated. Baconian inductivism had been discounted because "there is no known rigorous logical procedure by which theoretical principles can be inferred from empirical data."[5] The reigning theory of science in mainstream science, the hypothetico-deductivist model, is discredited within philosophical circles, although such discreditation has yet to be filtered down to the scientific community and the culture as a whole.[6] For example, Del Ratzsch states that in the hypothetico-deductivist model, "any given collection of empirical data is always consistent with and can be explained by any number of distinct, alternative theories."[7] Twentieth century Christian philosopher Gordon H. Clark in his polemics against the use of science as a valid source of knowledge aimed his guns primarily against the hypothetico-deductivist model, and more broadly against the fallacy of induction present in scientific methodology, promoting his chosen alternative of scientific anti-realism in its place.[8]

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[4] The hypothetico-deductive scientific method, which is derived from positivism, operates as follows: A scientist formulates a null hypothesis (H_0) and an alternate hypothesis (H_1) to explain a particular phenomenon. Empirical experiments will be conducted and the results from such experiments will be compared with that predicted by the null hypothesis. If the results agree (normally done with a statistical analysis of the degree of fit or Confidence Interval, mostly a 95% Confidence Interval), the null hypothesis is proven. Otherwise, it is rejected and the alternate hypothesis accepted. See also Del Ratzsch, 108-11 for a discussion on this theory.

[5] *Ibid.*, 107

[6] As a science graduate, that has been my observation at least for me and my peers, and the professors I have studied and done experiments and research under. To be fair, Popper's falsification theory (discussed below) was mentioned, but it was seen as a complement to the traditional hypothetico-deductivist model, probably to Popper's chagrin if he knew how his theory was utilized.

[7] Del Ratzsch, 110

[8] Gordon H. Clark, *The Philosophy of Science and Belief in God* (Unicoi, Tennessee: Trinity Foundation, 1996). Clark made much of the fact that there is a potentially infinite number of lines/curves which are able to connect a

In the discipline of the philosophy of science, such criticisms of the hypothetico-deductivist model have inspired new models of science and scientific methodology to arise. Probably the most conservative of the twentieth century science philosophers, Sir Karl Popper has reworked the hypothetico-deductivist model to form his theory of falsificationism, in which the aim of science is not to prove theories but to disprove them.[9] In the light of more recent critique, Popperian Imre Lakatos has differentiated what he calls 'methodological or sophisticated falsificationism' from 'naïve or dogmatic falsificationism', holding the former with Popper.[10] Thomas S. Kuhn, discussed in more detail later, came up with his novel theory of scientific revolutions in his landmark book *The Structure of Scientific Revolution*s, in which science is always done within the context of a paradigm, and paradigms do change in history through what Kuhn calls 'revolutions' or 'paradigm shifts.'[11] The most radical of them all, Paul Feyerabend, is a self-proclaimed anarchist or 'Dadaist' who is for pluralism in science, or as he says it in a tongue-in-cheek manner, "anything goes."[12]

KUHN"S VIEW OF NORMAL SCIENCE: NORMAL SCIENCE AND PARADIGMS

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series of points on a Cartesian graph. For example, given the three Cartesian coordinates (1.01, 2.10), (2.02, 5.06), (2.76, 7.54), one could either plot the equation $y = 3x - 1$ or $y = \frac{4x^2 - 4x + 2}{x}$, and both equations would approximately fit the given coordinates (See Appendix 1). The criterion of simplicity—of choosing one over the other (Occam's razor) is a philosophical claim which is decidedly non-empirical in nature (cf. Del Ratsch, 111) and does not necessarily lead to the truth, for after all, why must the truth necessarily be simple?

[9] The hypothetico-deductivist model is a verificationist model seeking to prove truths through the testing of hypotheses. Popper's model however seeks not to prove truths, but to disprove errors, and in so doing, to "get nearer to the truth." [Karl Popper, "Normal Science and its Dangers," in Imre Lakatos and Alan Musgrave, eds., *Criticism and the Growth of Knowledge: Proceedings of the International Colloquium in the Philosophy of Science, London 1965 volume 4* (Cambridge, UK: Cambridge University Press), 57]. The problem with Popper's approach is that there are theoretically an infinite number of alternatives explanations to disprove in order to get to the truth. That many alternatives are absurd is true, but again, science under the hypothetico-deductivist or Popper's falsificationist model deals with the fit of the data to theory, not the perceived absurdity real or otherwise of alternative hypotheses.

[10] Imre Lakatos, "Methodology of Scientific Research Programmes," in Lakatos and Musgrave, eds., 95-122

[11] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, IL: The University of Chicago Press, 1962)

[12] Paul Feyerabend, *Against Method*, 4th Ed. (Brooklyn, NY: Verso, 1975, 1988, 1993, 2010), xiii-xiv, 1-12

Thomas Samuel Kuhn (1922-1996) was a physics graduate at Harvard when he converted to the study of the history of science, and from there to philosophy of science.[13] Together with Feyerabend and Lakatos, the "historicist turn" of dealing with the philosophy of science from the vantage point of history surges to the forefront of discussion of science and scientific methodology.[14]

In his book *The Structure of Scientific Revolutions*, Kuhn puts forward his theory of scientific revolutions. According to Kuhn, scientists typically engage in what he calls 'normal science', which is that "research firmly based upon one or more past scientific achievements."[15] Such 'normal science' is based upon what Kuhn calls a 'paradigm', which as a term is however not initially clearly defined by Kuhn.[16] Broadly defined, a 'paradigm' consists of three aspects: a metaphysical notion or entity, a sociological dimension, and artifact or construct dimension.[17] In its first metaphysical aspect, Kuhn has in mind what lies behind scientific theories, and thus such is akin to a worldview (*Weltanschauung*). In its second sociological dimension, Kuhn has in mind the social interaction of scientists in the scientific community and how that contributes to the formation of some form of consensus within the scientific community. The third dimension is the application power of the paradigm in supplying both the problems and the tools to solve those problems, or what Kuhn calls "puzzle-solving."[18]

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[13] See the interview with Thomas Kuhn in Thomas S. Kuhn, *The Road Since Structure: Philosophical Essays, 1970-1993, with an Autobiographical Interview*, ed. James Conant and John Haugeland (Chicago, IL: The University of Chicago Press, 2000), 255-323.
[14] *Ibid.*, 309
[15] Kuhn, *Structure*, 10
[16] Kuhn denied that he was aware of [Georg Christoph] Lichtenberg's or [Ludwig] Wittgenstein's use of the term "paradigm" before he wrote his *Structure of Scientific Revolutions* (Kuhn, *Road*, 299). As such, the term "paradigm" as used by Kuhn must be defined on its own terms with a distinctively Kuhnian meaning and not by reference to either Lichtenberg or Wittgenstein.
[17] Margaret Masterman, "The Nature of a Paradigm," in Lakatos and Musgrave, eds., 65. Kuhn was impressed by her summary of his idea of 'paradigm', which he could not come up with by himself (Kuhn, *Road*, 299-300).
[18] Kuhn, *Structure*, 35-42.

'Normal science' therefore in Kuhn's view is the type of science that functions within an existing scientific paradigm. As Kuhn argues, how can we actually learn anything about swans in general by looking at particular swans (the classical problem with induction)? According to Kuhn, what we "learn about swans from exposure to paradigms is very much like what children first learn about dogs and cats, tables and chairs, mothers and fathers."[19] In other words, normal science is done not by pure rationalist cognitive reasoning, but inference made within an existing paradigm of thought which make the knowledge gained in such manner scientifically sound.[20]

The idea of scientific revolutions, or 'paradigm shifts', by Kuhn refers to the macro change in the way science is done and perceived due to growing insurmountable crises in the existing paradigm. From his background as an historian of science, Kuhn sets forth a few concrete examples like the Copernican revolution as one and the discovery of oxygen and the consequent repudiation of the phlogiston theory as another. Such paradigm shifts cannot be merely described as a progression from less to more knowledge. Rather, in the change of paradigms, the problems, instruments, and canons of solutions change.[21] Those before the paradigms were attempting to solve different problems from those working after the paradigm shift has occurred. The idea of science as the slow addition of knowledge through experiments of scientists through the ages according to Kuhn is a myth. Rather, the accumulation of knowledge is the collection and interpretation of experiments which support the current paradigm, even if the original scientists did not have the particular research goals their experiments are called upon to prove. As an example, Kuhn cites Newton's interpretation of Galileo's discovery that "the constant force of gravity produces a motion proportional to the square of the time," when in fact Galileo rarely

[19] Kuhn, "Logic of Discovery or Psychology of Research," in Lakatos and Musgrave, eds., 17
[20] *Ibid.*
[21] Kuhn, *Structure*, 140

alludes to forces at all.[22] Galileo's research can and has been interpreted to teach what Newton state of Galileo's discovery, but that was not Galileo's original intent or focus.

Kuhn views differing paradigms as being incommensurable with each other. His idea of incommensurability however is not relativity, but instead deals with what he calls "local incommensurability," akin to what is seen between different languages and language translation.[23] Just as it is impossible to translate all the nuances of one language to another, so therefore translating from one paradigm to the other "always involves compromises which alter communication."[24] Kuhn acknowledges that much similarity exists and therefore most (but not all) translation of meaning is easily done, but this conversely makes it easy also to miss the minor paradigm shifts when they occur.[25]

The last thing in Kuhn's idea of scientific revolution is that Kuhn denies the idea of progress of science in the arena of truth. Rather, there is penultimate local progress within 'normal science' as more and more of the puzzles are solved, but ultimately progress is in the eyes of the beholder.[26] As paradigms change, science is said to evolve "*from* primitive beginning" but there is no evolution "*towards* anything," any goal.[27] Kuhn therefore denies that science has a teleology beyond that of local expansion of the understanding of the world within a paradigm.

KUHN'S VIEW OF NORMAL SCIENCE: NORMAL SCIENCE AS A LEGITIMATE ENTERPRISE

[22] *Ibid.*, 138
[23] Kuhn, *Road*, 33-57
[24] Kuhn, "Reflection on My Critics," in Lakatos and Musgrave, eds., 268
[25] *Ibid.*, 269
[26] Kuhn, *Structure*, 162
[27] *Ibid.*, 169-70. Emphasis original.

Kuhn's view of 'normal science' has been criticized by other philosophers. Is there really such a thing as 'normal science' and thus are there really 'paradigms' and 'paradigm shifts'? Sir Karl Popper, who still embraces the progressive view of science and scientific progress, certainly begged to differ. In his essay for the 1965 colloquium in London, Popper essentially says that the goal of scientists is to go about challenging and breaking paradigms.[28] Popper acknowledges that the phenomena of 'normal science' and 'paradigms' do exist (although as we shall see later, he misunderstood the concepts). Practitioners of 'normal science' according to Popper are the "not-too-critical professionals" who go along with the prevailing scientific framework to solve the problems found within them.[29] Such a person is an "applied scientist," as opposed to a "pure scientist," who goes about challenging the status quo and seeking new answers and better ways of doing science and understanding the world.[30]

In this light, Popper sees 'normal science' as being harmful because it curbs the imaginative and restricts the inquisitive spirit, or the "bold conjectures and criticisms," necessary for the advancement of science.[31] Popper further charged Kuhn with historical relativism in his description of 'paradigms' as incommensurable, seen as relativizing all scientific frameworks throughout the history of science.[32]

The problem with Popper's critique is his misidentification of 'normal science' with 'convention applied science', and 'paradigm' with 'framework'.[33] Kuhn for example totally

[28] Karl Popper, "Normal Science and its Dangers," in Lakatos and Musgrave, eds., 51-8
[29] *Ibid.*, 52-3.
[30] *Ibid.*
[31] *Ibid.*, 55
[32] *Ibid.*
[33] Kuhn did utilize the term "framework" as a rough synonym in his response to his critics (Kuhn, "Reflection," in Lakatos and Mugrave, eds., 242), but he utilized it differently from Popper. Rather than differentiating between 'framework$_1$' and 'framework$_2$', it is easier to contrast 'framework' as utilized by Popper with 'paradigm' as popularized by Kuhn.

agrees with Popper's view of how scientists ought to be boldly conjecturing and criticizing.[34] The key issue however is that if we understand 'paradigm' as not a mere theoretical framework but a worldview, then there is nothing wrong with scientists doing 'normal science' for scientists are after all human beings situated in time and place. The charge of historical relativism thus also misunderstands the nature of paradigms and sees them as mega-theories of science and knowledge, instead of the worldview(s) held by scientists in their historical situatedness. Similar misunderstandings of Kuhn's philosophy of science persist in the critiques offered by Popperians Stephen Toulmin and John Watkins.[35]

Having looked at Kuhn's idea of 'normal science', how does it relate to Christian thought? What are the implications and possible imports it has on our view of science in relation to Christianity and apologetics?

NORMAL SCIENCE IN RELATION TO THE CHRISTIAN ENTERPRISE

Kuhn's idea of 'normal science' and science as paradigmatic, if true, would certainly be helpful to the Christian cause, which since Galileo is perceived to be in a perpetual retreat into the 'spiritual' aspect of faith and the surrendering of various parts of Scripture (most notably Genesis 1-11) to science as myths that are considered untrue in this "scientific age."[36] This help would come in the form of looking at two aspects of science and 'normal science': the nature of the scientific enterprise, and the nature of 'paradigms'.

[34] Kuhn, "Reflection," in Lakatos and Mugrave, eds., 242.
[35] Stephen E. Toulmin, "Does the Distinction between Normal and Revolutionary Science Hold Water?" in Lakatos and Mugrave, eds., 39-48. John W. N. Watkins, "Against 'Normal Science'," in *idem*, 25-37
[36] The BioLogos foundation for example was set up to re-interpret Christianity in light of scientific truths through the embrace of evolution as truth and Genesis 1-11 as myths, although they see themselves as showing how faith and science can co-exist (BioLogos, "About the BioLogos foundation," BioLogos., http://www.biologos.org/about (accessed May 12, 2011)

As we have seen, in Kuhn's philosophy of science, 'normal science' is all about puzzle-solving. Since such puzzle-solving is not about truth but about describing how things function in the world utilizing language and concepts from the reigning paradigm(s), science and scientific theories are merely descriptive not explanatory. Scientific theories if proven true are therefore true and valid descriptions of scientific experiments and reality as described using the language of that paradigm, and that only. Scientific theories are therefore not objective truths and not objective explanations of a true event. They are contingent truths depending on the continuing validity of the reigning paradigms, and will be altered (or translated) into other scientific theories when evaluated through the lens of any new paradigms that have arisen and may arise in the future.

C. John Collins therefore is in error in decrying Kuhn as being an anti-realist and as promoting irrationalism.[37] Nothing is further from the truth. What Kuhn denies is absolute universal truth being present in science.[38] The contingent truths within a paradigm are objective, being available to be proven objectively right or wrong within the standards and language of that paradigm.

Likewise, the nature of 'paradigms' in their three-fold aspect helps us to see the intellectual and social environmental factors that play a role in theory formation.[39] Paradigms encompass more than merely presuppositions, contrary to R. J. Rushdoony's interpretation of Kuhn's

[37] Collins, 47, 428-9. There is furthermore no relation between anti-realism and irrationality, since something that is not real can still be rationality discussed and constructed, for example science fiction like the Star Wars universe.
[38] The difference between absolute knowledge and objective knowledge is that absolute knowledge is transcendentally true, while objective knowledge is true for all people but may not actually be ontologically true of reality.
[39] Collins' critique of Kuhn on this point as showing "little or no recognition of a *hierarchy* of precommitments" (Collins, 427) shows that he does not understand what Kuhn was driving at. See footnote 17 and Masterman's essay where this particular issue was hashed out in greater detail.

work.[40] Rather, because they have in mind the situatedness of scientists as well, we can come to be less intimidated by the supposed authority of scientists mythically described as dispensers of absolute truth which they have wrestled from nature.

Along this line of the nature of paradigms, Collins like Popper before him commits the same error when he misinterprets Kuhn as decoupling 'science' from 'rationality'.[41] Such is a misunderstanding of 'paradigm' as a mega-theory rather than a worldview and situatedness which is what Kuhn was driving at.

The theory of science that lines up best with such an understanding of science is instrumentalism—where scientific theories are not truth-evaluable in the sense of matching it with absolute truth, but as contingent descriptors of reality are truth-evaluable in the sense of the nature of the fit between data and theory within the paradigm used.[42] Science is therefore concerned with description of the world without any commitment to absolute truth.

CONCLUSION

In his posthumously published book *The Tyranny of Science*, Paul Feyerabend attacked the notion of Science as an entity, stating:

> …the people who say that it is science that determines the nature of reality assume that the sciences speak with a single voice. They think that there is this monster, SCIENCE, and when it speaks it utters and repeats and repeats and repeats again a single coherent message. Nothing could be further from the truth. Different sciences have vastly different ideologies.[43]

[40] Rousas John Rushdoony, *The Mythology of Science* (Nutley, NJ: The Craig Press, 1979), 85-93
[41] Collins, 428
[42] Instrumentalism, Dictionary.com, *Collins English Dictionary - Complete & Unabridged 10th Edition.* HarperCollins Publishers, http://dictionary.reference.com/browse/instrumentalism (accessed May 12, 2011).
[43] Paul Feyerabend, *The Tyranny of Science* (Malden, MA: Polity Press, 2011), 55

Feyerabend as an anarchist promotes pluralism in science. Nevertheless, one does not have to embrace subjectivism to see that his quote on science is correct. Science as a non-living entity does not speak; it is scientists who speak. The myth of scientific unanimity is just that, a myth. Behind the façade are competing factions of scientists doing science, be the controversy over Creation/ Evolution or the Age of the Earth just to name two pertinent examples.

In the realm of Apologetics therefore, Christians do not have to be worried about the supposed 'facts' of science. While certainly this is not to say that the findings of science do not have any bearing on the way we do theology and understand the world, by telling us how God could not historically have used an investigated natural process to do his work, yet we can be assured that scientific findings are always contingent and may be wrong, despite the longevity and widespread acceptance of theories such as evolution.[44] Let us therefore continue to stand firm on the truths of Scripture, especially on the historicity of Genesis 1-11, knowing that in time, God's truth will be validated and scientific theories contradicting the Scriptures discredited.

> The grass withers, the flower fades, but the word of our God will stand forever (Is. 40:8 —ESV)

[44] For example of how science aids us, the supposed proof of an old earth through radio-dating merely implies that God could not have created the rocks according to the supposed initial conditions (for example equal amounts of U-235 and U-238 in a rock sample) 6000 years ago and left the radioisotopes to naturally decay until the present time. It does not rule out the theory that God did create the world 6000 years ago but the initial radioisotope ratio was not 1:1, it does not rule out a theory of accelerated radioactive decay in the past, and others such theories. All scientists can prove is that God did not do things according to how the scientists thought He would have done it.
On the longevity of models being not an indication of scientific validity, we must remember that the Ptolemaic model lasted for centuries before it was overthrown by the Copernican model.

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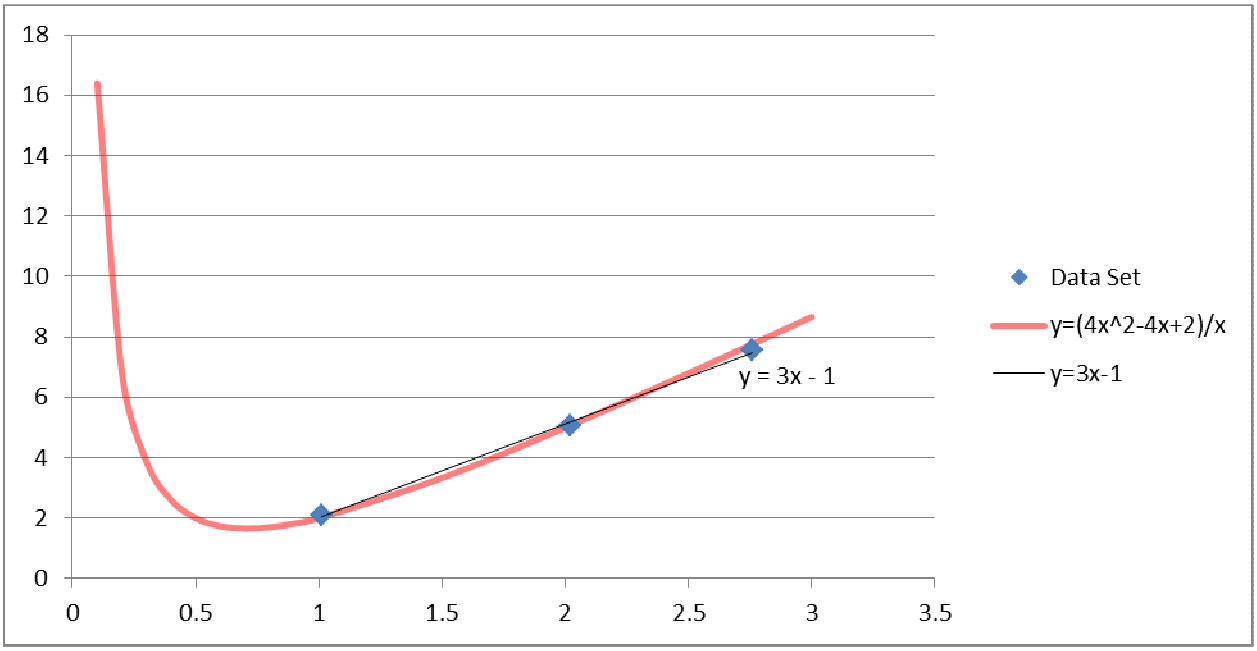
Appendix 1: Graph

Data Set:

(x, y) = (1.01, 2.10), (2.02, 5.06), (2.76, 7.54)

Graph:



Note that the given data set can also accommodate an infinite number of equations in the form of $y = 3x - 1 + \frac{1}{a \pm x}$, where $a \gg x \text{ or } a \ll x, a \in R$.