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Recent Trends in the Philosophy of Science: Lessons for Sociology

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ABSTRACT Auguste Comte's positivist claim of sociology was readily accepted by the succeeding generations of sociologists. Their efforts to vindicate this claim served to establish sociology on firm empirical foundations. Within a relatively short period, sociology succeeded in amassing a vast body of empirical data. Although meticulous attention was paid to methodology, most of it seemed to be misplaced, as it was mainly concerned with the tools and techniques of empirical research rather than with the logic of scientific procedure. It was however at the theoretical level that the limitations of sociology as a positivistic discipline were most apparent. Though some attempts had been made to develop general theories, these were far from satisfactory. In the natural sciences, whose model sociology has been trying to emulate, the terms science and scientific methodology have no longer the same meaning as in Newton's time. But unfortunately, the debate about the scientific status of sociology is still carried on in terms of an antiquated concept of science.

INTRODUCTION

When Auguste Comte founded the new field of inquiry called sociology during the first quarter of the nineteenth century, he had explicitly intended it to be a positivistic discipline. This was amply reflected in the very title of the book in which he expounded this subject, viz., Positive Philosophy. Comte happened to live at a time when natural science, especially, physics was making remarkable progress and like many other thinkers of his day, he too was profoundly influenced by the achievements of natural science. The extent to which Comte was influenced by physics may be gauged from the fact that the name he originally proposed for his newly founded field was "social physics". It was only when he discovered that this name had already been pre-empted by the Belgian statistician, Adolf Quetlet that Comte chose to redesignate it as sociology. Further, following physics, Comte also divided sociology into two parts, viz., social statics and social dynamics. Comte believed that positivism marked the culmination of man's intellectual development and all disciplines are ultimately destined to become positivistic. He defined positivism by contrasting it with the two earlier stages of thinking in human history, viz., the theological and the metaphysical. For Comte, positivism meant the extension and application of the method of natural science to the study of social phenomena. These methods, in turn, comprised of observation, experimentation and comparison. To these, Comte added the historical method as something special to sociology. In reality, however, the historical method is nothing new, as it signifies the addition of the temporal dimension to the comparative methods. Comte saw no reason why these methods which had been so successfully employed in the study of the natural phenomena should not yield similar results when applied to the investigation of the social phenomena.

Positivism is premised upon two basic postulates. The first is called the unity of science or methodological monism. According to this postulate, there is one and only one scientific method regardless of the nature of the phenomena to which it is applied and it is the method followed in the natural science. The postulate of the unity of science implies the principle of methodological primacy according to which the method of investigation is completely independent of the objects of investigation and that the scientific possibilities of a discipline is solely determined by the amenability of its subject matter to this pre-determined method.

The second postulate of positivism, which is a logical corollary of the first, assumes that reality is necessarily empirical. The methods of observation and experimentation evidently presuppose that the phenomena under investigation are open to sensory experience. This postulate seems to affirm that science is concerned with and is confined to facts, facts which exist in the spatio-temporal world, where they can be observed as they are, yielding objective knowledge. The truth of such knowledge is independent of the investigator and can be verified before it is accepted. Thus, objectivity and verifiability have been considered to be the two essential attributes of science. In an age dominated by science and obsessed with scientism, it is hardly surprising if positivism has led to the extreme view that anything that fails to fit into the scientific mould is not worthy of serious pursuit. Pelz (1974) has remarked that "today positivism is pervasive. Also Comte's positivistic conception of sociology was widely welcomed and enthusiastically espoused by the succeeding generations of sociologists with whom it remained an abiding article of faith. However, dissenting voices were not completely absent. William Dilthey (1833-1911) was one of the earliest to express serious reservations about the applicability of the methods of natural science to the study of human social phenomena. He was of the view that the socio-cultural phenomena are qualitatively different from the natural phenomena and any attempt to understand them in terms of the methods employed in the latter is bound to distort them. He pointed out that the socio-cultural phenomena are endowed with the special quality of carrying subjective meaning- a theme which was elaborated in considerable detail by Max Weber (1864-1920). Accordingly, Dilthey proposed a classification of knowledge into natural and human sciences geisteswissenschaften). The attempt to extend positivism to history also had met with a similar reaction, prompting Windelband (1848-1915) and Rickert (1863- 1936) to treat history as an ideographic discipline in contrast to the natural sciences which were described as nomothetic.

Since then there have been indications of a growing disenchantment with positivism. (Adorno et al., 1976). The doctrine of the unity of science no longer finds ready and uncritical acceptance. Similarly, there have been serious debates about the meaning of facts, whether facts can be apprehended independently of the observer, the validity of the

doctrine of verification and the belief in the objective truth of scientific knowledge. It is therefore, contended that "positivism-like any-ism, is a specific group-determined and determining attitude of particular individuals, who as is not infrequently the case, wish to claim objectivity, i. e., a kind of absoluteness, for their understanding. As one way of looking, positivism has proved immensely fertile. As the one and only way, it refutes itself and the humanity of the investigator and his subject. As a myth, positivism is neither right nor wrong. It is. It cannot be refuted. As an exclusive myth, it is highly dangerous" (Pelz, 1974).

When Comte propounded his doctrine of positivism, philosophy of science was in its infancy. But since then, the discipline has undergone radical and revolutionary developments. The current positivistic critique in sociology is inspired, partly at least by the ongoing debate in the philosophy of science, which has centered around the problematic concerning the nature of scientific knowledge, scientific method, scientific explanation as also the problems concerning the relation between theory and facts. Sociologists do not seem to be aware that even in the natural sciences the meaning of the concept of science has undergone drastic change. Especially, physics, which Comte adopted as a model for sociology, has advanced to a stage where the second tenet of positivism has all but lost its relevance. Against this background, it is felt that an understanding of the recent developments in the philosophy of science may prove to be useful to the sociologists and offer some valuable insights in their quest for understanding the true nature of their own discipline. It is with this aim in view that the present paper has been attempted.

ON THE TERM 'SCIENCE'

Before turning to the main theme of this paper, a few preliminary remarks may be made about the usage of term 'science'. The current and widely accepted view is that science is a relatively recent development and its beginnings scarcely go beyond the sixteenth century. According to this view which identifies science only with modern science, all that may have existed in the name of science earlier can be dismissed as either pre-science or proto-science. A second and far more comprehensive view regards science as something vitally connected with human existence and human experience and tries to locate its origin in common-sense. Comte had observed that 'the knowledge which mankind even in the earliest ages chiefly pursued being that which they needed most was foreknowledge. When they sought for the cause, it was mainly in order to control the effect, or if it was uncontrollable, to foreknow and adapt their conduct to it. Now all foresight of phenomena and power over them, depend on knowledge of their sequence, and not upon any notion we may have formed respecting their origin or inmost nature. All foresight, therefore and all intelligent action, have only been possible; in proportion as men have successfully attempted to ascertain the succession of phenomena. Neither foreknowledge which is practical power can be acquired by any other means (Mill, 1961). Barber (1962) has precisely this in mind, when he tries to equate the history of science with the history of human civilization. Philosophy of science is however concerned only with the former sense of the term 'science'.

Another source of confusion is the widespread tendency to identify science with its practical applications. In the popular mind, modern science is generally associated with its results, which represent its most tangible, concrete and easily visible manifestation. Much of the popular appeal of science, as well as opposition to it, can be traced to the consequences lowing from the practical applications of modern science. Scientists for whom there exists a clear line of demarcation between pure and applied science, with the latter being identified with technology do not always share this view. Moreover, the scientists often disclaim any responsibility for the consequences of science, especially its negative and destructive aspects. To them science is an intellectual pursuit, the outcome of which may be used for beneficial or harmful purposes depending upon the inclinations of the user and this is not the special concern of the scientist as qua scientist. In other words, scientists can be held no more responsible for the consequences of science than any other professional in society. The role of the scientist, like all other occupations and professions is a specialized one which does not confer on him the authority to control the overall use of science. Nor can the scientists arrogate to themselves the wisdom needed to judge what is in the best interest of mankind. Needless to say, this is in striking contrast to the conventional image of the scientist as a disinterested seeker after truth and reduces him to the level of an ordinary worker or at best a salaried employee.

Another misconception about modern science relates to the popular tendency to consider all scientific knowledge as absolutely certain and infallible. According to this view, science is regarded as a linear, continuous, cumulative and irreversible process necessarily leading to progress. This blind and uncritical belief in the value and validity of all scientific knowledge is what is termed as scientism'. This is not a correct image, because the history of science is replete with numerous instances of failures. Moreover, successful scientific discoveries are mediated as much by chance, good luck and intuition as by regular and methodical efforts. The accounts of successful scientific discoveries are often partial and incomplete as they highlight only the success stories. It will not be far from the truth if it is asserted that science advances by moving from one error to another. This is one of the problems discussed in the philosophy of science.

The term science' is also used to refer to a special and unique system of knowledge which is considered to be qualitatively different from all other systems of knowledge. This scientific knowledge is also claimed to be superior to all other knowledge, by virtue of which it is often placed on a higher pedestal. While the truth or validity of all other systems of knowledge is sought to be judged in terms of the canons and criteria of modern science and rejected if they are not found to confirm to them, scientific knowledge itself is not considered to be in need of any validation by external standards. This epistemological privilege is in turn attributed to the special methods and procedures employed in the development of scientific knowledge. In other words, science is not only treated as a uniquely superior system of knowledge transcending all other forms of knowledge and enjoying an epistemologically privileged status, but is also identified as a method or mode of inquiry. It is elliptical to regard science as a superior system of knowledge and also to treat it as a unique method. While the superiority of scientific knowledge is attributed to the special method employed by science, the validity of the scientific method, in turn, is sought to be justified in terms of the superior nature of the knowledge generated by it. Moreover, the scientific method is premised upon certain system of knowledge should not be applied to judge the validity of a totally different system and that all systems of knowledge must be validated in terms of their own respective criteria. This debate has led to the formulation of alternative conceptions and interpretations of modern science. As we shall see presently, a critical examination of these debates and controversies has led to some radical and unexpected developments in philosophy of science.

PHILOSOPHY OF SCIENCE

If we look at the history of modern science or scientific method, it is possible to discover at least four different conceptions. Aristotle is generally believed to be the first to explicitly set forth what may be termed as a scientific method. In contrast, his predecessor, Plato is generally dismissed as being opposed to science or as anti-cum-scientific owing to his commitment to the idealist philosophy and his preoccupation with abstractions (Ardono et al., 1976).

Aristotle's view of science was that it is an inductive-cum-deductive method in which we proceed from observation to general principles and back again to observation. It is the observation-based inductive method, which supplies the general principles, which in turn are verified by deducing empirical consequences from them and by checking their agreement with empirical reality.

"Scientific explanation is a transition from knowledge of a fact to knowledge of reasons for the fact (Losee, 1993). Aristotle speaks of two types of inductive generalizations:

(a) Inductive by simple enumeration

(b) Intuitive induction.

While the former is based on observation of facts, the latter is often a matter of insight. Inductive generalizations, if they are to serve as premises of a scientific explanation, must according to Aristotle, fulfill four empirical or extra-logical requirements. These are:

(a) The premises must be true.

(b) The premises must be undemonstrable.

(c) They must be better known than the conclusions.

(d) They must be causes of the attribution.

Aristotle was responsible for setting forth the idea of necessary truth, which he ascribed to genuine scientific explanations. This implies the following theses:

a) Certain properties inhere essentially in the individuals of certain classes and the individuals would not be a member of one of these classes if it did not posses the property in question.

b) An identity structure exists between universal affirmative statements that predicate an attribute of a class term and the non-verbal (real) inherence of the corresponding property in the members of the class.

c) It is possible for the scientist to intuit correctly this isomorphism of language and reality.

These theses have been seriously questioned in recent times. The idea of necessary truth is closely related to the idea of causal attribution and Aristotle tried to distinguish causal relation from accidental relations on the basis of three criteria. These are:

(a) A causal attribution must be true of every instance of the subject without exception.

(b) It must be true of the subject precisely and not as part of a whole.

(c) It is essential to the subject. Aristotle however did not offer any criterion of essentiality.

He recognized four aspects of cause, viz. Formal, material. Efficient and final and insisted that an adequate causal explanation must cover all these four aspects.

Aristotle also distinguished between two levels of generalizations. At the lower level are those propositions peculiar to each individual science and pertaining to its subject genus and its proper predicates. These are the first principles and definitions of these particular sciences and hence are self evident and not demonstrable. Above these and transcending them are the general propositions common to the various sciences and which constitute the first principles of all demonstrations, viz. the laws of identity, non-contradiction and excluded middle. From this it is clear that the second requirement of a scientific explanation mentioned above means that within every science, there must be one general proposition which cannot be deduced from a still more general proposition and those first principles of each science must be accepted as self-evident.

Aristotle's inductive-cum-deductive conception of science received wide acceptance and it was further advanced during the medieval period. Robert Grosseteste (1168-1253) considered the inductive stage as resolution of the phenomenon into constituent elements, and the deductive stage as composition in which the elements are combined to reconstruct the original phenomenon>Roger Bacon (1214-1292) added experimentation as the basis of the inductive method. Grosseteste also anticipated the outlines of what William Ockham (1280-1349) later developed as the method of difference, while the method of agreement was enunciated by John Duns Scotus (1265-1308). These scholars also devised some methods for evaluating competing explanations. Bacon's First Prerogative of Experimental Science added a third to Aristotle's inductive-deductive method, in which the principles induced by resolution are submitted to the test of further experience. This, along with Ockmham's criterion of simplicity for choosing from competing theories and Grosseteste's method of falsification by the method of modus tollens are other important contributions in this direction.

According to Aristotle, the deductive process marked only the second stage of scientific inquiry, because the major pemises of the deductive syllogism are to be yielded by induction. The fact that induction is unable to yield truly universal general propositions was held as the fundamental weakness of induction and this led to an alternative conception of science exclusively anchored on deduction. The starting point of deductivism was that, if according to Aristotle, general propositions have the status of necessary truth, then their sources cannot be in the observation of facts, but must be located in the idea of the inherent rationality of the universe, which is one of the basic assumptions of Aristotelian science, had its origin in Plato and had been developed by the Pythagoreans and culminated in the mathematical explanation of natural phenomena. Thus, deductive systematization reached its ideal mathematics.

This deductive conception of science, which was first developed in mathematics, starts from a set of axioms and definitions. Subsequently, deductive consequences of these axioms are drawn in the form of theorems whose truth is verified with reference to observation. The deductive conception of science has three characteristics:

(a) The axioms and the theorems are deductively related.

(b) The axioms themselves are self-evident truths.

(c) The theorems agree with observation.

Of these characteristics of deductivism, the last two have been a subject of controversy. The Pythagoreans and mathematical astronomers have taken different views about the claim that the axioms are self-evident truths. While the Pythagoreans had no difficulty in agreeing with this since it was in accordance with their view that there are mathematical relations in nature which can be discovered by human reason, the mathematical astronomers who subscribed to the tradition of 'saving the appearance', maintained that all that was necessary was to ensure that the theorems deduced from the axioms agreed with observation, and it was of no consequence even if the axioms themselves were false.

Similarly, the claim about the agreement of the theorems with observation has been contested. Because the terms used in the axioms and the theorems are generally defined in an ideal sense, there arises the problem of their correspondence to reality and this is reminiscent of the Platonic distinction between the world of ideas or pure forms and the world of reality. During the fifteenth and sixteenth centuries, following the contributions of Nicholas Copernicus (1473-1543), the debate about the relation between scientific explanations, particularly mathematical explanations and the world of reality was revived. One interpretation of Copernican theory was that it was only a computational device designed to save the appearances of planetary motions, though Copernicus as a committed Pythagorean, claimed physical truth for his theory. In the triumph of Pythagoreanism during this period, Copernicus was strongly supported by Johannes Kepler (1571-1630), Galileo Galilei (1596-1650).

Because Galileo believed that the universe and the world of nature were ruled by mathematical relations and principles, he maintained that the scientific study of nature must be aimed at those aspects of nature which undergo quantitative variations. He thus came to establish a distinction between 'primary qualities' and 'secondary qualities' in the subject matter of physics. In trying to define the subject matter of science, Galileo established the distinction between scientific and non-scientific interpretations and secondly, a further distinction between the acceptability or otherwise of those interpretations which qualify as scientific.

Galileo's attack on Aristotleanism was directed against those who had a tendency to begin their inductive process not with observation, but with dogmatically assumed self-evident first principles, which threatened to divorce science from empirical reality. But in his own works, in spite of his fervor for experimentation, he did not attach much importance to empirical facts and employed abstractions and idealizations and whenever there was a discrepancy between his theory and the observed facts, he was inclined to dismiss it as either unimportant, or due to minor experimental complications, or as due to other secondary causes. In other words, though Galileo did not repudiate the importance of observation, he doubtlessly de-emphasized it because he maintained that hypotheses about idealization or abstractions could not be directly obtained from sense experience. Mere sense experience could not even suggest a hypothesis, which was possible only through the intuitive imagination of the scientist. It was Rene Descartes who completed the process of the separation of induction and deduction in his attempt to derive the self-evident and necessarily true first principles exclusively through a process of reasoning.

A third alternative conception of science, which emerged as a reaction to Aristotle's method, was inductivism. The inductivist movement was led by Francis Bacon (1561-1626). Though Bacon did not completely deny the importance of the deductive method, he was inclined to emphasize the role of inductism. His main objections against deductivism were two:

(a) Science cannot be reduced to deductive syllogistic arguments, especially when the terms of the syllogisms are not well defined.

(b) Deductive arguments can be scientific only when the premises have proper inductive support.

At the same time, Bacon did not fully agree with Aristotle's view of induction either. Firstly, he contended that Aristotle had never clarified how observation was to be made or data were to be initially collected as a base for drawing an inductive generalization. Secondly, Aristotle's induction permits hasty generalization from the observation of a few instances to the most general propositions. thirdly, in trying to generalize the relation between two phenomena on the basis of induction by simple enumeration, Aristotle had ignored the existence of negative instances. Bacon therefore offered his own method with a view to overcoming these objectives.

Bacon held that inductive generalization is not, as is often supposed a blind leap from few instances to the most general principles. On the contrary, it represents a step by step ascent starting from observation of carefully selected natural and experimental facts, through the discovery of invariant relationships among these facts, to still more inclusive correlations of such invariant relations, leading ultimately to the discovery of forms. In order to eliminate accidental relations from these correlations, Bacon suggested a method of exclusion.

A noteworthy contribution of Bacon to science is his emphasis on the instrumental value of science, in glaring contrast to Aristotle's view that knowledge of nature is an end in itself. He strongly advocated the need to gain control over nature so as to use it to improve the quality of human life. He thus emphasized the importance of the practical application of science and was firmly of the view that genuine scientific inquiry should lead to new works of inventions like printing, gunpowder, the compass, etc. He was of the view that explanation in terms of final cause or teleological explanations must be restricted only to the volitional aspects of human behavior and had no place in the investigation of physical and biological phenomena.

Inductivism received strong support from the empiricist philosophy of John Locke (1632-1704) and David Hume (1711-1776). Locke questioned the idea of necessary truth and the correspondence theory because he believed that we have no means of knowing the real connection between phenomena and their essences. He was of the view that there is an unbridgeable epistemological gap between the "real world" and the realm of ideas that constitute our experience. He therefore dismissed the attempt to understand the former as foredoomed to failure and limited the scope of science to the generalizations of how phenomena were linked through association and succession. Such generalizations were, according to him, Probable by their very nature and could not claim of necessary truth.

Hume carried Locke's empiricism to its logical conclusions. He contended that even if we could penetrate the essence of things, it would still not give us knowledge of necessary truth. He divided knowledge into two mutually exclusive categories, viz. relations of ideas and matters of facts, and restricted the idea of necessary truth as applicable only to the former. Similarly, he asserted that there is a difference in the way we ascertain the truth or falsity of statements in the two types of knowledge. The truth of falsity of the statements about relations of ideas is established either intuitively or demonstratively, but independently of any appeal to empirical evidence, whereas appeal to empirical evidence is indispensable for ascertaining the truth or falsity of statements about matters of fact. Corresponding to this, he made a distinction between mathematical sciences and tried to locate the source of the latter in our sensory experience and thus reinforced Baconian inductivism.

The denial of necessary truth to statements of empirical sciences led Hume to reject the idea that causal relations constitute necessary truth, if it meant constant and necessary connection. He argued that our belief in causation is mostly a matter of mental habit and has no basis in objective reality. Hume thus denied the possibility of necessary knowledge of nature and maintained that all scientific knowledge is contingent. He thus came to the conclusion that scientific laws can claim no more than probable validity.

Inductivism found its most powerful champion in John Stuart Mill (1806-1873). Mill's inductivism encompasses both the content of discovery and the context of justification, a distinction originally made by John Herschel (1792-1871). This distinction implies that the procedure used to formulate a theory is strictly irrelevant to the question of its acceptability. With regard to the context of discovery the inductivist position is that scientific inquiry is a matter of inductive generalization from the results of observation and experiments. With respect to the context of justification, inductivism insists that a scientific law, or theory, be justified only if the evidence in its favor conforms to the inductive schema.

In the context of discovery, Mill advocated four methods, viz. the method of agreement, difference, concomitant variation and the method of residues. These methods had already been discussed by Dun Scotus, Ockham, Hume and Herschel among others. Though Mill emphasizes the importance of these methods in the discovery of scientific laws, he also concluded the role of hypothesis, particularly in the analysis of multiple causation. He distinguished among four types of multiple causation:

1. Multiple causes producing separate effects.
2. Multiple causes producing intermixture of effects, which, in turn is sub-divided into
3. Composition of causes, and
4. Different results and effects.

Mill realized that especially in dealing with composition of causes, one could not proceed inductively and recommended a deductive method. He also justified the use of hypotheses, if their deductive consequences agreed with observation.

Mill, however refused to make any concession in regard to the context of justification and insisted that the justification of a scientific law is a matter of satisfying the inductive schema. A scientific explanation is a statement of causal relations. He defined a causal relation as invariable and unconditional and this distinguished it from accidental relations. Though Mill sometimes claimed that the four methods were not only methods of discovery but also of proof, in his more cautious moments he restricted this claim only to the method of difference. Thus Mill dispensed with the need for the deductive method even for the purpose of verifying inductive generalizations, thereby taking inductivism to its limits.

Aristotle had suggested that once a general proposition is derived, it must be verified by the deductive method and by ensuring that the conclusions agreed with observed facts. Since this procedure is likely to involve a tantology, others had suggested that the agreement of the conclusion of the deductive syllogism should be with observed facts that were not included in the initial set of facts from which the generalization had been originally derived. From the deductivist point of view, the problem of verification assumed great importance, because, because the major premises of the deductive syllogism were axioms that had been accepted a priori, and therefore their correspondence with empirical reality had to be established. Inductivism had not succeeded in bridging the gap between the particular and the general. Also, inductivism did not duly recognize the role of hypothesis, even though Aristotle had spoken of intuitive generalizations. In inductivism the problem of verification was reducsince Mill recommended the same method for both the purposes.

Deductivism had gone to one extreme in assuming that scientific inquiry begins with axioms, definitions, or abstract entities that had no direct reference to observed phenomena. Inductivism went to the opposite extreme and claimed that mere collection of facts or observation would necessarily lead to a generalization in terms of which the observed facts could be satisfactorily explained. Perhaps the truth lay somewhere inbetween. The major premises of deductive syllogism are neither completely a priori nor simple generalizations, but are hypothesis is only a probable statement, it can best be refuted and therefore it is accepted only it is refuted.

The real issue in the verification of a general proposition however concerns its status. If it is asserted, as is usually done, that a general proposition is universally valid and is also necessarily true. then this claim has to be established. We have noted earlier the limitations in applying the deductive procedure for verifying the validity of general propositions.

It is against this background that the fourth conception of science as hypothetico-deductive was developed. This represents an attempt to revive the Aristotelian method by ridding it of its limitations. Much of the success of Isaac Newton (1642-1727) is attributed to his use of the hypothetico-deductive method. This method has been elaborated by Karl Popper (1902-1994), who also provided the most powerful critique of inductivism in recent times.

Popper refused to subscribe to the generally accepted view that empirical sciences used inductive method on the ground that this did not guarantee the truth of universal generalizations. We have already observed that inductivism is fraught with the problem of the paradox of induction or a priorism. Popper contended that the inductive method is more concerned with the psychology of knowledge, while what we are really interested in is the logic of knowledge, or logical relations (Popper, 1931).

It was noted earlier that one of the major weaknesses of the deductive method was that it is tautological and it fails to yield synthetic knowledge. As opposed to this, the inductive method, according to the positivists, had the merit of being grounded in experience. They therefore claimed that the concepts and statements of inductive logic are either directly derived from empirical experience or are reducible to "elementary statements of experience", "judgments of perception", "atomic propositions", "protocol sentences" or "primitive statements". But Popper rejected inductivism as a satisfactory criterion of demarcation between the empirical system on the one hand and the mathematical, logical or metaphysical system on the other. Along with inductivism, he also rejected empiricism as the hallmark of scientific knowledge, because according to him empiricism was only a method used to distinguish one theoretical system from others. Moreover, the empirical experience relevant to science was diffexperience, which was necessarily subjective, whereas scientific statements must be objective. The objectivity of an empirical statement does not lie in its correspondence with an individual's experience or in its confirmation by the experience of others. On the contrary, its objectivity is ensured by subjecting it to logical testing by oneself as well as by others, and also by deducing other conclusions that could refute it. In this sense, all statements including basic statements or protocol sentences as well as other generalizations are equally testable and refutable. Therefore Popper argued that nothing in science could be accepted on faith or a priori for the reason that it could not be logically tested. As he put it, "systems of theories are tested by deducing from them statements of a lesser level of universality. These statements, in their turn, since they are to be inter-subjectively testable, must be tested in like manner- and so ad infinitum". Popper thus denied the existence of any ultimate statements in science. Science does not start with basic statements or protocol sentences or sense experience or induction. On the contrary, a science needs points of view and theoretical problems.

Having rejected inductivism, positivism and naive empiricism, Popper proceeded to expound his conception of the scientific method, which he argued is essentially deductive. He also formulated the doctrine of falsification, which served as the criterion of demarcation between empirical theoretical systems and metaphysical or non-empirical systems of knowledge. The distinction between these two is not that the former is verifiable while the latter is not. The distinction is also not that the truth of the statements in the former can be ascertained with reference to its meaning ('meaning' implying a correspondence with reality), while this is not possible in the latter. All systems of knowledge, empirical and non-empirical, are logical systems and their truth can neither be verified, nor should be dogmatically accepted on faith. Also, no statement can be accepted as true for all time. On the contrary, a statement can be accepted as true, only so long as it is not falsified. The unique characteristic of empirical theoretical knowledge is not falsifiable. While the idea of falsification had already been propounded by Grosseteste, John Herschel and Pierre Duhem (1861-1916) , Popper employed it as a crucial test for deciding whether a theoretical system is empirical or non-empirical, that is, whether it can be falsified by a basic or singular statement. Each one of such statements must be tested in accordance with the doctrine of falsifiability before it is accepted as true and this process must necessarily and inevitably go on infinitely, for there are no ultimate or final statements in science. Popper observed that "science does not rest upon solid bedrock. The whole structure of its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not down to any natural or 'given' base; and if we stop driving the piles deeper, it is not because we have reached firm ground. We simply stop when we are satisfied that the piles are firm enough to carry the structure, at least for the time being".

One of the perennial problems which have plagued the philosophy of science concerns the relation between what is stated in a scientific theory and the world of empirical reality. In more recent times, Edmund Husserl (1859-1938) has raised the question of the relation between experience and knowledge. Similarly, a distinction has been made between epistemic and non-epistemic experience, or what Husserl has called pre-phenomenological knowledge. We have seen that the origin of this problem goes back to Plato and Pythagoras and various solutions have been proposed since then. While on the one hand, this has led to a correspondence theory of truth, postulating an isomorphism between theory and reality, at the other extreme theories have been regarded as linguistic explanations. when they are mathematical in form, they are considered as computational devices meant to account for reality or to 'save the appearance'. This has given rise to the problem of theory-fact relations on the one hand and the The problem of the language of science is directly derived from conception of science according to which the primary concern of science is with the context of justification and not with that of discovery. The justification of a theory consists in its ability to account for observed facts and this presupposes some relation between theory and fact. a theory can be conceivably related to facts only if it contains terms that directly refer to facts. If this is absent, certain linguistic linkages between theory and fact will have to be provided and various alternatives have been suggested this respect.

Norman R. Campbell (1880-1949) has argued that the truth of hypothesis or axiom cannot be ascertained empirically and the only way which this can be done is by introducing another set of statements that link the hypothesis with facts. He has called this "a dictionary for the hypothesis". Therefore according to him, the structure of a scientific theory consists of a hypothesis and a dictionary.

Campbell's views were restated by Rudolf Carnap (1891-1970) who maintained that a physical theory could be presented in the form of an interpreted system consisting of a specific calculus (axiom system) and a system of semantical rules for its interpretation. This claim has been repeated by Philip Frank (1933) and Carl Gustav Hempel (1905-1997). Hempel's version of the "hypothesis-cum-dictionary" view is sometimes called the 'safety-net view' of scientific theory, that is, the axiom is a net supported by rods anchored at observational level and hence it is not necessary for every knot in the net to be supported by a rod.

Another solution to the problem of theory-fact linkage has been proposed by Percy William Bridgman (1882-1961) through his concept of operationalism, according to which "every bonafide scientific concept must be linked to instrumental procedures that determine its value". He claimed that operational definitions link concepts to primary experimental data.

None of these solutions has been completely satisfactory as they raise other insurmountable difficulties. However, all these attempts have served to emphasize the distinction between a theory language and observation language. What this distinction means in reality is that while the theory language may be far removed from reality, the observation language which consists of either primitive terms of protocol sentences are close to reality. The validity of this very distinction has been called into question on the ground that there is no theory-independent or theory-neutral observation is conditioned or determined by some theoretical idea or the other.

This thesis has been advanced by Paul Feyeraband (1924-1994).

The orthodox view has been that the truth or falsity of observation language can be directly ascertained without appealing to the sentences of the theoretical level. It was further assumed that theory-independent observational level provides bonafide tests of theories. The orthodox position also assumed that the sentences of the theoretical level acquire empirical meaning from the sentences of the observational level. Feyeraband argued that the dependence is the other way round and that it is the observation reports that are parasitic on theories. He concluded that "the interpretation of an observation language is determined by the theories which we use to explain what we observe and it changes as soon as these theories change. "One consequence of Feyeraband's thesis is that the observational terms- theoretical term distinction is context dependent.

The theory-dependence of observation language has also been recognized by Willard van Orman Quine (1908-2000), who following Pierre Duhem, has argued that it is misleading to speak of empirical content of an individual statement. This is because any statement can be retained as true, provided sufficiently drastic adjustments are made elsewhere in the theoretical system and there is no sharp boundary between synthetic statements whose truth is contingent upon empirical evidence and analytic statements whose truth or falsity is independent of empirical evidence. This goes contrary to the safety-net interpretation of theory and indicates that observation reports have no status apart from the theoretical contexts in which they occur.

The failure to arrive at a satisfactory solution to the problems connected with the meaning of scientific explanation, nature of scientific theory, procedure for validating the theory and ascertaining its truth, etc. has prompted some philosophers of science to react by turning their preoccupation away from the analysis of the method of science and towards scientific practice, since the latter scarcely seems to be affected by the former. In this analysis of the developments in science, Thomas Samuel Kuhn (1922-1996) came to the conclusion that how science is practiced or how science advances bears little resemblance to the theories that have been propounded about it. He observed that the term science is often identified with what he termed as normal science, which he characterized as a puzzle-solving activity and it involves the following:

a) Increasing the precision of agreement between observation and calculations based on a paradigm.

b) Extending the scope of the paradigm to cover additional phenomena.

c) Determining the value of universal constants.

d) Formulating quantitative laws that further articulate the paradigm.

e) Deciding which alternative way of applying the paradigm to a new idea or interest is the most satisfactory.

But the discovery of new data which cannot be explained by the paradigm and which constitutes an anomaly leads to a shaking of confidence in the paradigm and this marks the beginning of paradigm shift, which may lead to a revolutionary science. According to Kuhn, scientific progress is a process in which periods of normal science alternative with periods of revolutionary science. Kuhn's idea of the paradigm shift resembles closely Hanson's idea of gestalt shift or Toulman's (1967) idea of conceptual revolution. It is however not the same as Popper's doctrine of falsification in which a general proposition can be falsified by a basic statement. The mere presence of an anomaly is not sufficient to cause a paradigm shift. On the contrary, paradigm switch is a three-term relation involving an established paradigm, a rival paradigm and the observational evidence.

Kuhn's use of the concept of paradigms has come in for severe criticism and so also has his concept of normal science. Kuhn has employed the term paradigm in two senses, viz. as a "disciplinary matrix" or "an entire collection of beliefs, values, techniques and so a shared by members of a given community" in the broader sense, and "an exemplar" or influential presenting of scientific theory in the narrower sense. He has not cared to clarify the meaning of the term 'crisis', responsible for causing the paradigm shift.

Lakatos (1922-1974), while agreeing with Kuhn's view of continuity in the progress of science, found his thesis of paradigm shift unacceptable because it failed to offer a rational explanation of the development of science. In the absence of a rational explanation of paradigm switch, interpretation of changes in science will have to be left to historians or psychologists. In trying to offer a rational explanation of scientific change, Lakatos tried to improve upon Popper's rational reconstruction in which scientific progress had been portrayed as a sequence of conjectures and attempted refutations. His main disagreement with Popper was that the basic unit of appraisal was not individual theories as believed by Popper, but rather research programs consisting of methodological rules, some of which tell us what paths of research to avoid (negative heuristic) and others what paths to pursue (positive heuristic) . The negative heuristic of a research program isolates a hard core of propositions that are not exposed to falsification but are accepted by convention and are deemed irrefutable by those who implement the research program. The positive heuristic on the other hand, is a strategy for constructing a series of theories in such a manner that shortcomings at any particular stage can be overcome. It is a set of procedural suggestions for dealing with anticipated anomalies.

As regards the rule for appraising a sequence of theories, Lakatos distinguished between two kinds of sequences, viz. those which constitute "progressive problem-shifts" and others which constitute "degenerating problem-shifts". He defined a sequence of theories as progressive, if the latest theory accounts for the success of all the preceding theories possesses greater empirical content than all the preceding theories and also corroborates some of the excess content of the latest theory. Of course, Lakatos did concede the possibility that a problem-shift that was degenerative at one time may stage a comeback and constitute a progressive one.

Paul Feyeraband cast serious doubts on the contemporary philosophy of science with its emphasis on logical reconstruction. He argued that such a philosophy of science is of hardly any use to either the practicing scientist or to the historian of science. According to him, contemporary philosophy of science has ignored science as such and has tended to oscillate between logicism at one extreme and relativism at the other. While the former renders the history of science irrelevant to the philosophy of science, the latter reduces the philosophy of science to a description of scientific practice, past and present. Feyeraband has proposed a "return to the source" which means a return to the history of science. He is not prepared to recognize the philosophy of science as a discipline distinct from the history of science and the practice of science. Nor does he acknowledge the need for a separate history of science distinct from a broad cultural history. This is quite in keeping with his anarchistic theory of knowledge.

CONCLUSION

In the light of these ongoing controversies in the philosophy of science, the entire debate about the positivist claims of sociology may seem to be both uncalled for and out of place. There is no agreement among the philosophers about the meaning of science and the scientific method, nature of scientific theory, place of empiricism and the relation between scientific theory and empirical reality. While some have argued against the idea of a single universally recognized scientific method necessarily and invariably followed by all scientists, others have gone to the extent of questioning whether there is anything called a scientific method at all, asserting that in science anything that works is accepted. Viewed against this background, the sociologists' obsessive preoccupation with scientific methodology would appear to be completely misdirected.

Equally misplaced is the excessive concern with empiricism. While empirical facts are no doubt essential, to be considered as a science, a discipline has to transcend these facts and aim at formulating theories that by their very nature are general and abstract. As a humanistic and cultural discipline engaged in the study of conscious and purposive human behavior marked by a remarkable degree of historical continuity, it may be more appropriate for sociology to subscribe to the principle of methodological pluralism instead of uncritically adhering to the outdated idea of the unity of science. The methods employed in the natural sciences have little or no applicability to sociology, since the facts of sociology are mostly qualitative and defy quantification. Moreover, given the fact that human societies differ from one another in terms of their history and culture, it is a moot point if sociology can ever hope to yield theories of universal validity, unless they are reduced to mere statements considerations should persuade the sociologists to look for alternative ways to study social phenomena.

REFERENCES

Adorno, Thodor, William Wentworth and Robert Sampson.1976. *Positivist Dispute in German Sociology*. London: Heinemann.

Barber, Bernard. 1962. *Science and the Social Order*. New York: Collier Books.

Emmet, Dorothy. 1958. *Function, Purpose and Powers; Some Concept in the Study of Individuals and Societies*. London: McMillan.

Feyeraband, Paul. 1978. *Against Method: Outline of an Anarchistic Theory of Knowledge*. London: Verso.

Habermas, Jurgen. 1972. *Knowledge and Human Interests*. London: Heinemann.

Kuhn, Thomas. 1970. *The Structure of Scientific Revolutions*. Chicago: The University of Chicago.

Lakatos, Imre. 1970. *Criticism and the Growth of Knowledge*. Cambridge: Cambridge University Press.

Losee, John. 1993. *A Historical Introduction to the Philosophy of Science*. Oxford: Oxford University Press.

Mill, John Stuart. 1961. *Auguste Comte and Positivism*. Ann Arbor: The University of Michigan Press.

Nagel, Ernest. 1961. *The Structure of Science*. London: Routledge and Kegan Paul.

Pelz, Werner. 1974. *The Scope of Understanding in Sociology*. London: Routledge and Kegan Paul.

Popper, Karl R. 1967. *The Logic of Scientific Discovery*. London: Hutchinson.

Popper, Karl R. 1957. *Poverty of Historicism*. London: Hutchinson.