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KUHN'S NEW TERMINOLOGY IN PHILOSOPHY OF SCIENCE (A CRITICAL APPRAISAL)

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Abstract. Thomas Kuhn is the prominent personality of the twentieth century. He secured the position as a historian and a philosopher of science. A good historian, famous and real teacher, genuine physicist and scientist and scholar of philosophy of science and great writer, he presented many new thoughts which were either unknown or in the seeds of thought e.g. the novel ideas of 'The Paradigm', 'Paradigm Shift', 'Normal science', 'Revolutionary Science', 'Crises' and 'Incommensurability'. These ideas influenced all the branches of Science and Social Sciences directly or indirectly in the previous century. So his ideas and philosophy of science is a part of the study of modern philosophy. Here I have tried to present a simple, precise and clear understanding of the terminology used in philosophy of science with especial reference to Thomas Kuhn.

Key Words: Anomalies, Crises, Incommensurability, Normal Science, Paradigm, Revolutionary Science, Revolution,

Life Sketch

Born at Cincinnati, Ohio on July 18, 1922[1] and lived a life as a philosopher and historian of science as well as a teacher, writer of such books that changed the scenario of thought in the 20th century and as a

[1] Newton-Smith, ed. *A Companion to the Philosophy of Science.* Massachusetts: Blackwell, 2001.

thinker who introduced innovative ideas in the field of philosophy of science, and known as one of the most important philosophers and historian of the science of the 20th century died in Cambridge, Massachusetts on June 17, 1996.

Educational Career

In 1939 he entered Harvard University and remained there till 1956. During this he got bachelor's (1943) and master's (1946) degrees in physics at Harvard University and obtained his Ph.D. degree in Physics in 1949, he also taught there history and philosophy of science from 1951 to 1956, and in many other institutions like University of California, Berkeley (1956–1964), Princeton University 1964–1979, and Massachusetts Institute of Technology 1979–1991 as well.

Works

1957: The Copernican Revolution: Planetary Astronomy in the Development of Western Thought. Cambridge, MA: Harvard University Press. Rev. ed., 1979.

1962: The Structure of Scientific Revolutions. 2nd ed. With postscript. Chicago: University of Chicago Press, 1970. 3rd ed. with index, 1996.

1977: The Essential Tension: Selected Studies in Scientific Tradition and Change. Chicago: University of Chicago Press,

1993: The Road since Structure: Philosophical Essays, 1970–1993, with an Autobiographical Interview, edited by James Conant and John Haugeland. Chicago: University of Chicago Press, 2000. Contains a complete bibliography of Kuhn's publications.[2]

1978: Black-Body Theory and the Quantum Discontinuity 1894-1912. Oxford, Clarendon Press

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[2] Borchert, D. M., ed. *Encyclopedia of Philosophy.* Thomson Gale, Macmillan Reference, 2006.

1993: In World Changes: Thomas Kuhn and the Nature of Science, ed. Paul Horwich Cambridge Press.[3]

How Science Develops

In the course of history there have been many hot discussions and debates about the nature of scientific progress since the Greeks to the modern world. Many philosophers of science have paid a great attention to this subject. Most recent debates about science are carried out by Karl Popper, Thomas Kuhn, and Imre Lakatos. But Kuhn has presented a new and a unique account about the development in scientific knowledge. In this present work I try to explain Kuhn's views about scientific development which he primarily expressed in his famous work *The Structure of Scientific Revolutions*…Kuhn, in his well-known masterpiece cited above describes how science develops and it is quite contrary to the prevailing concept.

The old view was that sciences develop due to the addition of new theories to the heap of the old one or due to the correction of the errors done in the past. Such type of progress is guaranteed by the "Scientific Method"

Kuhn on the development of science

The Normal Science

Kuhn defines normal or ordinary science as "research based firmly upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for its success".[4] He says that these types of scientific investigations do not intend or invent new theories nor they discover new phenomena rather these investigations aim to increase the scope of the existing theories. Therefore, normal science can be classified into three categories; explanation of the facts by using the theory, resembling the facts with the theories and interrelation the theories.

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[3] Pearsall, Judy B., ed. *he New OXFORD Dictionary of English. Oxford.* Oxford: Clarendon Press, 1998.

[4] Kuhn, Thmas. *The Structure of Scientific Revolution.* 3. Edited by The University of Chicago Press. Chcago, 1996.

According to him, sciences develop but not in a uniform way rather they develop in the two alternating phases e.g. the 'normal' and the 'revolutionary' (or 'extraordinary'). Here 'Normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice.[5] Kuhn in his book calls it as 'puzzle-solving'.[6] Its main purpose is to convey that the idea like a person solving a chess problem or a crossword puzzle, the person expects of having a reasonable chance of solving it. His expectation depends on his ability. He is not entering in unseen territory instead the method of solving and the method is familiar to him, likewise in the normal science one expects to accumulate a growing stock of solution of puzzles."… the theoretical problems of normal science, which fall into very nearly the same classes as the experimental and observational. A part of normal theoretical work, though only a small part, consists simply in the use of existing theory to predict factual information of intrinsic value".[7]

The Revolutionary

In Kuhn's opinion the revolutionary phases should not be regarded as merely accelerated patches of progress but in fact they are also different qualitatively from normal science. Normal science paints the picture of accumulative nature of scientific progress. But Revolutionary Science is not so e.g. it is not accumulative in its nature. This involves the revision of the existent scientific beliefs and practices. The achievements of the normal science are not totally preserved in revolutionary phase. This feature of scientific revolutions has become known as 'Kuhn-loss'

The similarities in Normal Science and Puzzle Solving are consisted of two things.

First, both assure solution. For example, a scientist, who is researching about the qualities of a particular object, is quite sure about

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[5] Ibid.

[6] Ibid.

[7] Kuhn, Thmas. *The Structure of Scientific Revolution.* 3. Edited by The University of Chicago Press. Chicago, 1996.

the existence of that object and also knows that these qualities can be known.

Second thing is about following the rules just like in the game, and in science these rules are provided by the theories. For example, how an experiment should be conducted and what type of qualities the object has or the metaphysical believes about the object etc.

Characteristics of both Sciences:

Kuhn expresses that the history of science can be divided into the above mentioned phases or two types of activities e.g. the "normal science" and the "revolutionary science". The former comprises long and calm periods of time in which the researches work to deepen and broaden the theoretical accounts based on a set of beliefs which are generally unquestioned. The latter activity is seen in the small and brief phases of chaos in which the fundamental beliefs of the former phases are questioned and replaced. To recognize these set of unquestioned fundamental beliefs, Kuhn assigns it the term of Paradigm.[8]

Paradigm.[9]

Etimology Gk. ***Paradeigma***, from ***"paradeiknunai***" 'shown side by side

("***para",*** beside, "***deiknunai".*** to show)[10]. A pattern or model; Typical example or pattern of something; Paradigm means a world-outlook that is the core behind the methodology and theories of a particular science.

He defines Scientific Paradigm as a recognized scientific achievements accepted universally and these are for a phase of time, they supply the model problems as well as solutions for a researchers' group.[11]

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[8] Barker, B.G. "Kuhn, Lakatosh, and Lauden (Application in the history of physics and psychology)." *Americal Psychologist* (Americal Psychologist), 1985: 40 (07), 755,769.

[9] Kuhn, Thomas. *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought.* HArvard: Harvard University Press, 1957.

[10] Pearsall, Judy B., ed. *he New OXFORD Dictionary of English. Oxford.* Oxford: Clarendon Press, 1998.

[11] Kuhn, Thmas. *The Structure of Scientific Revolution.* 3. Edited by The University of Chicago Press. Chcago, 1996.

"In its established usage, a paradigm is an accepted model or pattern,…"[12] Kuhn as a philosopher of science has given it new meaning in its peculiar way. According to him "Paradigm" means a set of practices which define a scientific framework and discipline in a particular passage of time.

This concept was developed, as Kuhn has mentioned in the *Preface* of the 'The Structure of Scientific Revolution', during the observation of natural and social sciences. In the former there are very few points of disagreements because of its hard and fast rules, while in the latter, one can find enormous number of disagreements and differences in views about research methods. He introduces this term to explain the point of agreements among scientific communities about the past scientific discoveries and their expectations about future researches that how these researches should be carried out.

This agreement, according to Kuhn, prevailed among scientific disciplines because of the past successes of science on problems and their solutions. Whereas, the social sciences have not acquired such successful paradigms Kuhn used the term for past scientific developments, which are either theoretical and practical or both. By using this term he affirms the general criteria of scientific investigations which are established by the international scientific communities.

In his opinion this term "stands for the entire constellation of beliefs, values, techniques and so on shared by the members of a given community". He regards Ptolemy's *Almagest*, Lavoisier's Chemistry, Newton's Principia, and Aristotle's Physics, as paradigm defining works.[13] Such mentioned texts contain the laws and key concepts that make paradigms.

According to him fundamental changes into a paradigm cannot come from the normal science. The transition from one to another paradigm consist of reconstruction of the fields out of new

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[12]Ibid.

[13] Borchert, D. M., ed. *Encyclopedia of Philosophy.* Thomson Gale, Macmillan Reference, 2006.

fundamentals, it is a rebuilding and reconstruction which changes many elementary and conceptual generalizations along-with its implications and methods.

The paradegms as exemplars are hoped to describe the nature and essence of normal science, the crises process, the revolution and the renewal of new one and also describe the birth of a mature science (immature is the one which is in the pre-paradigm period and lacks consensus). The term 'paradigm' or 'exemplar' are used by Kuhn for the novel puzzle-solutions which crystallizes consensus are considered and used as a model for exemplary science.

As an exemplar, a paradigm performs the following three functions:

(a) It put forwards new puzzles,

(b) It provides ways for solving the puzzles,

(c) It provides the criterion by which the quality of a proposed puzzle-solution can be measured.

In the 'Postscript' added later to his opus magnum *The Structure of Scientific Revolutions*, Kuhn said about the 'paradigms' that they are "the most novel and least understood aspect of this book".[14]

Incommensurability;

'Incommensurable' (adj.) not to be judged by the same standard as 'something'; having no common standard of measurement.

> *"The thesis that terms in different scientific traditions and communities are radically distinct, and the modifications that have stemmed from that thesis, became known as the thesis of incommensurability."*

When in the course of time a tradition or a theory has been replaced by any other one in a revolution, the basic thoughts and fundamental concepts changed. In Kuhn's opinion, tradition of science

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[14] Kuhn, Thmas. *The Structure of Scientific Revolution*. 3. Edited by The University of Chicago Press. Chcago, 1996.

can be recognized by the follower of the paradigms. According to Kuhn we judge a theory due to the comparison with its paradigm and this comparison among them is not straightforward. Theories are called "incommensurable" when they do not have any common measures. But it does not mean that it is incomparable or incomparability of comparison between or among theories.

Kuhn describes that incommensurability has three types.

1. Methodological Incommensurability

2. Observational or Perceptual Incommensurability

3. Semantic Incommensurability

The first one explains that due the change in the methods of evaluation and comparison, there are no measure those are common.

The second one describes that because the experiences relating to perception are theory dependent so evidences of observation do not provide the common grounds for the comparison among theories

The third one reveals the fact that in the different periods of normal science the languages of theories are not "inter-translatable" so theory cannot be a comparison.

The thesis of incommensurability presented by Thomas Kuhn became a challenge to the scientific change of the positivist as well as for realists.

History of Science

Kuhn's works *Copernican Revolution in Planetary Astronomy* and *The Structure of Scientific Revolutions* covered many topics of physics and astronomy. Kuhn in discussion concerning to Ptolemaic System and the Copernican solution described two notions e.g. first is that he regards the Aristotelian science as a genuine and the researches who are working in the this field especially the Ptolemaic Astronomy are doing quite reasonable research. The second is that Copernicus was indebted to that tradition.

Four Stages of the Development a Science

He presented the four stages in which the sciences have grown.

Pre-paradigm period. This period starts from the zero and there is no organize data because there is no paradigm. Science is mere a collection of data without any real organizational systematic principle.

Normal science. The paradigm developed and formed the pre-paradigm science into normal science it consists of puzzles and puzzle solving phases and it enhanced our knowledge. The scientists in this phase regarded the assumed assumptions as true.

Period of Crisis. Anomalies arose at this stage (means that what we expect in the framework of our paradigm, the observations do not match with it)

Revolution. In this phase the old paradigm is replaced by the new paradigm. In it the old thoughts are also takes place. The new researchers interpret them with new ways.

Anomalies

Paradigm was to explain the point of agreement in scientific communities about the past scientific discoveries and their expectations about future researches that how these researches should be carried out. But in course of time there arise some problems which cannot be solved in light of the established paradigm. Such problems are called *Anomalies.* "Anomalies are unexpected or unclear empirical results".[15]

"Anomalies enable scientists to isolate weaknesses within the dominant paradigm and to devise a solution that ultimately induces the scientific community to embrace a new and more effective paradigm".[16]

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[15] Nickles, T., ed. *Thomas Kuhn: Contemporary Philosophy in Focus.* Cambridge University Press, 2003.

[16] Borchert, D. M., ed. *Encyclopedia of Philosophy.* Thomson Gale, Macmillan Reference, 2006.

In Kuhn's view the recognition of an anomaly shows the ways and phases of crises and these lead to the "extraordinary science." These Anomalies make the scientists to think, review and reconsider about the established ways of investigation. Furthermore they demand modification of the accepted tools. In the presence of these anomalies the accepted tools can also be abandoned. They are able to question the already existing tools.

All paradigms have to face anomalies and have to confront obstacles in the process of development of normal or ordinary scientific research and anomalies (which are unclear or unexpected results) are prominent among these obstacle.[17]

To make scientific investigation about a thing that counter the already existing solutions and ontological believes about the physical objects, it is very difficult task. A scientist cannot easily fore-sees a scientific discovery. Therefore if something that did not exist, after the discovery, is usually taken as something wrong because it cannot be classified under existing categories of scientific knowledge. Kuhn has clearly described about this problem that the "awareness of anomaly opens a period in which conceptual categories are adjusted until the initially anomalous has become the anticipated". All paradigms in the process of research regarding the development of normal or ordinary science are destined to face unclear or unexpected empirical results which have been termed "Anomalies" which may take place repeatedly. Some of them may be resolved but some persist and "some anomalies can erode a community's commitment to a paradigm".[18]

There is an important thing to be noted in the case of anomalies that every anomaly should not be considered very severe. So, when scientists try to investigate every anomaly usually does not get significant results. Therefore some anomalies can be neglected in initial stages. Kuhn explains this idea by giving an example of Newton's law. The motion of Mercury was a little different from the findings of

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[17] Nickles, T., ed. *Thomas Kuhn: Contemporary Philosophy in Focus.* Cambridge University Press, 2003.

[18] Ibid.

gravitational law but nobody criticized Newton's law on this ground. But there are some anomalies that can be taken as severe and have potential to question the existing tools and believes. There are three types of anomalies which can be taken as severe.

First, which questions very basic findings of science, Second, which questions the practical developments of science and Third, that is focused by normal science and gains its importance.

But a theory cannot be falsified even in the presence of severe anomalies. A theory cannot simply be abandoned until there comes a new theory to replace it. This point is made by Kuhn to refuse the popper's views about scientific development. According to Popper science develops by making hypotheses and then by their falsification Kuhn has also mentioned that "Once a first paradigm through which to view nature has been found, there is no such thing as research in the absence of any paradigm. To reject one paradigm without simultaneously substituting another is to reject science itself".

Crises

Considering the above discussion regarding paradigm and anomalies, one may find that when an anomaly occurs the existing theory comes into crises. This crisis occurs primarily because of the failure of the normal science in solving the puzzles. When a crisis takes place it blurs the existing paradigm and consequently the normal science losses its rules. In this phases research resembles to that of pre-paradigm phase. Because the crises occurs primarily due to the failure of the normal science in solving the puzzles so in this situation, the activity of solving problems is done by *Extraordinary Research.*

In the period of crises which leads to changes in paradigm at larger level, Scientists develop many unarticulated and speculative theories which can themselves point the ways to discovery. "The significance of crises is the indication they provide that an occasion for retooling has arrived".[19] So, for the appearance of novel theories, the crises are prerequisite and essential condition which demand the scientist that how they can react to their existence.

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[19] Kuhn, Thmas. *The Structure of Scientific Revolution*. The University of Chicago Press. Chcago, 1996.

During the crises, the scientific ways of investigation and evaluation falls a prey to change. This happens when a severe anomaly gets too much attention of scientific community because of its severity and no answers would be given to the existing methods. This problem make scientists think about the prevailing methods of their discipline. At this point of change scientists try to fix the problem by using diverse techniques. If the problem still continues then this diversion is also occurred continuously. During this period of diversions the existing rules of normal science are put aside and gradually they vanish.

During this phase of change and in the activity of extraordinary science, scientists change the rules of normal science to solve the problem. Though this change is objected by some scientists who prefer to solve problems by old rules or paradigms but some new scientists go beyond their limits of research to get the solution of the problem and discontinue the practice of old paradigm. This leads the scientists towards new discoveries. "If existing theory binds the scientist only with respect to existing applications, then there can be no surprises, anomalies, or crises".[20]

According to Kuhn, during this period of extraordinary science new theories are developed. This paradigm shift may happen accidently, such as Kuhn describes "the new paradigm … emerges all at once, sometimes in the middle of the night, in the mind of a man deeply immersed in crises". Finally, Kuhn states that this stage of crises may end in three different ways; these are as follows.

Firstly, there are chances that scientists find the solution within the old paradigm and return to practice normal science.

Secondly, scientists may not find the solution of the problem neither within old paradigms nor by using new methods. This will lead them to believe that this problem cannot be solved and they return to normal science by putting the problem aside for future generations of more equipped scientists.

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[20] Ibid.

Thirdly the way is that the problem gets its solution using some new theory and that new theory replaces the old theory in practice. This stage is called the *Scientific Revolution*. This revolution becomes the cause of rapid growth in science and a major shift of old paradigms into new ones. These new paradigms get their approval from scientific community on the basis of their authenticity in solving problems and capacity to determine new ways of investigation. The ways which old paradigms fail to recognize.. Kuhn defines scientific revolution precisely that "those non-cumulative development episodes in which an older paradigm is replaced in whole or in part by an incompatible new one"

The "scientific development" which we termed the process is a long journey of science in which there has come numerous periods of normal science, crises, extraordinary researches, and revolutions. Every step of the scientific development has its unique significance and importance in the disciplines of science.

Criticism and Influence

From the philosopher generally and from the "Orthodox Philosophers" Kuhn had to face severe criticism. When Kuhn's work was understood by some they had to transform their ideas. His philosophy opened new ways of thought and novel avenues of research. The focus of criticism was Kuhn's two main points, e.g. His account of the development of science was not absolutely correct and the notion of 'Incommensurability' that does not exist but if really exist, it is not important one. Regardless the criticism, his works have been enormously influential, not only philosophy, philosophy of science, social science and outside these fields.

The Structure of Scientific Revolutions is an important stimulus to those who have been working or doing research and also for what has been called Scientific Studies.

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Philosophy Of Science. Â¾ The study of the scientific process or method and its validity. Â¾ Identifies different styles of explanation characteristic of different sciences (e.g., psychology versus neurophysiology) or different stages in a given science (e.g., Newtonian versus Einsteinian theories of gravity) to determine how different explanatory styles reflect the characteristic problems of different scientific fields and periods. Â¾ Central philosophical task: analyze clearly and explicitly. Â¾ Standards by which scientists decide whether some interpretation is legitimate, justified, and conclu Kuhnâ€™s contribution to the philosophy of science marked not only a break with several key positivist doctrines, but also inaugurated a new style of philosophy of science that brought it closer to the history of science. His account of the development of science held that science enjoys periods of stable growth punctuated by revisionary revolutions.Â This led Kuhn to concentrate on history of science and in due course he was appointed to an assistant professorship in general education and the history of science. During this period his work focussed on eighteenth century matter theory and the early history of thermodynamics. Kuhn then turned to the history of astronomy, and in 1957 he published his first book, The Copernican Revolution. Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science. Paul Hoyningen-Huene. CategoriesÂ Neither traditional theories of word meaning nor the newer theories that reduced meaning to reference were suited to the articulation of these concepts. Allusions to altered ways of seeing could at best disguise the deficiency. Since the publication of Structure my most persistent philosophical preoccupation has been the underpinnings of incommensurability: problems about what it is for words to have meanings and about the ways in which words with meanings are fitted to the world they de- scribe. Commensurability (philosophy of science). From Wikipedia, the free encyclopedia.Â Once an alternative theory is presented the critical phase commences regarding T' which must answer the following questions: (a) why has theory T been successful up until now and (b) why has it failed. If the new theory T' answers both questions then T is discarded.Â Kuhn's thinking on incommensurability was probably in some part influenced by his reading of Michael Polanyi who held that there can be a logical gap between belief systems and who also said that scientists from different schools, "think differently, speak a different language, live in a different world."[7]. criticisms concerning the appropriateness and applicability of Kuhnâ€™s influence on the history of economics. The same approach is followed in the case of I. Lakatos. After a classification and discussion of the main findings, the paper attempts to offer an interpretation of the general impact of these two philosophers of science on ideas relating to the development of economic thought . II.Â In the same spirit, Weintraub (1979) believes that Kuhn's account of scientific revolutions and the rise and fall of different paradigms, is not a correct way to approach the history of economic thought.Â Criticisms on Kuhnâ€™s explanation. Vagueness In terminology. Non-appropriateness for economics. Stigler, 1969.