Lecture 3
Kuhn's Methodology

We now briefly look at the views of Thomas S. Kuhn whose magnum opus, *The Structure of Scientific Revolutions* (1962), constitutes a turning point in the twentieth-century philosophy of science. Before we comment in the radical ramifications of Kuhn's views, a brief exposition of his fundamental ideas are in order.

The life of every major science, according to Kuhn, passes through two stages which can be characterized as pre-paradigmatic and paradigmatic. During the pre-paradigmatic period of a science, one finds more than one mode of practising that science. Thus, there was a time when there were different schools in astronomy which practised astronomy differently. So was the case with disciplines like physics, chemistry and biology too. Their situation at that stage of their development was similar to the one which obtains today in the case of creative areas like art, literature, philosophy and even medicine wherein divergent modes of practising these disciplines coexist. But, whereas even today we speak of schools of art, schools of literature, schools of philosophy, and systems or schools of medicine, we do not speak of schools of astronomy, schools of physics, schools of biology, etc. This is because, according to Kuhn, areas like art, literature, philosophy and medicine did not, and perhaps cannot, make a transition from pre-paradigmatic stage to paradigmatic stage. So, what characterizes a science which enters the paradigmatic stage is the disappearance of "schools". In other words, the transition from the pre-paradigmatic stage to the paradigmatic stage implies the replacement of plurality by uniformity of practice. When a science reaches the paradigmatic stage, it becomes, according to Kuhn, "mature" or "Science" in the present sense of the term. Astronomy was the first to enter the paradigmatic stage followed by physics, chemistry and biology. Social sciences are very much in the pre-paradigmatic stage since they have not yet succeeded in bringing about consensus over their practice as is shown by the prevalence of schools in social sciences. Creative areas like art and literature perhaps can never reach the second stage.

A science thus becomes "mature" when it acquires a paradigm. It is the acquisition of a paradigm which replaces plurality by uniformity of practice. But what are the paradigms?

We all know that Ptolemy's Almagast, Newton's Principia and Darwin's Origin of the Species are path-breaking works in the areas of astronomy, physics and biology respectively. According to Kuhn, these works provided paradigms for these disciplines. They did so by specifying the exact manner in which these disciplines ought to proceed. They laid the ground rules regarding what problems these disciplines must tackle and how to tackle them. Hence, paradigms are "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners"[1]. First, a paradigm specifies what the ultimate constituents of that sphere of reality which a particular science is inquiring into are. Secondly, it identifies the model problems. Thirdly, it specifies the possible range of solutions. Fourthly, it provides the necessary strategies and techniques for solving the problems. Finally, it provides examples which show how to solve certain problems. In other words, a paradigm is a disciplinary matrix of a professional group.

Once a science comes to possess a paradigm, it develops, what Kuhn calls, a "normal science tradition". Normal science is the day-to-day research activity purporting to force nature into conceptual boxes provided by the paradigm. The practitioner of normal science, that is, a scientist who is engaged in day-to-day research, internalizes the paradigm by professional education. This explains the prevalence of textbook culture to science education.

Of course, scientific practice is not exhausted in terms of day-to-day research or "normal science". When a paradigm fails to promote fruitful, interesting and smooth normal science, it is considered to be in a crisis. The deepening of the crisis leads to the replacement of the existing paradigm by a new one. This process of replacement is called scientific revolution. Therefore, scientific revolutions are "the tradition-shattering complements to the tradition-bound activity of normal science"[2]. Thus, once a science enters the paradigmatic stage, it is characterized by (1) normal science and (2) revolutions. In sheer temporal terms, "normal science" occupies much larger span than does "revolutionary science". That is to say, science is revolutionary once a while and mostly it is non-revolutionary or normal. Also, the scientific activity engaged in by most of the practitioners can be characterized aptly in terms of normal science. Because of this temporal and numerical magnitude, we can say that much of the scientific activity as we ordinarily encounter is normal though this "normal" course is occasionally interrupted by revolutions which change the form, content and direction of the process of the scientific activity which is basically "normal" by which we mean a non-revolutionary committed and tradition-bound activity. Normal science demands a thorough-going convergent thinking and hence, is preceded by an education that involves "a dogmatic initiation in a pre-established tradition that the student is not equipped to evaluate"[3]. Normal science is an activity that purports not to question the existing paradigm but to (1) "increase the precision… of the existing theory by attempting to adjust existing theory or existing observation in order to bring the two into closer and closer agreement"[4], and (2) "to extend the existing theory to areas that it is expected to cover but in which it has never before been tried"[5]. In other words, normal science consists in solving puzzles that are encountered in forcing nature into the conceptual boxes supplied by the reigning paradigm.

It is in this way Kuhn attempts to account for the smooth, defined and directional character of day-to-day scientific research in terms of the features of what he calls, "normal science". Normal science has no room for any radical thinking. It is limited to the enterprise of solving certain puzzles in accordance with the rules specified by the paradigm. These rules are never questioned but only accepted and followed. The aim of scientific education is to ensure that the paradigm is internalized by a student. In other words, the professional training in science consists in accepting the paradigm as "given" and equipping oneself to promote the cause of the paradigm by giving it greater precision and further elaboration. The day-to-day scientific research does not aim at anything fundamentally new but only at the application of what has already been "given", namely, the theoretical ideas and the practical guidelines for solving certain puzzles. It is in this sense that "normal science" is highly a tradition-bound activity.

Nevertheless, it is this tradition-bound activity which makes science a successful enterprise. Kuhn says, 'Normal science, the puzzle-solving activity, is highly a cumulative enterprise, eminently successful in its aim, the steady extension of the

scope and precision of scientific knowledge. In all these respects, it fits with great precision the most usual image of scientific works. Yet one standard product of the scientific enterprise is missing. Normal science does not aim at novelties of fact or theory and when successful finds none'[6]. In order to reconcile the undeniable fact of novelty that science exhibits by making new discoveries with somewhat hackneyed phenomenon of normal science, it is necessary to show that "research under a paradigm must be a particularly effective way of inducing paradigm change"[7]. But, then, how?

As pointed out earlier, normal science purports to force nature in the conceptual boxes provided by the reigning paradigm by solving puzzles in accordance with the guidelines provided by the paradigm whose validity is accepted without question. During this process of puzzle-solving, certain hurdles may be encountered. We then speak of "anomalies". That is, an anomaly arises when a puzzle remains puzzle defying every attempt to resolve it within the framework of the paradigm. But, appearance of one or two anomalies is not sufficient to overthrow a paradigm. The ushering in of the era of a new paradigm has to be preceded by the appearances of not one or two anomalies, not many small anomalies, but major ones. In order to declare a paradigm to be crisis-ridden, what is required is an accumulation of major anomalies. But, there is no "clear-cut" and "objective" criterion to decide which anomalies are major and how many anomalies must accumulate to declare a paradigm to be crisis-ridden. In other words, there is no criterion which decides whether a perceived anomaly is only a puzzle or the symptom of a deed crisis. The issue will be decided by the community of practitioners of the discipline through the judgment of its peers. Once the scientific community declares the existing paradigm to be crisis-ridden, the search for the alternative begins. Of course, the crisis-ridden paradigm will not be given up until and unless a new theory is accepted in its place. It is only during this transitional period of search for the new paradigm that the scientific debates become radical. During the process of the search for an alternative, the scientific community has to make a choice between competing theories. In this choice, the evaluation procedures of normal science are of no use, "for these depend in part upon a particular paradigm and that paradigm is at issue"[8]. The issue concerning the paradigm choice cannot be settled by logic and experiment alone. What ultimately matters is the consensus of the relevant scientific community. In other words, the choice of a theory as the new paradigm has to be understood in terms of the value judgments which a community of scientific practitioners exercises in the context in which it finds itself. While choosing a particular theory for the status of a new paradigm, the scientific community might advance arguments that seek to show that the chosen theory solves "important" problems, is simpler than the rest, etc. But, these are all value judgments since there is no objective criterion to decide which problem is "important" and what is "simple", etc. In other words, that theory is chosen which fits the value commitments of a scientific community. Hence, the question of choice becomes the question of value. Kuhn points out, "that question of value can be answered only in terms of criteria that lie outside of normal science altogether, and it is that recourse to external criteria that most previously makes paradigm debates revolutionary"[9]. Thus, a paradigm choice cannot be explicated in the neutral language of mathematical equations and experimental procedures, but in terms of specific perceptions which a scientific community as a social entity entertains what it considers to be the basic value of its professional enterprise. In other words, the ultimate explanation of a theory choice is not methodological but sociological. Hence, in Kuhn's scheme, the

idea of scientific community as a social entity is axiomatic. That is to say, according to Kuhn, 'If the term "paradigm" is to be successfully explicated, scientific communities must first be recognized as having an independent existence"[10], which implies that one must explain scientific practice in terms of paradigms and paradigmatic changes, and the latter are to be explicated in terms of a particular scientific community which shares the paradigms and brings about paradigmatic changes. Thus, the concept of a scientific community is basic to the concept of paradigm. The concept of scientific community can be explicated only in sociological terms. Hence, the ultimate terms of explication of scientific activity are sociological.

What is the relationship between the old paradigm which is overthrown and the new paradigm which succeeds it? Kuhn's answer to this question is extremely radical. According to him, in no obvious sense can one say that the new paradigm is better or truer than the old one. Kuhn maintains that the two successful paradigms cut the world differently. They speak different languages. Putting it metaphorically, the world changes when a paradigm changes. With his characteristic lucidity, Kuhn says, "the transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from accumulative process, one is achieved (not merely) by an articulation or extension of the old paradigm. Rather, it is a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its… methods and applications"[11]. This apart, Kuhn contends that the two paradigms talk different languages. Even if the same terms are used in two paradigms, the terms have different meanings. What can be said in the language of one paradigm cannot be translated into the other language. Based on this reason, Kuhn claims that the relationship between two successive paradigms is incommensurable. No wonder Kuhn compares paradigm-shift to gestalt switch. With this, the idea of scientific progress as a continuous process and the idea of truth as the obsolete standard stand totally repudiated. Kuhn advances what might appear to be an undiluted relativism according to which truth is intra-paradigmatic and not inter-paradigmatic. That is to say, what is true is relative to a paradigm, and there is no truth lying outside all paradigms.

Popper and Kuhn – Comparisons

Some of the radical implications of Kuhn's position can be brought about by juxtaposing his views with those of Popper. The hallmark of science, according to Popper, is critical thinking. In fact, science exemplifies critical thinking at its best. Since critical thinking considers nothing to be settled and lying beyond all doubt, fundamental disagreements and divergent thinking must, and in fact do, characterize science. As we have seen, according to Kuhn, what constitutes the essence of scientific practice is normal science and we have also seen why normal science is a highly tradition-bound activity, an activity made possible by a consensus among the practitioners who share a paradigm. Thus, if Popper sees the essence of science is divergent thinking and fundamental disagreements, Kuhn sees the essence of science in convergent thinking and consensus. In other words, the hallmark of science, according to Kuhn, is tradition-bound thinking. In fact, according to Kuhn, what distinguishes science from the other areas of creative thinking is that whereas in science one finds institutional mechanisms of enforcing consensus, the other areas suffer from perpetual disagreements even on fundamentals.

Secondly, if Popper considers the individual to be the locus of scientific activity, Kuhn bestows that status upon the scientific community. Both positivists and Popper looked upon science as the sum total of the work of individual scientists working in accordance with a method though positivists and Popper fundamentally differed on the characterization of that method. As opposed to this individualistic account of scientific enterprise, Kuhn propounds a collectivistic account of scientific activity. In Kuhn's scheme, it is the scientific community which constitutes the change. This is borne out by the fact that according to Kuhn the scientific community has institutional mechanisms like peer review by which it can settle all the issues such as whether an anomaly is a symptom of crisis, how many anomalies suffice to warrant the search for an alternative paradigm, what factors are to be considered in choosing a new theory for the status of a new paradigm, etc.

Thirdly, Popper and Kuhn differ fundamentally in their attitude towards the transition from one theory to another in science. According to Popper, we can explain every case of theory-change in terms of certain norms which science always adopts and follows meticulously. In fact, scientific rationality consists in following these norms. But, Kuhn contends that an adequate explanation of theory-change must be in terms of the value judgments made by a community while making the choice. According to Kuhn, recourse to the so-called methodological norms explains nothing. From the point of view of Popper, Kuhn is an irrationalist because he sets aside methodological norms and seeks to explain theory-change exclusively in terms of non-rational or sociological factors like value-commitments of a professional group. Whatever be the merit of Popper's attack on Kuhn as an irrationalist, we can say that Kuhn's construal of scientific practice is sociological. That is to say, according to Kuhn, scientific activity cannot be understood by trying to find out the absolute standards which have guided the scientific activity in all ages. It can only be understood in terms of the specific judgments which a community makes at a particular juncture regarding what it considers to be its value commitments as a professional group.

The above juxtaposition between Popper and Kuhn brings out the radical implications of Kuhn's views regarding the nature of scientific practice. However, in one respect, Kuhn is very close to Popper. Both, like positivists, contend that there is something unique to science though they differ in their explanation of what that uniqueness consists in. Positivists maintain that the hallmark of science is the systematic verifiability of its claims. According to Popper, the uniqueness of science consists in the systematic falsifiability of theories. According to Kuhn, it is consensus which marks out science from the other areas of human endeavour. That is to say, Kuhn, like positivists and Popper, does not question whether science is really unique. He assumes that to be so. He only wants to show how it is unique. That is to say, instead of raising critical questions about the status science has acquired in the contemporary culture, Kuhn only seeks to provide an alternative account of how it has acquired that status. In that sense, Kuhn's position is quite conservative. This conservation character of Kuhn's views becomes evident when we look at the views of Paul Feyerabend whose iconoclast ideas about science have made him a legend in his own life time.

Notes and References

[1] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Chicago University Press, Chicago, 1970 (first edition: 1962), p. viii
[2] *Ibid.*, p. 6
[3] Thomas S. Kuhn, *The Essential Tension: Selected Studies in Scientific Tradition and Change*, Chicago University Press, Chicago, 1977, p. 229
[4] *Ibid.*, p. 233
[5] *Ibid.*
[6] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Chicago University Press, Chicago, 1970 (first edition: 1962), p. 52
[7] *Ibid.*, p. 53
[8] *Ibid.*, p. 94
[9] *Ibid.*, p. 110
[10] Thomas S. Kuhn, *The Essential Tension: Selected Studies in Scientific Tradition and Change*, Chicago University Press, Chicago, 1977, p. 295
[11] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Chicago University Press, Chicago, 1970 (first edition: 1962), pp. 84-85