"Paradigm" as a Central Concept in Thomas Kuhn's Thought

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Abstract

After having published The Structure of Scientific Revolutions, Kuhn's contribution has not only been a break with several key positivist doctrines but also triggered the growth of a new academic discipline – the sociology of science. His idea that the development of science has periods of stable growth punctuated by the scientific revolutions is based on the cycle of normal science, crisis, and revolution. For him, such regularity in the development of various sciences is a paradigm which he thought to be a general feature of science. Thus, this study aims to analyze Kuhn's concept of paradigm as an intellectual framework which makes research possible. It is debated that the term could globally be understood as a disciplinary matrix in a sociological context whereas the term particularly refers to the concrete puzzle solutions which could be seen as exemplars of good science. It is showed that the process of paradigm change, for Kuhn, leads to a scientific revolution. Finally, Kuhn's argument on incommensurability of competing paradigms and the problem of objectivity are also discussed in order to show the problematic aspects of the concept.

Key words: Paradigm, scientific revolutions, disciplinary matrix, exemplar, incommensurability.

1. Introduction

Thomas Kuhn's *Structure of Scientific Revolutions* (SSR) is believed to be one of the most important books in the 20th century. The book conceived a whole industry of commentary, interpretation, and exegesis. The growth of a new academic discipline – the sociology of science- came into existence around a shared paradigm following Kuhn's emphasis on the importance of communities of scientists. After the book was published researchers began to examine scientific disciplines much as sociologists studied social/cultural groups, and in which science was regarded not as the most esteemed, untouchable product of the Enlightenment but as just another subculture. Yet, as Kuhn claimed "the philosophy and sociology of science cannot be practiced independently of each other" (Hoyningen-Huene, 1992: 491). However, Kuhn saw the communities (not individuals) as the basic agents of science and he thought that communities must be characterized by the specific cognitive values to which they are committed.

Until the 1950s, the hegemony of logical empiricism reached to its highest level- by the representatives of the logistic approach such as R. B. Braithwaite, Rudolf Carnap, Herbert Feigl, Carl G. Hempel, and Hans Reichenbach. Prior to Kuhn's SSR, historians and philosophers of science considered the scientific enterprise to be a rational endeavor in which progress and knowledge are achieved through the steady, daily, rigorous accumulation of experimental data accredited facts and new discoveries. But SSR served as an unparalleled source of inspiration to philosophers with a historical bent (Salmon, 1990). Kuhn referred to this traditional approach as normal science, and he used the then-obscure word paradigm to refer to the shared ideas and concepts that guide the members of a given scientific field (Goldstein, 2012). Therefore, it could be said that Kuhn's SSR had been a sort of key document in both producing and preserving a deep division between the logical empiricists and those who adopt the historical approach. Afterthe 1960s and 70s, following Kuhn's historiography, and philosophers such as Paul Feyerabend, Imre Lakatos, Larry Laudan and Michael Polanyi have greatly contributed to the creation of an anti-positivistic philosophy of science as a new tradition. History of science after Kuhn has frequently taken a more consciously externalist line, in looking outside science for the causes of the content of science (Bird, 2012: 876). Yet the book had more enemies than friends after it was published and even its friends, fellow historicists such as Imre Lakatos and Larry Laudan have almost invariantly tried to change or reformulate Kuhn's view (De Langhe, 2012: 12-13; Firinci Orman, 2016).

When we look at Kuhn's central claim in SSR it is that a careful study of the history of science reveals that development in any scientific field happens via a series of phases. The first he named normal science this phase, a community of researchers who share a common intellectual framework engage in solving puzzles thrown up by discrepancies (anomalies) between what the paradigm predicts and what is revealed by observation or experiment. Most of the time, the anomalies are resolved either by incremental changes to the paradigm or by uncovering the observational or experimental error. And Kuhn suggested major changes come about in scientific fields and conjectures that they probably do not evolve gradually from patient and orderly inquiry by established investigators in the field. Rather, he suggests, revolutions in science come about as the result of breakdowns in intellectual systems, breakdowns that occur when old methods won't solve new problems. He calls the change in theory that underlies this kind of revolution a paradigm shift (Hairstone, 1982). But Kuhn was never deeply engaged by the wider effects of his claims, the philosophical and historical critiques led him to specify more carefully just what he meant by paradigm and normal science. Even today the term paradigm is very controversial and Kuhn himself revised its meaning and tried to answer his critiques' questions. Yet, the effect of a paradigm term, as a central concept in Kuhn's thought has been very wide and strengthened the anti-positivistic philosophy tradition it belongs.

Thus, the aim of this study is to analyze the term paradigm in Kuhn's thought, especially with the stress on its meaning within the sociology of science. To this end, firstly Kuhn's sociological perspective of how science develops is tried to be revealed in order to see Kuhn's position among the existing models of scientific development. Eventually, the paradigm term is analyzed stressing on two different senses of paradigm – disciplinary matrix and examplar. It is also showed why the process of a paradigm shift, for Kuhn, leads to a scientific revolution and the revolutionary stages of such shift are explained. Finally, Kuhn's argument on incommensurability of competing paradigms and the problem of objectivity are also discussed in order to show the problematic aspects of the concept.

Undoubtedly, that it is important to mention that the reaction formation towards Kuhn's thoughts and his historiography immediately came from the scientists, science philosophers, and science historians. However, after the 1990s, the same science philosophers who had heavily criticized Kuhn used Kuhn's thoughts as their gun against the then scientists who they waged a battle with (Serdar, 2001). Moreover, anthropologists seeing the sociologists using Kuhn's terminology of normal science and following this trend have created a discourse that the scientific phenomenon is not completely discovered and that every phenomenon conveys a sociological basis. Not only anthropology but also economics and political sciences developed their own discourses on paradigms (Güneş, 2003). This trend in social sciences let the post-colonial scientific research to become popular due to the view that culturally western history of science could be revised by giving space to its eastern paradigms (Serdar, 2001: 68). Thus, the importance of the paradigm term with the reference to its wide affect in social sciences makes way for new investigations on its updated meanings by considering its questionable and ambiguous position.

2. Scientific Development and Normal Science

Before Kuhn, our view of science was dominated by philosophical ideas about the scientific method. According to Samian (1994:126), the assumption of the positivists is that a scientific change is necessarily progressive. Additionally, the path of change is cumulative, objective, nomological and linear. The scientific progress was seen as the addition of new truths to the stock of old truths, or the increasing approximation of theories to the truth, or at least the correction of past errors. In other words, as Naughton (2012) points, we had what amounted to the Whig interpretation of scientific history, in which past researchers, theorists, and experimenters had engaged in a long march, if not towards truth, then at least towards greater and greater understanding of the natural world. While the Whig version refers to the steady, cumulative progress, Kuhn saw discontinuities – a set of alternating normal and revolutionary phases of the developmental periods. These revolutionary phases – for example, the transition from Newtonian mechanics to quantum physics – correspond to great conceptual breakthroughs and lay the basis for a succeeding phase of business as usual. Kuhn based his model on the classic paradigm shifts in physics. He gave examples from the history including the Copernican, Newtonian and Einsteinian revolutions, the development of quantum mechanics, which replaced classical mechanics at the subatomic level, and the accidental discovery of X-rays by Roentgen, one of the great unanticipated anomalies in the history of science.

For example, *The Copernican Revolution, Planetary Astronomy in the Development of Western Thought,* to give its complete title, Thomas Kuhn's first book, may be the second bestselling book ever written on the history of science (Swerdlow, 2004: 64). In this book, Kuhn notes "each new scientific theory preserves a hard core of the knowledge provided by its predecessor and adds to it. Science progresses by replacing old theories with new," and the history of Copernican theory, as of any scientific theory, can illustrate the processes by which scientific concepts evolve and replace their predecessors (Swerdlow, 2004: 76-78).

In order to understand the place of the Kuhnian approach on scientific development in a historical scene, it is important to mention M. J. Mulkay's well-known article namely *Three Models of Scientific Development.* Mulkay (2010) proposed three models of scientific development in a sociological context, which he conceptualized as the model of openness, the model of closure, and the model of branching. The main claim of the openness model which Merton has systematically explained is that science develops in open societies surrounded by democratic norms. The closure model in which Kuhn takes place refers to scientific orthodoxies and the scientific development is just like the revolution reached by overthrowing an oppressive regime. Kuhn's main claim is that; a cumulative progress of a scientific knowledge is not stemming from the openness of their practitioners but paradoxically from their intellectual closure. That is to say, a normal science is directed by the paradigm – by a series of connected assumptions. In addition, the last model of branching claims that regularly new problem areas are created and they are being connected to a pre established social networks. Thus, any evolution visible in one of the networks note worthily is believed to be connected to the developments in other neighboring areas. As seen a discovery of a new scientific field often formed as a result of a scientific migration process.

It can be said that Kuhn accepts the scientific progress as a reality. Accused of being a relativist he does not share this accusation and refers to the problem-solving skills criteria within the existing paradigms, appreciating that most discoveries occur during periods of normal science (Buchwald and Smith, 1997: 366; Goldstein, 2012). In his SSR, Kuhn argues that science evolves when there is a consensus among scientists about basic ontological commitments, explanatory principles, general methodology, research priorities, and guidelines which should be followed, in other words, when scientists share a paradigm. Scientists' sharing a paradigm is in the stage of normal science. Elements in the paradigm include the scientists' tacit knowledge. As a result, scientists cannot articulate what they believe nor can they easily envision alternative ways of doing science (Samian, 1994: 127). Yet, Kuhn's (1962) great insight was to realize that real progress did not result from the puzzle-solving of normal science. Instead, he argued that true breakthroughs arise in a totally different way -when the discovery of anomalies leads scientists to question the paradigm, and this, in turn, leads to a scientific revolution that he termed paradigm shift. In other words, Kuhn argues that a science does not progress as a linear accumulation of new knowledge, but undergoes periodic revolutions called paradigm shifts.

For Kuhn, scientific progress/development follows 1. Pre-paradigmatic stage, 2. The emergence of normal science, 3. The emergence of anomaly and crisis, and 4. Scientific revolution as a result of the birth and assimilation of a new paradigm. As could be seen a scientific discipline goes through several distinct types of stages as it develops. Thus, to simply show the development of scientific ideas, is an alternation of . . .

Normal Science->Revolution->NS->R-> NS

Kuhn (1963: 362) thinks that "rather than resembling exploration, normal research seems like the effort to assemble a Chinese cube whose finished outline is known from the start." Normal science is characterized not only by a shared paradigm but also by disciplinary matrix "'disciplinary' because it refers to the common possessions of the practitioners of a particular discipline; matrix because it is composed of elements of various sorts" (Kunh 1970, 182). Kuhn's disciplinary matrix refers to shared elements in a social group which include values (Kuhn, 1970: 184). Other elements of normal science are examples which are established achievements serving as guides to solving new puzzles. Puzzles are problems arising in a paradigm within the terms set by the paradigm (Samian, 1994: 127). Kuhn (1962) suggested that normal science can enable us to solve a puzzle for whose very existence the validity of the paradigm must be assumed. So in short, he thought that work within a paradigm (qua disciplinary matrix) is possible only if that paradigm is taken for granted. The paradigm functions very well until scientists in their collaborative efforts have a puzzle that does not fit. This is where an anomaly occurs. A crisis is what is needed. Scientists begin to question their basic assumptions and different paradigms emerged. This is followed by a clash of conflicting, incommensurable paradigms, with a final victory of a single paradigm. Thus, a scientific revolution has occurred and scientists experience a gestalt switch. Following the revolution is again the normal science stage. Kuhn maintains that this cyclical process goes on continuously.

3. Paradigm as a Disciplinary Matrix and/or an Exemplar

Kuhn's use of the term paradigm and definitions made by several other researchers seems to have determined its current major meaning. Kuhn attempts at explaining his use of the word paradigm in the first pages of his book (1962). He first describes two characteristics of specific achievements: being "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity" and being "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve." Then he states the following (1970: 10):

"Achievements that share these two characteristics I shall henceforth refer to as 'paradigms', a term that relates closely to 'normal science'. By choosing it, I mean to suggest that some accepted examples of actual scientific practice –examples which include law, theory, application, and instrumentation together– provide models from which spring particular coherent traditions of scientific research.… Men whose research is based on shared paradigms are committed to the same rules and standards for scientific practice."

In SSR, Kuhn focuses on the normal science, characterized as puzzle-solving, is practiced according to a paradigm, the examples of science and practice, theories and procedures, of a community of scientists, which may be large or small depending upon the subject of research. Thus, the paradigm is described within the normal science and the process of scientific activity based on the existing "strong network of commitments—conceptual, theoretical, instrumental, and methodological" (Kuhn, 1970: 42).

One paradigm merely is chosen in order to direct normal science as it is seen more successful than its competitors in solving some problems which the scientific community accepted them as crucially important. Moreover, Kuhn (1970: 38) asserts that "if it is to classify as a puzzle, a problem must be characterized by more than an assured solution. There must also be rules that limit both the nature of acceptable solutions and the steps by which they are to be obtained". Kuhn (1970: 39) notes that a rule can be seen as an established viewpoint or preconceptions that they associate better in showing a set of puzzle characteristic.

Despite the fact that any success having similar features as set above could be considered as paradigms, Kuhn was heavily criticized because of his differing paradigm definitions in SSR. As depicted earlier, within the explanations of paradigm in a scientific activity Kuhn discussed its relation to a puzzle solving activity and to the existing rules of a normal science. Margret Masterman, however, in her article namely *The Nature of a Paradigm* (1970), identified no fewer than 21 possible meanings for a paradigm in the book. Masterman (1970) argued, they can be compressed into three encompassing categories, which she termed the metaphysical (meta-paradigm), the sociological, and the art factual. According to Masterman, only the third seemed to her to capture what Kuhn had in mind (Buchwald and Smith, 1997: 367). To Masterman, existing multiple definitions of paradigm in SSR is really problematic. However, if one asks what a paradigm does, it becomes clearer at once, assuming always the existence of normal science which refers to the artefactual sense of paradigm. Again, Masterman (1970: 70) debates that puzzles cannot be solved only by an artefact and points out that the paradigm concept is tightly bound to an exemplary problems.

In his paper namely *Second Thoughts on Paradigms* (1974) presented at a philosophy symposium and in the Postscript to the second edition of SSR (1970), Kuhn conceded that he had used paradigm too broadly. As he remarked a few years later in the *Preface to the Essential Tension* (1977). Thus, in his *Proscript* Kuhn (1970: 175) acknowledges having used the term paradigm in two different meanings. In the first one, paradigm designates what the members of a certain scientific community have in common, that is to say, the whole of techniques, patents, and values shared by the members of the community. In SSR, Kuhn begins to use the term paradigm to refer to the entire cluster of problems, methods, theoretical principles, metaphysical assumptions, concepts, and evaluative standards that are present to some degree or other in the concrete, definitive scientific achievement. Kuhn (1970) in his *Postscript* to SSR refers to such a cluster as a disciplinary matrix. A disciplinary matrix is an entire theoretical, methodological, and evaluative framework within which scientists conduct their research. This framework constitutes the basic assumptions of the discipline about how research in that discipline should be conducted as well as what constitutes a good scientific explanation. Kuhn (1970: 182) referring to paradigm sets that:

"For present purposes, I suggest 'disciplinary matrix': 'disciplinary' because it refers to the common possession of the practitioners of a particular discipline; 'matrix' because it is composed of ordered elements of various sorts, each requiring further specification. All or most of the objects of group commitment that my original texts make paradigms, parts of paradigms, or paradigmatic are constituents of the disciplinary matrix, and as such, they form a whole and function together".

In the second sense, the paradigm is a single element of a whole, say for instance Newton's Principia, which, acting as a common model or an example, paradigm means simply an example, as you know, stands for the explicit rules, and thus defines a coherent tradition of investigation. Thus, the question is for Kuhn to investigate by means of the paradigm what makes possible the constitution of what he calls a normal science. That is to say, the science which can decide if a certain problem will be considered scientific or not. Normal science does not mean at all a science guided by a coherent system of rules, on the contrary, the rules can be derived from the paradigms, but the paradigms can guide the investigation also in the absence of rules. This is precisely the second meaning of the term paradigm, which Kuhn considered the newest and profound, though it is in truth the oldest. The paradigm is in this sense, just an example, a single phenomenon, a singularity, which can be repeated and thus acquires the capability of tacitly modeling the behavior and the practice of scientists. Kuhn (1970: 187) in his postscript to SSR, refers to an achievement of this sort as an exemplar:

"I shall here substitute 'exemplars.' By it I mean, initially, the concrete problem-solutions that students encounter from the start of their scientific education, whether in laboratories, on examinations, or at the ends of chapters in science texts. To these shared examples should, however, be added at least some of the technical problem-solutions found in the periodical literature that scientists encounter during their post-educational research careers and that also show them by example how their job is to be done."

Among the numerous examples of paradigms Kuhn, gives are Newton's mechanics and theory of gravitation, Franklin's theory of electricity, and Copernicus' treatise on his heliocentric theory of the solar system. These works outlined a unified and comprehensive approach to a wide-ranging set of problems in their respective disciplines. As such, they were definitive in that disciplines. Agamben (2002), in his analysis on how science can decide if a certain problem will be considered scientific or not, stress on the importance of examplar as they (paradigms) can guide the investigation also in the absence of rules. A paradigm, in this sense is just an example, a single phenomenon, a singularity. In other words, normal science does not mean at all a science guided by a coherent system of rules; on the contrary, the rules can be derived from the paradigms. Bird (2012: 861) similarly comments that normal science is thereby built on and built by the exemplars. A crisis occurs when science modeled on the exemplars fails to answer key puzzles. Accordingly, exemplars are transmitted and inculcated by the training of young scientists. Training with exemplars allows scientists to see the world in a certain way that enables them to solve scientific problems in ways analogous to those in the exemplars. Thus, revolutions come about when exemplars are replaced by new exemplars; such revisions to exemplars will bring about other changes in the disciplinary matrix.

4. Paradigm Shift and Scientific Revolution

In SSR, Kuhn named an epistemological paradigm shift as a scientific revolution. A scientific revolution occurs, according to Kuhn, when scientists encounter anomalies that cannot be explained by the universally accepted paradigm within which scientific progress has thereto been made. The paradigm, in Kuhn's view, is not simply the current theory, but the entire worldview in which it exists, and all of the implications which come with it. As depicted earlier, normal science is an enterprise of puzzle-solving according to Kuhn. Though the paradigm guarantees that the puzzles it defines have solutions, this is not always the case. Sometimes puzzles cannot admit of solution within the framework (disciplinary matrix) provided by the paradigm. In such case, scientists may become acutely distressed and a sense of crisis may develop within the scientific community. This sense of desperation may lead some scientists to question some of the fundamental assumptions of the disciplinary matrix. Typically, competing groups will develop strategies for solving the problem, which at this point has become an anomaly that congeals into differing conceptual schools of thought much like the competing schools that characterize pre-paradigmatic science. The fundamental assumptions of the paradigm will become subject to widespread doubt, and there may be general agreement that a replacement must be found. One of the competing approaches to solving the anomaly will produce a solution that, because of its generality and promise for future research, gains a large and loyal following in the scientific community. This solution comes to be regarded by its proponents as a concrete, definitive scientific achievement that defines by example how research in that discipline should subsequently be conducted. And if enough scientists become convinced that the new paradigm works better than the old one, they will accept it as the new norm (Hairstone, 1982). Eventually, a new paradigm is formed, which gains its own new followers, and an intellectual battle takes place between the followers of the new paradigm and the hold-outs of the old paradigm.

The pattern of scientific change, Bird (2012) reminds, shows a pattern: normal science, crisis, extraordinary science, a new phase of normal science, etc. The normal science which is characterized as puzzle-solving is conservative, with scientists building on rather than questioning existing science. For Kuhn, in contrast, extraordinary science is revolutionary. That is, some significant component of the existing tradition (for example, a key theoretical commitment) is jettisoned and replaced in the expectation that the revised practice will solve many of the crisis-precipitating anomalies and provide a fruitful platform for future research. In other words, extraordinary science is expected to generate new puzzles and provide the means of solving them. Kuhn (1970: 12), in SSR, wrote, "Successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science." Kuhn's idea was itself revolutionary in its time, as it caused a major change in the way that academics talk about science. Thus, it could be argued that it caused or was itself part of a paradigm shift in the history and sociology of science. However, Kuhn would not recognize such a paradigm shift as in the social sciences, people can still use earlier ideas to discuss the history of science.

On the other hand, in Kuhn's late works such as *The Road Since Structure* (1990), Kuhn reported on a book in progress, a project that would eventually remain unfinished at his death. In this and other fragments of that work, he develops the biological metaphor broached at the end of SSR. No longer do we hear of revolutions as paradigm change, certainly not in the sense of large paradigms. In fact, Kuhn preferred to speak of developmental episodes instead of revolutions. However, he does retain something of his original idea of small paradigms, the concrete problem solutions that he had termed exemplars in the *Postscript* to SSR. Most revolutions, he tells us, are not major discontinuities in which a successor theory overturns and replaces its predecessor. Rather, they are like biological speciation, in which a group of organisms becomes reproductively isolated from the main population.

5. Discussion

In SSR (1962), Kuhn made the dramatic claim that history of science reveals proponents of competing paradigms failing to make complete contact with each other's views so that they are always talking at least slightly at cross-purposes. Kuhn characterized the collective reasons for these limits to communication as the incommensurability of pre- and post-revolutionary scientific traditions. He claims that the Newtonian paradigm is incommensurable with its Cartesian and Aristotelian predecessors in the history of physics, just as Lavoisier's paradigm is incommensurable with that of Priestley's in chemistry (Kuhn, 1962, 147–150; Hoyningen-Huene, 2008).

On the other note, Paul Feyerabend first used the term incommensurable in 1962 in *Explanation, Reduction, and Empiricism* to describe the lack of logical relations between the concepts of fundamental theories in his critique of logical empiricists models of explanation and reduction (Feyerabend 1962: 74).Kuhn's introduction in SSR of the concept of incommensurability, alongside Feyerabend's use of the concept, was an important moment in intellectual history. Such that incommensurability became the focus of Kuhn's philosophical thinking in his later work. As Kuukkanen (2009: 218) discuss, new concepts emerged and old ones received new definitions during the evolution of Kuhn's thinking.

Kuhn later regarded incommensurability as a defining feature of scientific revolutions. In return for this, for many critics, the debate has focused on his notion of the incommensurability of paradigm and normal science (Samian, 1994: 134-135; Irzık and Grünberg, 1998). Kuhn himself states that not only shared criteria but also specific factors such as biography and/or personality of scientists play an important role in their decisions. One focus of many critics has been Kuhn's insistence to compare scientific revolutions with political or religious revolutions, and with paradigm change as a kind of conversion. A paradigm shift is so much one changing his/her religion. Thus, some questions arise related to the paradigm shift. Firstly, if there is no neutral standpoint from which to evaluate two different paradigms in a given discipline can we still consider science as rational? According to Kuhn, in deciding between different paradigms, people can give good reasons for favoring one paradigm over another, it is just that those reasons cannot be codified into an algorithmic scientific method, that would decide the point objectively and conclusively. Thus, science is not irrational, just mere competing paradigms are incommensurable: that is to say, there exists no objective way of assessing their relative merits.

To put the objectivity matter concisely, Kuhn argues that different paradigms are incommensurable because they involve different scientific language, they do not acknowledge, address, or perceive the same observational data nor they have the same questions or resolve the same problems, neither they agree on what counts as an adequate, or even legitimate, explanation. Thus, 3 types of incommensurability can be respectively distinguished in Kuhn's thought - semantic, observational and methodological obstacles could be seen in comparing those theories. Incommensurability could be defined more in depth, but rather it will be debated that how substantial its influence is.

It should be stressed that Kuhn's incommensurability thesis presented a challenge to the realistic conception of scientific progress. As debated earlier the positivistic tradition asserts that later science improves on earlier science. A counter view of Kuhn claims that science is not cumulative – we cannot properly say that Einstein's theory is an improvement on Newton's since the key terms (for instance 'mass') in the two theories differ slightly in meaning (Bird, 2007). Therefore, we can note that Kuhn saw incommensurability as precluding the possibility of interpreting scientific development as an approximation to the truth (Kuhn 1970: 206). He rejects such characterizations of scientific progress because he recognized and emphasized that scientific revolutions result in changes in the ontology.

6. In Place of Conclusion

Thomas Kuhn, the author of SSR, is probably the best-known and most influential historian and philosopher of science of the last century. His concepts of paradigm, paradigm change and incommensurability have changed our thinking about science. As Kuukanen (2009: 217) reveals in his review study named *Rereading Kuhn*, since mid-1990's Kuhn's thought has been studied with denotations such as a conservative Kuhn, the last logical empiricist Kuhn, the cognitive science Kuhn, the Wittgenstein an Kuhn and sociological Kuhn. This brief review remarks obviously that Kuhn's thought have been and still is seen as a very important role in the research tradition of philosophy of science.

His thoughts on scientific development and scientific revolution could be better understood if his central concept of paradigm is defined in detail. Thus, more specifically, it has been discussed that the meaning and definition of a paradigm, distinguishing between the primary, narrow sense of the term (an exemplar, i.e. a definitive, concrete achievement) and a broader sense of the term (a disciplinary matrix or framework). Merging two of the definitions, the following definition of paradigm could be set like this: A paradigm is a specific theoretical orientation, based on a particular epistemology and research methodology, reflective of a particular scientific community at a particular time in history. It also frames and directs the nature of the type of research inquiries generated from that theoretical orientation, as well as provides the fundamental basis for evaluating the results of the generated research.

Under the discussion part, it was tried to show that incommensurability term in the context of the paradigm shift and scientific revolutions seem very problematic in Kuhn's thought. Yet, it is evident that Kuhn's revolutionary effect in the sociology of science by his seminal Works was to overthrow the logical empiricism and to throne the historical approach.

References

Agamben, G. (2002). What is Paradigm? *Lecture at European Graduate School.* A transcribed text of the Agamben lecture that can be seen on [Youtube]: http://www.youtube.com/watch?v=G9Wxn1L9Er0

Bird, A. (2007). Incommensurability naturalized, in L. Soler, H. Sankey, and P. Hoyningen-Huene (Eds.), *Rethinking Scientific Change and Theory Comparison* (Boston Studies in the Philosophy of Science 255), Dordrecht: Springer, pp. 21–39.

Bird, A. (2012). The Structure of Scientific Revolutions and its Significance: An Essay Review of the Fiftieth Anniversary Edition, *Brit. J. Phil. Sci*., 63: 859–883.

Buchwald, J. Z. and Smith, G. E. (1997). Thomas S. Kuhn, 1922-1996. *Philosophy of Science,* 64 (2): 361-376.

C. Hung, E.H. (2001). Kuhnian Paradigms as Representational Spaces: New Perspectives on The Problems of Incommensurability, Scientic Explanation, and Physical Necessity. International Studies in The Philosophy of Science, 15 (3): 275-292.

De Langhe, R. (2012). The Problem of Kuhnian Rationality. *Philosophica*, 86: 11-31.

Feyerabend, P. (1962). Explanation, Reduction and Empiricism, in H. Feigl and G. Maxwell (ed.), *Scientific Explanation, Space, and Time*, (Minnesota Studies in the Philosophy of Science, Volume III), Minneapolis: University of Minneapolis Press, pp. 28–97.

Fırıncı Orman, T. (2016). Science Model of Imre Lakatos. *III. International Multi-Track Conference On History of Philosophy (PHILHIST'16),* pp. 48-56.

Goldstein, J.L. (2012). Foreword. *Nature medicine*. 18 (10).

Güneş, B. (2003).Paradigma Kavramı Işığında Bilimsel Devrimlerin Yapısı ve Bilim Savaşları: Cephelerdeki Fizikçilerden Thomas S. Kuhn ve Alan D. Sokal. *Türk Eğitim Bilimleri Dergisi*, 1 (1): 23-44.

Irzık, G. & Grünberg, T. (1998). Whorfian Variations on Kantian Themes: Kuhn's Linguistic Turn, *Studies in History and Philosophy of Science*, 29: 207-221.

Hairstone, M. (1982) The Winds of Change: Thomas Kuhn and the Revolution in the Teaching of Writing Author(s): Maxine Hairston Source: College Composition and Communication, 33 (1): 76-88 Published by: National Council of Teachers of English Stable URL: http://www.jstor.org/stable/357846

Hoyningen-Huene, P. (1992). The Interrelations between the Philosophy, History and Sociology of Science in Thomas Kuhn's Theory of Scientific Development, *The British Journal for the Philosophy of Science*, 43 (4): 487-501.

Hoyningen-Huene, P.(2008). Thomas Kuhn and the Chemical Revolution, *Foundations of Chemistry*, 10: 101–115.

Kuhn, T.S. (1962). *The structure of scientific revolutions*. Chicago Uni. Chicago Press.

Kuhn, T. S. (1963). The Function of Dogma in Scientific Research, in A. C. Crombie

(ed.), *Scientific Change*, New York: Basic Books, pp. 347–369.

Kuhn, T.S. (1970). *The structure of scientific revolutions*. 2nd Edition, Chicago Uni. The University of Chicago Press.

Kuhn, T. (1974). Second Thoughts on Paradigms, in Frederick Suppe (ed.), *The Structure of Scientific Theories*. Urbana: University of Illinois Press, pp. 459-482.

Kuhn, T. (1977).*The Essential Tension: Selected Studies in Scientific Tradition and Change.* Chicago: University of Chicago Press.

Kuukkanen, J. M. (2009). Rereading Kuhn. *International Studies in the Philosophy of Science*, 23 (2): 217-224.

Masterman, M. (1970), The Nature of a Paradigm, in I. Lakatos and A. Musgrave (ed.), *Criticism and the Growth of Knowledge*. Cambridge: Cambridge University Press, pp. 59-89.

Mulkay, M. J. (2010). Bilimsel Gelişime Dair Üç Model. *Bilim Sosyolojisi İncelemeleri: Temel Yaklaşımlar, Kavramlar ve Tartışmalar.* Ed. Bekir Balkız ve Vefa Saygın Öğütle. Ankara: Doğu Batı Yayınları. s. 308-328.

Naughton, J. (2012). Thomas Kuhn: the man who changed the way the world looked at science. *The Guardian*. (Saturday 18 August 2012-19.05 EDT).

Salmon, W. (1990) Rationality and objectivity in science or Tom Kuhn meets Tom Bayes. in C. Wade Savage (ed.), *Scientific Theories*. University of Minnesota Press, pp. 175-204.

Samian, A. L. (1994). The Impact of Kuhn's Structure of Scientific Revolutions on Sociology of Science. *Akademika*, 44 (1): 125-136.

Serdar, Z. (2001). Thomas Kuhn ve Bilim Savaşları. Çev. Ebru Kılıç. İstanbul: Everest Yayınları.

Swerdlow, M.N. (2004). An Essay on Thomas Kuhn's First Scientific Revolution, The Copernican Revolution. Proceedings of the American Philosophical Society, 148 (1): 64-120. URL: http://www.maxfm.com.tr/haber/max-fmin-radyo-sponsorlugunda-basyapitlar

Swerdlow N. M. (2013). Thomas S. Kuhn:1922–1996, *Biographical Memoirs*. National Academy of Sciences.