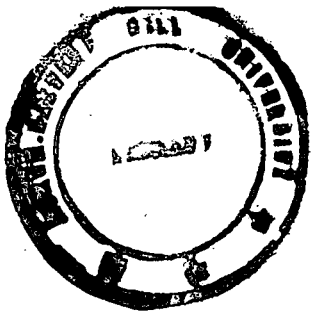
KARL POPPER'S VIEW OF SCIENCE :
A CRITICAL EXAMINATION



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Certified that the subject matter of this dissertation is the record work done by Bibhu Prasan Patra, that the contents of this dissertation did not form a basis of the award of any previous degree to him, or, to the best of my knowledge, to anybody else, and the dissertation had not been submitted by him for research degree in any other University.

In habit and character, Bibhu Prasan Patra is a fit and proper person for the degree of MASTER OF PHILOSOPHY (in Philosophy).

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I fail to find words to give vent to my innermost feelings for my brothers for their silent sacrifices without which perhaps I would not have been what I am today.

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I dedicate this humble work to the memory of my parents who are no more in this world to rejoice even at my small achievement.

Bibhu Prasan Patra

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CHAPTER - I

INTRODUCTION

The term science, etymologically is derived from the Latin root 'scientia' meaning knowledge. In its generic sense, it stands for any systematic and coherent body of knowledge. In this sense, of course, every discipline or faculty worth the name can be labled as scientific. But by convention, the term science connotes the body of knowledge constituting the natural sciences. In this restricted sense of the term, science signifies the rational, objective and systematic study of reality not only with a view to discovering its underlying laws and the principles but also to regulate, control and harness nature to man's convenience. "Knowledge, is power," observes Bacon.

A scientific enquiry can, for purposes of clarity, be contradistinguished from the non-scientific enquiries. The scientific enquiry is bound to be objective in so far as it conforms to the empirical facts. The methods employed to corroborate the scientific hypothesis, are observation and experiment or both. In other words, a scientific view point is tentative in so far as it is amenable to revision or modification in the light of factual evidences. The explanation in scientific parlance consists chiefly in discovering the causal correlations between the given putative phenomena and the

determining antecedent conditions. Science is not a stagnant phenomena. Its frontiers grow and expand with the growth of human mind. Despite the open endedness of scientific knowledge the scientific thinking need not be misconstrued as subjective for all the while the scientist is constrained by the objective considerations.

On the other hand, the non-scientific pursuits include, religion, ethics, aesthetics etc., within their purview. The marked difference between the former and the latter consists in the difference of their content, method and nature of explanations. The religious man talks about entities or experiences that are hardly empirical or amenable to sense experience. The moral thinkers talk about values, norms or paradigms relating to human conduct. Prescriptions and evaluations are more normative than descriptive. Since the concern of the religious man and the moral thinkers is not to describe any empirical fact the method of observational and experimental corroboration are not only unnecessary but also irrelevant.

Science in its broad sense subsumes natural, social and the formal sciences under its head. The natural scientist devotes himself to the objective study of natural facts—animate and inanimate. The study of inorganic things is under-

taken from different aspects by Physics, Chemistry, Geology, Astronomy, etc. Again, the Life Sciences like Botany, Zoology, etc. study the nature, growth and behaviour of plants and living beings respectively. Unlike other existent beings, man is not just an organism living in instinctive interaction with circumstances. Man is a social animal. The instinct to lead an organised corporate life leads him to form the social, political, economic and religious institutions. The social scientist does precisely study men in relation to social phenomena. Sociology, Economics, Political Science, etc. study man from different social perspectives. Mathematics and logic are considered as formal sciences distinguished from the other material or factual sciences. The very term "formal science," is indicative of the fact that mathematicians as well as the logicians study mere form of things - emptied of any factual or material content whatsoever. For example, the proposition 2 + 2 = 4 does not in actuality, always make 4. If two drops of water added to two drops of alcohol, the latter would be soaked into water, will not retain their identity and thus not making four. But for that matter, the mathematical truth that 2 + 2 = 4 is not subject to revision in the light of changes in fact. '2 + 2 = 4' rather points to the formal operation undertaken by decimals 2 and 4 by the help of the rules surrounding the operational symbols 'plus' (+) and 'is equal

to' (=). Moreover, the number 1, 2 etc. do not stand for any particular object - like one mango, one tiger, one man. The mango, tiger and the man are different from each other from the point of view of content, i.e. they are different from each other. Nonetheless, all of them share the common form that they are all one. Similarly, 'A is A,' the law of identity and the argument of the form:

No A is B

All C is A

Therefore: No C is B

This does not represent or qualify any specific object or argument. They are true of any objective content whatsoever.

The growth of human civilization is bound up with the human mind. The science and technology of today with accumulated stock of knowledge was not accomplished overnight. The history of science reveals that man in the hoary past was like an innocent babe struggling against forces of the nature, persistently trying to understand the <u>why</u> and <u>how</u> of creation. Unlike the other existent beings man possesses the peculiar trait to ask questions about the why and how of things. This speculative interest of man contains the roots of all theoretical endeavours often expressed as adventure in ideas. This accounts for genesis of philosophy and science.

The germ of philosophical as well as scientific thinking can be seen in the cosmological interest and speculations in the pre-socratic philosophers, like Thales, Anaximander, Anaximenes, Pythagoras, Heraclitus and Permenides. Thales probably made the maiden attempt to explain the manifoldness of the universe in terms of ultimate substance. He contemplated water to be the basic substratum and substance of everything that is the case. Though this hypothesis could not stand the test of time and is discounted as a fanciful conjecture, on the part of Thales typify the crude speculation of the primitive mind, the fact remains that the latter innovations were possible only on the bedrock of this.

Anaximander, Anaximenes, Pythagoras, Heraclitus and Permenides though had their respective hypothesis in support of their world view, they can be seen only as furthering the tradition of Thales. For Anaximenes, air is the ultimate world stuff, for Heraclitus the fire, for the Pythagorians, the number and for Permenides the unchangable being, each supporting their conjectures by rational articulations. In the light of the findings of modern science these cosmological speculations can justifiably be dubbed as mere conjectures. But this observation of the 20th century man should not make him oblivious to the positive contribution of the speculations in growth and development of scientific thought as such. And one should be alive to the platitude that all the revolutions in

scientific ideas are of the nature of conjectures and stand refuted in the light of newer conjectures that are more explanatory and plausible. This will be discussed thread bare in subsequent chapters.

In the beginning, human thinking was mainly speculative and theoretical. Philosophy, science and religion were indistinguishable from each other, in the absence of their respective methodology and defined scope of their activities. It is Aristotle who for the first time by his versatility, undertook the classification of knowledge into theoretical, practical and productive. In a sense, Aristotle can be credited to have pioneered the rationalist tradition in Philosophy and Science. Science for Aristotle concerns itself with explanation of things and events. The explanations of a phenomena consists in discovering the causal co-relations between effect and the cause. He detailed out four distinct aspects of the causal agent. The material cause, the efficient cause, the formal cause and the final cause are theoretically distinguishable though not practically separable. But this clearly shows that the Aristotelian scheme very much accommodated the possibility of teleological explanations i.e. explanations in terms of purposes or ends. Moreover, in case of Aristotle, though rationality was considered to be sine qua non of scientific endeavour, there was less appeal to observation

and experiment. With the advent of modern science pioneered by Copernicus, Kepler, Galileo and Newton, the teleological explanations are considered to be dispensable and irrelevant in scientific explanations. All the scientists came to hold that nature reveals a pattern governed by inexorable objective laws. Newton remarks 'Nature writes in the hands of mathematics.' The world reveals a rational order which lends itself to exact formulation in mathematical formulae. Mechanical explanations were adequate for all practical purposes.

The most important revolution was brought about by Copernicus when he questioned the geocentric hypothesis of Ptolemy. Before Copernicus, geocentric theory was supposed to explain facts and phenomena and served as basis of correct and precise predictions. But it involved theoretical complications of cycles and epicycles. The earth was conceived as solid and immovable base towards which all things fall. Copernicus, by proposing the heliocentric hypothesis brought about radical and diametrically opposite mode of explanation. The earth was construed no more previleged planet than others which also by the laws of attraction and repulsion move around the Sun.

Galileo by devising the telescope gave an observational corroboration to the Copernican hypothesis and Kepler's laws regarding planetary motion. It is worth noting here

that in sciences the acceptance and rejection of hypothesis are done on the strength of explanatory adequacy. Copernicus is preferred to Ptolemy for the simple reason that the former fails to explain certain facts which the latter quite successfully does. It is important to stress that hypotheses have their relative value. Even today in some places the solar eclipse and lunar eclipse are predicted with precision by the geocentric hypothesis. Even if it is known for certain at present, that the geocentric hypothesis is obviously false, its relative merit at least in so far as it gave rise to further corrective processes of conjecture in form of Copernican hypothesis cannot be denied. Despite the fact that the Ptolemic hypothesis was a conjecture it should not on that account be brushed aside as useless. Possibly if there were no Ptolemy there would have been no Copernicus.

It is Newton who for the first time elaborated the Galilean observations and presented in form of knitly formulated laws. He related matter with force and motion. But he construed space and time as absolute. Eienstein again brought about radical changes in scientific thinking by proposing the theory of relativity. Space and time are considered to be relative. It had far reaching implications for classical mechanics of Newton.

Scientist, by and large, till very recently assumed the mechanistic model of explanations. The mechanistic model does necessarily employ causal explanations and therefore is bound to be deterministic in nature. Recent findings in quantum mechanics acquaint man with the sub-atomic phenomena where the causal or the deterministic model prove to be generally inoperative. The energy particles move in quanta and jerks. Since the energy packets move in discontinuous fashion, the causal model explicative of linear movement of the particles do not help us in understanding such phenomenon. It is observed that the causal model is true of the macro objects but not the micro ones.

Thus, the history of science is found to be a series of bold conjectures prompted by certain features of the world and aimed at explaining the totality, and subsequent refutations made in the light of new conjectures. No conjecture, however crude or primitive is absolutely without any use and no conjecture however sophisticated or adequate, is absolutely ture. The frontier of human knowledge is ever expanding by series of conjectures and refutations.

Science is not apriori. But at the same time, it does not proceed through observation and experiment as is generally supposed. In this sense, there is an affinity between science and metaphysics. Both metaphysics and science are cosmologies.

CHAPTER - II

INDUCTIVE METHOD

Scientific knowledge grows with the progressive discovery of the laws underlying various phenomena. The scientist proceeds with the assumption that the universe with all its multiplicity is governed by certain basic and unalterable principles the discovery of which would empower him for establishing control over them. The laws that govern nature, in the generic sense, are unlike the laws made by men to guide and regulate the social behaviour of his fellow beings. Those are obviously laws enacted and enforced by the state to ensure discipline and harmony among the people. The violation of which makes one susceptible to punishment. There are also do's and do not's in social as well as religious domain, the violation of which makes one amenable to social prohibitions or religious damnation respectively. That which stands out as a demarcating feature between the scientific and non-scientific laws is that the laws constituting the body of scientific knowledge are descriptive whereas the laws other than the scientific ones are prescriptive. That is why it is quite semantically odd to ask normative questions in case of the former, such as, "is it good for the material body to gravitate." "Are the laws of motion desirable"? The laws are just there independent of man's knowledge of them; they can neither be improved nor modified. The scientist, can at best, with necessary skill, discover them. The quest for this

immutable and eternal principles has been the principal task of scientific investigations. Another characteristic feature of scientific investigation is that it is observational and experimental. In other words, a scientist would not accept any item as legitimate or genuine unless and untill it is duly certified by observation and experiment.

The procedure or the method leading to the discovery of the universal laws expressed in form of general propositions through observation and experiment is called induction.

John Stuart Mill defines induction as:-

> ".... Induction may be defined, the operation of discovering and proving general propositions. It is true that the process of indirectly ascertaining individual facts, is as truely inductive as that by which we establish general truths. But it is not a different kind of induction; it is 'a' form of the 'very' same process: Since, on the one hand, generals are but collections of particulars, definite in kind but indefinite in number; and on the other hand, whenever the evidence 'which we derive' from observation of known cases justifies us in drawing an inference respecting even one unknown case, we should on the same evidence be justified in drawing a similar inference with respect to a whole class of cases. The inference either does not hold at all, or it holds in all cases of certain description; in all cases which, in certain definable respects, resemble those we have observed."[1]

Traditionally, induction has been defined as the method of establishing the material truth of a general real proposition based on observation of particular instances, in

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1. J.S. Mill, A System of Logic, p. 284.

reliance on the principle of uniformity of nature and law of cusation. If induction is taken as a superstructure it stands on two main pillars namely material grounds and formal grounds. Observation and experiment constitute the material ground and the law of cuasation and uniformity of nature the formal ground of it. The scientist has to begin with observation and experiment of the individual instances where the phenomena under investigation occurs. Observation refers to the process of systematic perception of the facts or events in their natural settings. It is to be distinguished from random perception in so far as the observer is selective in attending to the phenomena that are relevant for his purposes. In other words, the investigator has to segregate only those specific items that may have bearing on the problem under investigation, from the multitude of external stimulii. In course of investigation, the investigator may stand in need of analysing the sense content by artificially reproducing it in the controlled conditions of the laboratory. Thus, experimentation refers to the process by which the investigator seeks to get at the true explanation of the putative phenomena by reproducing it at will eliminating the inessential characteristics and enumerating the essential ones. Hence, observation and experiment can be taken as complementary methods directed to the discovery of causal connection between the putative phenomena and its necessary antecedents. The

limitations in observation consequent upon the fallibility of sense organs is overcome by experimentation. It is worth noting that explanation in scientific domain consists in discovering the causal order.

The cause of an event constitute its explanation. For example, explaining the 'why' or 'how' of earthquake calls for delimiting the antecedent conditions, necessary and sufficient for its emergence. Having discovered the causal connection between two successive phenomenon, the scientist goes to generalise the principle. The discovery of general principle which marks the culmination of the scientific investigation are expressed in form of universal laws. A law is supposed to be a principle that holds good for all the particular instances irrespective of time and space. In other words, a law in order to be vital and worth the name must admit of no exception and is to be true of all particular instances past, present and future. Thus, the essence of inductive enquiry consists in arriving at the truth about the totality on the strength of the observation of few particular instances. For example, if x is found to be cause of y in 'n' number of cases, then in all cases x can be said to be the cause of Y. If smoking is found to be causally connected with the phenomena of cancer one can, on the strength of this, claim the validity of the statement that smoking is the

cause of cancer. So, in induction one proceeds from particular to general, observed to unobserved, examined to unexamined, thus invariably involving the inductive leap.

The philosophers of science at large raise doubt as to the very rationale of the inductive leap. They maintain that the observation of regularity in observed cases of the past and present does not logically entitle one to say that they will also hold good in future. The observation that X and Y are found to be invariably co-existent in a number of cases in the past and present does not guarantee that they will be so in future. Hume would observe that the causal necessity is a myth. All that we find in the causal nexus is "thereafterness" but not "therebyness". Experience records a constant conjunction between the set of antecedents and the consequents but hardly tells us as to why they should be necessarily so. The addition of each confirming instance in favour of the causal principle enhances its probability of being true in future. But whatever may be number of instances it would, at no point entitle one to claim the absolute certitude.

The only possible defence from the side of the inductivist will consist in arguing that since nature is uniform the regularity observed in case of the causal nexus of the past must hold good in future. For example, if the conditions

A, B, C are found to have causal correlation with the phenomenon X, then one can predict with certainty that 'the appearance of A, B, C will invariably be followed by the appearance of X. Therefore, the law of uniformity of nature is assumed to be true and justifies the inductive leap from some to all.

But when the logical status of the law is subjected to scrutiny it turns out that the law itself is a case of induction. On the basis of the observation of the uniformities in the natural phenomena it is established that nature will behave similarly under similar circumstances. This, in turn serves as the formal ground of all other inductive generalisations. The empiricists in general and Mill in particular observe that whatever may be the number of instances they never conclusively prove the validity of the general proposition. Therefore, the passage from particular to general is illicit.

Upon analysis, three principal features stand out of the claim of the inductivist with regard to scientific laws (a) Scientific laws are cases of empirical generalizations (b) the problem of induction consists in asking for justification of inductive leap from observed to unobserved (c) induction being the sine qua non of scientific enquiry serves as a point of demarcation between science and non-science.

Karl Popper strikes at the very root of inductivism by directing his Polemics against these three basic fundamentals. As regards the genesis of the scientific theory the inductivist would obviously submit that the scientist in his quest for general laws goes on piling up instances under meticulous and controlled observations. And then seeks to find a pattern emerging out of it which leads him to formulate hypothesis in the light of the problems at hand and it is subsequently deduced from the hypothesis is modified or altered. Hypothesis is a provisional supposition which after verification is exalted to the status of law. Therefore, a law or a theory can be said to be verified hypothesis and a hypothesis is a unverified law in retrospect.

Popper would observe that the above mentioned accounts as to the genesis of a scientific theory is not only untrue but does not have any bearing on its validity. He is of opinion that -

> "Yet even supposing this were the case - for after all the whole of science might err and I shall still contend that a principle of induction is superfluous, and that it must lead to logical inconsistencies."2

A close look into the way the scientific inventions take place would reveal that a scientific theory does not always proceed by the cumbersome process of observation and experiment. There have been number of ways of arriving at the theory

2. Karl R. Popper, The Logic of Scientific Discovery, p.29.

occasioned by flashes of intuition, bold leap of the imaginative faculty and some time by common place events. An event like falling of an apple was sufficient to tickle the imagination of Newton to propound law of gravitation. The theory of relativity was evidently not a result of laboratory work on the part of Einstein. Instances can be multiplied to corroborate that there can be various ways of arriving at a new theory. But what is still more noteworthy is that the way a scientist arrives at theory does not determine its validity. The validity of a theoretical construction is determined by degree to which it explains facts and its internal consistency. Hence the description of the ways leading to a scientific investigation can at best be of psychological relevance. In respect of genesis, a scientific invention is akin to the creation of a work of art. It is not observation that preceeds hypothesis. But it is rather the observation that is invoked to test the legitimacy of it. In fact, bare observation of sense data pre-supposes a point of view of classification, analysis and a framework of interpretation which collectively constitute the framework.

The failure of the inductivist to perceive the distinction between psychology and logic of scientific invention gave rise to the problem of induction. Popper would agree with Mill and others that no amount of factual corro-

boration would necessitate certainty of a general proposition. The piling up of instances would only increase its probability. As the general proposition purports to include the future instances, the observed instances would neither factually nor logically establish the truth of it. Scientific propositions being paradigm of general propositions cannot conclusively be verified. He would not go along with the logical positivists in making 'verifiability' the criterion of meaning. Because of the dangerous consequence that scientific propositions not being conclusively verifiable; will be rendered meaningless. He would submit that though scientific propositions are not provable in the sense of being completely verifiable are nonetheless testable in the light of contrary instances. In other words, though number of instances cannot conclusively establish the universality of a proposition a single instance to the contrary would result in its conclusive falsification. Popper proposed this criterion of falsifiability to draw a sharp boundary between scientific statements and non-scientific statements.

> "Thus the problem which I tried to solve by proposing the criterion of falsifiability was neither a problem of meaningfulness or significance nor a problem of truth or acceptability. It was the problem of drawing a line (as well as this can be done) between the statements, or system of statements, if the empirical sciences and all other statements - whether they are of a religious or of metaphysical character, or simply pseudo-scientific - I call this first problem the problem of demarcation. The criterion of falsifiability is a solution to this problem."3

3. Karl R. Popper, Conjectures and Refutations, p.39.

A scientist gives a theory which aims at explaining facts. All the corroborating instances in favour of the theory could only enhance its probability of being true but at no point would make it absolutely so, because if we encounter a single instance militating against the established theory it would stand refuted. And this would call for a new theory which would accommodate not only the facts already explained by the earlier one but also the new phenomenon. The latter hypothesis would definitely have more informative content, more explanatory power marking the advancement of knowledge. The horizon of human knowledge expands only when the existing framework is questioned in the light of the discovery of new elements in experience and new and wider theories are invoked into existence. The more and more one leaps into the unknown and encounter the strange the more is the attempt to enrich our theoretical framework. As long as a frame work is taken for granted or is assumed as a paradigm, knowledge remains confined to a given area. So the validity or the viability of scientific theory is put to test only when a contrary instance is advanced which resists all explanation in the given framework. Thus falsifiability is the criterion of testability and furthers the cause of scientific progress. Therefore the attempt to look for a counter instance goes a long way in contributing to the growth of knowledge.

The history of growth of scientific knowledge is a series of theory making and rebuttals. A scientific theory must knitly be formulated with no ambiguity within so that it lends itself to easy refutation. The inductivists craving for the absolute certitude is gratuitious and misplaced, for it is based on the unsound assumption that science is a body of absolute, unalterable and established truths. Popper would maintain that knowledge is relative, provisional and an ever growing phenomenon. The highest knowledge ideally speaking can only be approximated but at no point can one claim to have attained it, for there is nothing logically inherent in a theory which prevents it from being refuted. The finality in regard to a scientific view is a myth. The "wrong view of science betrays itself in the craving for the right."[4] This takes us to the problem of demarcation between science and non-science. The inductive method based on observation and experiment distinguishes scientific enquiry from other non-scientific ones. Under this assumption, the metaphysical and religious discourses are deemed to be unscientific. As we have seen, Popper opines that falsifiability being the criterion of testability the metaphysical propositions though not scientific in not being falsifiable are nonetheless meaningful. Metaphysics being essentially speculative sciences can also be seen to have a basis in metaphysical speculations. To

4. Karl R. Popper, The Logic of Scientific Discovery, p.281.

question metaphysics in the interest of science as logical possitivist would do is to question the very foundation on which science stands.

In the contemporary period, Popper enjoys the credit of challenging inductivism in philosophy of science. Which owes its origin chiefly to John Stuart Mill. Mill and his followers wrongly thought that scientific discovery and invention start in a straight jacket fashion i.e., through observation experiment, generalisation, formulation of hypothesis and so on. Popper challenges all these. A scientific enterprise is a type of adventure. It is a bold conjecture - it is a leap to the unknown.

In subsequent chapters we will spell out and examine in detail, the anti-inductivist doctrine propounded by Popper.

CHAPTER - III

CONJECTURES AND REFUTATIONS

I

Methodology of Natural Sciences

'Science' in its most generic sense stands for a systematic body of objective knowledge. The goal of science is, conventionally, supposed to be one of discovery. The basic pre-suppositions of the scientific enterprise is that there is a world of pure objectivity i.e. the realm of facts and events that appear, exist and disappear according to certain immutable laws. The scientist in his attempt to understand and control nature is only to discover them. Objectivity is the sine-qua-non of the scientific enquiry. Observation and experiment are, by far, the twin methods that afford substance and rationale to the findings of the scientist. Observation and experiment of particular instances, generalization in the form of a hypothesis and verification of it in the light of subsequent experiencial corroboration (i.e. the method of induction) are regarded as the set procedures and explain the dynamics of scientific discovery. The inductive method has been construed to be not only the raison detre of science but also makes scientific explanation unique of its kind distinguishing it from non-science or pseudo science. It would not be out of place to mention here that a practising scientist is devoted to the task of actual

operations in the understanding of reality; whereas the philosopher of science stands by him, helping him, reminding him or coming to his rescue in laying bare the logic of the assumptions or postulates (the corner stone of the scientific edifice). A critical examination or philosophical reflection on the foundational questions relating to the nature, methodology and nucleus concepts of science are, though not scientific, organically related to it in so far as it enhances the understanding and contributes indirectly to the success of science.

Karl Popper will go down as one of the pioneers and trend setters in the history of philosophy of science. His classics 'The Logic of Scientific Discovery' and 'Conjectures and Refutations,' urge one to pause and reflect on the time honoured truisms and assumptions underlying the scientific enterprise. Popper begins with the problem of demarcation between science and non-science which makes him question the legitimacy of inductivism (as a demarcating criterion), the principle of verification (as theory of meaning) and describes the history of science as a series of conjectures and refutations.

Popper's chief dispute with the traditionalist is essentially criteriological. It relates to the question as

to how a scientific enquiry, per-se, is to be distinguished from an enquiry which has the semblance of being scientific. The classical thinkers posit induction as a line of demarcation. Induction consists in establishing a general proposition on the basis of the observed regularities in a determinate number of instances. The passage from particularity to generality is characteristic of the inductive procedure. A scientific law or a theory has its basis in facts as it is generated by them and its validity in turn is also tested in the light of factual confirmation. Popper directs his Polemics against inductivism by observing that no practising scientist, as a matter of fact, begins with observation and experiment and then goes on to formulate the hypothesis. Bare observation is a myth. The scientist in quest for knowledge, no doubt, undertakes observation and experiment. But the very act or fact of observation is not random, but is selective and goal oriented. The observer has not to attend to the whole plethora or medley of the observable stimulii. But has to confine himself to the assembling of the relevant data and classify them so as to incorporate them into the hypothesis. This obviously involves the process of selective assimilation and purposeful elimination, which progressively enable the investigator to arrive at the bed rock of his findings.

> "Clearly the instruction, 'observe!' is absurd. Observation is always selective. It needs a chosen object, a definite task, an interest, a point of view, a problem."1

Hence all this imply a prior framework of reference. Before going to observe, the investigator knows apriori what he is going to observe. In other words, the problem at hand determines apriori the mode of perception. The so called regularities are in fact not things which exist irrespective of the observer, but rather they are the alternative modes of perceiving events or externalities according to the pre-conceived models. In this respect Popper disagrees with Hume. The problem of induction presented by Hume is not satisfactory to him, for its psychological explanation in terms of custom or habit. He observes that the individual does not wait for the uniformities to influence him so as to expect uniformities always; it is rather that the prior theoretical framework makes him impose patterns or uniformities. Thus there can be no pure or dispassionate observation, far less the virgin facts uncontaminated by the preferences of the knowing mind.

The different theories are but alternative ways of looking at the same reality. This betrays the idealistic strain in Popper. Knowledge for him is not a discovery but

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1. Karl R. Popper, Conjectures and Refutations, p.46.

a progressive reconstruction. Nonetheless theories are subject to evaluation and sublation in the light of the more viable theories and to that extent Popper is a realist. In this regard Popper departs from the conventionalists by questioning the confirmability as the test of the soundness of a theory. If experiencial corroboration is taken as the test then probably all theories shall pass this test. And if conclusive verification is taken as the criterion of acceptability then no theory whatsoever can be regarded as conclusively verifiable; for it is always possible to conceive of a future experience contradicting it. Instead, Popper advances the doctrine of falsifiability or refutability as the test criterion. All theories are absolutistic in the sense that they are meant to be interpreting every instance whatsoever as a case of positive confirmation even to the extent of denying a contrary evidence as a case of refutation. Popper would mention that the merits or strength of a theory depends on the extent to which it resists refutation. Hence while assessing the relative viability of a theory one should look for a limiting case which would falsify it. Conversely a theory which is such that it does not leave room for any actual or possible refutation is indirectly a theory which takes all actual and possible evidence as the cases of positive confirmation. Such a theory in fact explains nothing genuine. This theory must be clear, concise, so that it tends itself to

actual or possible refutation. Refutation remains a perpetual possibility. In other words, one cannot at any stage claim finality or completeness in case of a theory which logically precludes the possibility of refutation. This underlies the assumption that knowledge is tentative or provisional. And the progress in knowledge is ensured by constant criticism, evaluation, improvisation and cancellation of the existing views or theories by a sustained endeavour to look for contrary instances. Human knowledge progresses through trial and error.

As pointed out earlier the scientist does not proceed through piecemeal observation of facts and then marshalls them into a hypothesis which are subsequently escalated to the status of a theory or law through repeated observation and experiment. It is rather that the theorist throws a bold conjecture or creative insight which provides a working model to the practising scientist. This is basically non-rational and the investigator is held under its sway as it were, seeking to interpret and explain phenomena according to its schemata. This Popper dubs as pre-scientific or pseudo scientific attitude. Every scientific innovation has a beginning in such non-rational model of invoking some models. But he goes on to add that the pre-critical state is followed by a state of deliberate and critical examination of the theory in the light of facts.

> "...The dogmatic attitude is clearly related to the tendency to verify our laws and schemata by seeking to apply them and to confirm them, even to the point of neglecting refutations, whereas the critical attitude is one of readiness to change them - to test them; to refute them; to falsify them, if possible. This suggests that we may identify critical attitude with the scientific attitude and the dogmatic attitude with the one which we have described as pseudo scientific."2

So a given theory claims superiority over the other only when it overcomes the test of refutation which others have failed to pass and progress in knowledge would consist in formulating theories after theories, that survives the progressive elimination through test of refutability.

Popper describes this phenomena as one of trial and error. The picture of man is of the one who is pitted against the infinite mysteries, struggling with tenacity to understand and unmask the secrets through trial and error. This phenomena is all pervasive. Popper writes;

> "The method of trial and error is applied not only by Einstein but, in a more dogmatic fashion, by the amoeba also. The difference lies not so much in the trials as in a critical and constructive attitude towards errors; errors which the scientist consciously and cautiously tries to uncover in order to refute his theories with searching arguments, including appeals to the most severe experimental test which his theories and his ingenuity permit him to design."3

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2. Ibid. p.50.
3. Ibid. p.52.

Thus distinctiveness of man consists not so much in embarking upon repeated trials as in his attitude to errors. He learns from errors. He seeks to build on the past by overcoming the errors and improving on the omissions and commissions.

Popper reacts to the analysts and the positivists in their denunciation of metaphysics. Metaphysics is characteristically original. Metaphysics far from being a body of non-sense or bundle of confusion are at the very root of science. Science is rooted in metaphysics. The history of science confirms that the cosmological reflection of the Greeks latter matured into subsequent scientific inventions and discoveries. Popper observes;

> "... Scientific theories originate from myths, and that a myth contain important anticipations of scientific theories."4

Popper advances a hypothetico-deductive model to elucidate logic of scientific discovery. The so called scientific theory is like a hypothesis. In a word, science begins with hypothesis. But once the hypothesis is accepted other consequences follow it by way of implication. This is, in short, known as the hypothetico-deductive method in sciences.

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4. Ibid., p.38.

II

Methodology of Social Sciences

Popper's reflection on the social sciences embodied in 'The Poverty of Historicism,' 'The Open Society and its Enemies' antedates his views about social sciences. Popper is characteristically a non-conformist in his scathing attack of the totalitarian and absolustic thinking of Plato, Hegel and Marx. The Polemical aspect of his thinking is best spelt out in 'The Poverty of Historicism.' In this book, he offers a lucid exposition of historicism. Historicism as understood by Popper refers to the brand of social theories which believe in efficacy of building theoretical models to understand the social phenomena and to serve as effective guide in effecting social transformation. The historicist further assumes that there are objective universal and irrevocable laws underlying social change and growth. And a right comprehension of which equips one with expertise not only to explain the 'why' and 'how' of the societal phenomena in the past and present but also foresee or predict the 'not yet.' In other words, the historicist would subscribe to the theory of inevitability in history. Negatively they would undermine the thesis of accidental or fortuitous happening and explain everything in terms of the inner dynamics of social growth. This view according to Popper betrays the

bias and ignorance of its proponents in conceiving the social laws after the model of the physical laws in natural sciences. He, in fact, disputes the thesis of absolute determinism even in the natural sciences on the ground that the physical sciences do not cease to be scientific without the assumption of determinism.

> "Scientific method cannot, therefore, be said to favour the adoption of strict determinism. Science can be rigidly scientific without this assumption."5

However, he would probably acknowledge the distinction between the natural science and the social science in so far as the former deals with the universal laws whereas the latter explains a particular event with reference to its antecedent social condition.

> "If we consider the historical sciences in the light of our comparison between them and the theoretical sciences, then we can see that their lack of interest in universal laws act, among other things, as centers of interest to which observations are related, or as a point of view from which observations are made. In history the universal laws which for the most part are trivial and used unconsciously, cannot possibly fulfil this function... The only way out of this difficulty is, I believe, consciously to introduce a preconceived selective point of view into one's history; that is, to write that history which interest us."6

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5. Karl R. Popper, The Open Society and its Enemies, Vol. II, p.85.
6. Karl R. Popper, Poverty of Historicism, p.150.

Popper also denounces the thesis of predictability or historical inevitability on the ground that it is not only untrue but also under scores the role of human freedom and reason. It summons into view of the picture of grand holistic process with human beings as mere pawns or puppets. And the goodness of man or the rightness of his conduct is determined by the extent to which the individual contributes or participate in it. This kind of holistic metaphysics has led thinkers to build the totalitarian views about the state and state craft. According to a totalitarian or a collectivist the state is considered as an organic unit and the individual being a mere part has to subserve himself to the interest of the state or the collective body. The ultimate goal of the individual would consist in endeavouring to secure the good of the State and if need be the individual has to sacrifice his interest for the interest of the state. In other words, the interest of the state being more abiding and upper most, it would justify the state thriving at the cost of the individual freedom and well being. Rather, they would re-interpret freedom as the conditional obedience to the state. In nutshell totalitarianism is, basically, a revolt against reason and freedom. According to Popper, the totalitarian doctrine is not only unpaying but also inhuman and beguiles one to believe that there are inevi-

tability in history and human reason; initiative and freedom are worth nothing. Popper in 'The Open Society and its Enemies'takes Plato, Hegel and Marx as three representative thinkers in the history of the totalitarian thinking.

Plato in his time was opposed to democratic thinking and championed the cause of the aristocrats. He was in favour of the rule by the philosopher king or the selected few. On the basis of the distinction in natural endowments he perceives three distinct classes, such as the ruling class, the warrior class and the working class in the social hierarchy. According to him, the equilibrium in the state can be best ensured if people belonging to a particular class engage themself in the function appropriate to it. Conversely any change in their respective functions must result in disharmony in the collective body. The true justice consists in doing or getting what is appropriate to the class. The ruling class is no doubt more privileged than the other two and have the unique ability to control and regulate the fate of the state. For Plato change is always for the worst. Hence the ruler should leave no stone unturned in resisting all kinds of change. The state on earth is an imperfect shadow of the idea of the state in the realm of ideas. He proposes the socialisation of all private property; even wife and children to preclude man from degenerating into indulgent

seeker after the perishable. Though Plato's basic concern or motivation is for the good of totality by introducing the notion of natural privilege he rules out the possibility of development or evolution of the individual. The working class is condemned to work and follow like a herd of sheep and the ruler is to rule. Popper champions the cause of individualism by proposing that any humanitarian theory of justice makes three principal demands. According to him.

> "The humanitarian theory of justice makes three main demands or proposals, namely (a) the equalitarian principle proper, i.e. the proposal to eliminate 'natural' privilege, (b) the general principle of individualism and (c) the principle that it should be the task and the purpose of the state to protect the freedom of its citizens. To each of these political demands or proposals there corresponds a directly opposite principle of Platonism, namely, (a^1) the principle of natural privilege, (b^1) the general principle of holism or collectivism, and (c^1) the principle that it should be the task and the purpose of the individual to maintain, and to strengthen, the stability of the state."7

Thus Plato sows the seed of collectivism or totalitarianism which matures into flower and foliage in the hands of Hegel and Marx. Popper notices the Platonic root in Hegelianism. In Popperian terminology, Hegel's is a theistic historicism. Hegel observes that the state is a divine idea existing on earth and therefore it needs be worshipped as

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7. Karl R. Popper, The Open Society and its Enemies, Vol. I, p.94.

the manifestation of divine on the earth. And the individual owes everything to the state. Hence he pleads for the autonomy and authority of the state, which preponderates over all individual free will and preference. The state is conceived as an organism having will of its own and the individual being a part and parcel of it should do everything, even at his own cost, to nourish the organism called the state. The organismic conception of state leaves hardly any room for individual freedom or initiative. The well being of the state in relation to other state is determined by the law of dialectics which makes a nation enter into conflict with other nations in the struggle for the survival of the fittest. In the history of the inter-state dissension of the freedom of the individual freedom is a myth. The true freedom is the freedom of the nation, and the individual is a small sacrifice.

About Marx Popper observes;

> "In spite of his merits, Marx was, I believe, a false prophet. He was a prophet of the course of history, and his prophecies did not come true; but this is not my main accusation. It is more important that he misled scores of intelligent people into believing that historical prophecy is the scientific way of approaching social problems. Marx is responsible for the devastating influence of the historicist method of thought within the ranks of those who wish to advance the cause of the open society."8

8. Karl R. Popper, The Open Society and its Enemies, Vol. II, p.83.

Popper acknowledges that the moral concern for the exploited working class and the honest desire to improve their plight was the chief motivation behind the theoretical construction of Marx. The considerations were pragmatic. Marx's observation that 'philosophers hither to have interpreted the world in various ways, the point however, is to change it' only goes to show that the Marxian ideology was primarily a methodology and than a theory. Like all the theoretical historians Marxism is characteristically totalitarian too. He furthers the Hegelian legacy in conceiving the human history as being propelled by certain immanent and eternal laws with the sole difference that unlike the former Marx took matter (not idea or spirit) or economic factors as basic and central to all sorts of social growth and dynamism. Instead of dilectic of reason he thinks of the dilectic in form of class considerations. It is the incompatibilities in the forces of production and the productive relation in the economic substructure that manifest themselves in form of class struggle. The class conflict is deemed as necessary stages leading eventually to the establishment of a classless society which is nothing but a state of perfect synthesis, where each gives according to his ability and gets according to his need. Thus Marx visualises an ideal state of affairs, where the absolute socialism prevails.

To this, Popper remarks that the historical prophecy that capitalism shall meet its doom paving the way for the rule of the proletariates has proved to be false. But it is not so much the failure of prophecies that he dwells upon but the fact that by this he misled people to hink that there are certain objective social laws. In the Marxian scheme, the class is taken as a basic social entity. Since the laws of history decree the ultimate victory of the proletariates, the individual must learn to identify and merge subjective interest and the interest of the class with that of the state. The ethical merit of an action will be determined by the extent to which it contributes to the process of change. In the Marxian scheme the state is the supreme body and the interest of the state is the upper most centralised planning, suppression of individual initiative, psychic regimentation in the interest of the State are the characteristic features of communism.

Popper exposes the internal inconsistency in historicism. If the laws underlying the social movement are independent or transpersonal, this brings in an element of inevitability in the course of history. Man has little power to alter its course. All that he can do is to conform to it. Hence all endeavour or planning are but little aids in the realisation of the inevitable. The role of social activist is one of the social midwifery

Thus from the above account of various models, it is amply clear that the deterministic models not only go with thesis of predictability but hardly leave any room for human freedom or initiative. The totalitarian view projects state as a tangible entity demanding unconditional obedience from the individuals.

Against this, Popper advances his theory of liberal democracy. He champions the cause of 'open society', where the individuals are taken as the basic units. By doing so he seeks to restore dignity to man. The totalitarian models with their characteristic stress on collectivism reduces man to the status of a cog in the wheel. The beliefs in the so called social laws not only results in a kind of social automatism but also makes them oblivious to the nature of social realities and the role of the individual. Unlike in the physical phenomena where the effect is thought to be necessiated by the determinable invariable antecedent conditions. In social phenomena the complexity of the variable factors are so large that they baffle any finite attempt to codify them once and for all. Moreover, the role of the individual and his characteristic unpredictability because of his native rationality, render the social events all the more unpredictable. Every social situation is unique of its kind. It has a logic of its own. Hence any planning for the

whole has to countenance the specific or local peculiarities, surrounding the different units. Thus it is the situational logic that should serve as guiding principle and watch-word for the planner. This led him to talk of the concept of the piecemeal social engineering as opposed to the utopian holistic planning. In a totalitarian set up, the social planning is done as per the blueprint centrally prepared for the whole state that obviously ignores the local realities. As a result, it faces the operational handicaps or bottle-necks rendering the exercise utopian and frustrating. Hence Popper urges that the planning has to be made not according to certain apriori holistic ends but with an eye to the local realities and particular ends. By this Popper of course, does not rule out that the state cannot have any unitary objective for the entirety as, industrialisation, spread of education, removal of poverty etc. All that he insists upon is the implementation of these objectives in a piecemeal fashion. The differences, local exigencies may call for different modus operandi to realise the one common objective.

What is more significant is that the individual occupies a central place in the Popperian model. He urges that any planning whatsoever has to take cognisance of the hopes and aspirations of the individual and leave room for

the individual choice, deliberation and participation in the affairs of the state. History corroborates that it is the individuals who are not only influenced by the social institutions but also change the course of history by their revolutionary views and act.

> "... Is there nothing whatever in the historicist idea of 'periods'; of the 'spirit' or 'style' of an age; of irresistible historical tendencies; of movements which captivate the minds of individuals and which surge on like flood, driving rather than being driven by, individual men?...
>
> I have not the slightest sympathy with these 'spirit';... And yet I feel that they indicate, at least, the existence of vaccum, of a place which it is the task of sociology to fill with something more sensible, such an analysis of problem arising within a tradition. There is room for more detailed analysis of the logic of situation... Beyond the logic of situation, or perhaps as a part of it, we need something like an analysis of social movements. We need studies, based on methodological individualism, of the social institutions through which ideas may spread and captivate individuals, of the way in which new traditions may be created, and the way in which traditions work and breakdown."9

Popper argues that in the running of administration the individual should play integral role. The working of the state ought to be subjected to free opinion, critical deliberation, constructive criticism from time to time. This he calls the methodological individualism. It will not be out of place to state here that the liberal democracy

9. Karl R. Popper, The Poverty of Historicism, p.147-149.

is that man stands unique as a possessor of rationality, freedom and has the capacity to change and mould the course of history. He is not a passive victim of the impersonal process of history but he is very much the architect of his own destiny.

CHAPTER - IV

ALTERNATIVE MODELS

A thinker is better known and understood through his critics than his own creation. The greatness of a thinker to a large extent, consists in the nature and quantum of controversies that he evokes. Popper's view of science by all measures is novel as it introduces one to an alternative mode of looking at the nature and growth of scientific enterprise. From the exposition made in the preceeding chapters, Popper's view of science contains the following distinctive features.

Karl Popper parts company with the conventionalists by questioning induction as a mark of demarcation between science and non-science. He controverts it on the score that no practising scientist, as a matter of fact, begins with piecemeal observation and experiment with facts or experiences and then goes on to formulate his theories. Instead, he falls back upon the history of the growth of science to demonstrate that the history of science is a history of a series of conjectures and refutations. The enunciation of a new theory is the product of creative insight or immediate flash on the part of the thinker. It is of the nature of a bold conjectures. Such conjectures mark the beginning or a turning point in the established mode of thinking. It

is pre-scientific as it is invariably followed by the rigorous test of observation and experiment, before gaining the status of a more viable theory. But from this one should not jump to conclude that the conjectures that lie at the bottom of all scientific innovation is subjective and irrational. It is non-rational because its genesis is not amenable to any explanation in terms of causes. Popper argues that though science invariably has a root in metaphysics, it very soon grows out of it in being subject to objective tests and rigorous theoretical formulations, typical of scientific enquiry. But he does not go along with others in accepting verification as a mark of conclusive test of scientific theory. It is argued that the theories are so designed and the theorists are so disposed that every case of empirical evidence is interpreted as a positive confirmation of the theory even to the extent that they leave no room for actual or possible refutation. On the other hand, if conclusive verification be taken as the decisive criterion no theory whatsoever can be said to be verifiable in the strict sense of the term for it is logically impossible to bring all the possible experiencial evidence at a given point of time.

Having exposed the logical oddity involved in accepting verification as a test criterion, Popper offers,

instead, falsifiability as the potent criterion in determining the relative merit of the competing theories. A theory is not conclusively verifiable. Though a number of positive instances do not count as conclusive to the acceptance of the theory a single instance to the contrary is sufficient reason for sublating a theory in favour of another. The scientific progress is ensured by looking for the crucial instances or features that falsify an existing theory which in turn calls for another that verily overcome the test. Hence the development in a given field is marked negatively by refutation or falsification of a view current and positively invoking of a new model i.e. more immune to criticism in form of falsifiability. Thus falsifiability becomes a watch word for the working scientist. All that the pioneering genius does is to come up with a hard case against which the otherwise accepted views stands refuted. This is what is called revolution in science which marks a transition in the process of development and growth. The history of science is a history of alternative modes offered by different thinkers from time to time. Popper observes that human knowledge is tentative and provisional. It is ever growing a phenomenon. By seeking to fortify the theory against possible refutations, the scientist has got to be on the guard to make it more cogent and explanatory. But

the same time the theory should be so formulated that it leaves room for others to test it against the above criteria. Conversely, if the theory is so vague that it escapes all actual and possible refutations, it does so at the cost of being testable.

By all assessment, Kuhn is acknowledged to be the chief opponent of the above thesis of Popper. Even Popper himself admits; ... "Kuhn understands me very well—better, I think, than most critics of mine I know of."[1]

Kuhn's objection to Popper rests upon the distinction between the normal science and the extraordinary science. According to Kuhn, Popper's account of science is not only historically false but does not bring out the characteristic features of science. It is false because the host of practitioners that belongs to the core of scientific community do not by above admission qualify to be the scientist in the true sense of the term. And much of the activities that passes as contributory to scientific progress has to be discounted as peripheral. To substantiate this, Kuhn brings in and enunciates the notion of a paradigm. There appears to be difference in the various uses and meaning of 'paradigm.'

1. Karl R. Popper, "Normal Science and its Danger," in Lakatos and Musgrave, eds. Criticism and Growth of Knowledge, p.52.

However, the central meaning of the term suggest that a paradigm is the theoretical framework with its distinctive assumptions, body of doctrines, and language, shared or tacitly agreed upon by the group or the scientific community at a particular period of time. The observations, experimental findings, discussions, controversies, proofs and refutations presuppose the truth and validity of the paradigm. The solution of different problems, the resolutions of the apparent anomalies are made only within the accepted framework. Kuhn very much countenances the fact that an experimenter in course of his investigation comes across features that are anomalous in not being in consonance with the theory or paradigm taken for granted. It is argued that such an impasse in course of the investigation does not normally make one question the validity of the paradigm but urges the inquirer to multiply experiments or appeal to the findings of the co-workers to overcome it. The so called test according to Kuhn, occur inside the paradigm and the failure in a given case is attributed to the lapses of the individual rather than pointing to the weakness of the theory. A paradigm does not fall with the failure of the individual. Rather, it calls into question, the individual competence, the variable factors operative in course of experimentation. The apparent discrepancies of the findings with the paradigm

at hand, it is implicitly believed; can be overcome by more detailed and meticulous operations. So within the framework there are genuine problems or puzzles which the scientist is busy in solving. That is how the scientific community goes on in exploring various discussions of experience in relation to the theory at hand and see through the alternative implications of it in relation to experience and other theories. This is what Kuhn lables as the normal science. It is precisely in this connection that Kuhn sharply reacts to Popper's statement;

> "A scientist, whether theorist or experimenter, puts forward statements, or systems of statements, and tests them step by step. In the field of empirical sciences more practically he constructs, hypothesis or system of theories and test them against experience by observation and experiment;"2

as a virtual cliche. The so called tests or verifications do not either confirm or put the theories to test. They are integral to the devices to solve puzzles generated by the anomalies that are most often apparent. Hence the phenomenon of tests as envisaged by Popper does not qualify the activity of a working scientist. All that the scientist is mostly concerned with is to find a way out of a local difficulty by an

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2. Karl, R. Popper, The Logic of Scientific Discovery, p.27.

appeal to the framework at hand. Thus the success or failure in tests does neither enhance nor belittle the status of the paradigm. According to Kuhn, the so called test harped upon by Popper which, eventually, leads to the repudiation of the existing paradigm is very rare a phenomenon and occurs once in a while. Such revolutions leading to the overthrow of an existing framework is so few and far between that Kuhn demurs to include in what he calls normal science. He reserves the term extraordinary science or revolutionary science to describe the phenomena which Popper views as essential to the conception of genuine science. In enunciating the notion of falsifiability Popper leaves an impression that all genuine progress occurs only when an accepted framework or theory or mode of thinking is called into question in view of certain crucial features that are incongruous with it whereas for Kuhn, that there can also be genuine work inside a given framework in form of solving the problems or puzzles that arise within, even though they do not amount to questioning the very framework itself. As he observes;

> "Of the two criteria, testing and puzzle solving, the latter is once the less equivocal and the more fundamental."3

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3. T.S. Kuhn, "Logic of Discovery or Psychology of Research," in Lakatos and Musgrave, eds. Criticism and Growth of Knowledge, p.7.

> "To rely on testing as the work of science is to miss what scientist mostly do; within the characteristic feature of their enterprise."4

By thinking to the contrary, Popper is not only unfaithful to fact but also misrepresents a feature which is incidental (though necessary and consequential) to scientific thinking.

Kuhn questions the legitimacy of falsifiability as a criterion of demarcation though it is worth mentioning here that he does not offer an alternative formulation of his own. As pointed out earlier Kuhn shows to his conviction that the tests or so called verifications do not in fact occur inside a paradigm. Falsifiability which is essential to giving up a paradigm in favour of another, is a principle of verification in disguise as it contains justification for the new paradigm.

Kuhn further observes that discovering puzzles and solving them is a principal task that a scientist is wedded to. In this sense, conduct of the tests is a recurring feature in scientific domain but if test is taken to mean the test of the theory in terms of falsifiability then such test can be shown to be inessential to a given theory. Kuhn appeals to history to show that -

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4. Ibid, p.10.

> "... a theory was placed before it had failed to test but not before it had ceased adequately to support a puzzle solving tradition."5

In other words, a theory ceases to be useful not necessarily by the fact that it has failed to stand the test but by the fact that it ceases to be instrumental for puzzle solving.

While illucidating the structure of scientific progress, Kuhn conceives science after the model of theology or religious experience. To belong to the community of scientist pre-supposes a prior orientation and exposure to certain paradigms which is a kind of professional initiation working on particular problem in a given framework presupposes that the scientist has volunteered to be guided by the paradigm, which rules the day. As and when he comes across an anomaly or puzzle either it is explained in terms of the parent theory or explained away; otherwise while explaining the revolutions giving rise to extraordinary science Kuhn compares it to the characteristic of religious conversion. When an anomaly becomes so fundamental that it cannot be attributed to individual incompetence, the theory in that case is called into question and is replaced in favour of a theory which is congruous with the anomaly having explained it and is incompatible with earlier one. There is

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5. Ibid, p.10.

no interlude between the old and the new paradigm. The change over from one to another is sudden and swift.

In this perspective, Popper's reply to Kuhn's objection to his thesis is all the more illuminating. Popper agrees with Khun in the latter's observation that only meaningful work or success in science presupposes a definite universe of discourse signifying a set of fundamental postulates or assumptions, a body of doctrines, an accepted idiom. It is against this that all rational discussion are carried on and the framework constitutes the reference point of all agreements and disagreements. But Popper insists that genuine progress occurs only when the individual begins to question the very fundamentals underlying the system.

> "... it is much easier to discuss Puzzles within an accepted common framework, and to be swept along by the tide of new ruling fashion into a new framework, than to discuss fundamental — that is the very framework of our assumption."6

The normal scientist in Kuhn's opinion remains within the framework but Popper observes that as long as one lends oneself to be under the sway of the ruling dogma no significant progress is possible. The normal scientist, because of the prior conditioning fails to liberate himself from the

6. Karl, R. Popper, "Normal Science and its Danger," in Lakatos and Musgrave (eds.), Criticism and Growth of Knowledge, p.56.

tightening noose of the framework. It is a kind of wilful bondage, as it were. The investigator mistakes the thraldom as freedom. Popper observes that the normal scientist is badly taught and is a victim of indoctrination.

Popper further acknowledges that he is in favour of certain amount of dogmatism in defending and fastidiously holding on to the theory for if one easily gives into criticisms, the inner strength of the theory could not be ascertained. There is a sense in which Popper argues that the working scientist is a prisoner of the framework or the preconceived theories. But he would add;

> "We are prisoners in a Pickwickian sense: if we try, we can break out of our framework at any time. Admittedly, we shall find ourselves again in framework, but it will be a better and roomier one; and we can at any moment break out of it again."7

Here Popper seeks to explode the myth of framework. He does not toe with Kuhn in accepting the framework as independent, autonomous and mutually untranslatable. Rather, he mentions that though it is difficult to have meaningful discussion among people belonging to different frameworks, it is not impossible. Kuhn exaggerates a difficulty into an impossibility. Instead, he suggests that inter-system

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7. Ibid, p.56.

comparison and valuation are not only possible but also quite paying and illuminating. This obviously presupposes the Popperian assumption about the objectivity of truth, in contradistinctions to the methodological relativism of Kuhn. Human knowledge proceeds through conjectures, that prove to be tenative in the light of their refutations by subsequent conjectures that are more complete, cogent and explanatory.

Scientific knowledge, Popper observes can be regarded -

> "... as a system of theories on which we work as do masons on a cathedral. The aim is to find theories which, in the light of critical discussion get nearer to the truth. Thus the aim is the increase of the truth content of our theories."8

Popper's reply to Kuhn appears to be more radical, when he maintains that the so called normal science is not in fact normal. He accuses Kuhn of being unfaithful to facts. If one turns to the host of scientists as recorded in history (whom Kuhn would obviously dub as normal scientist) they are revolutionaries in the true sense of the term. Their worth as scientists have always proved themselves to be non confirmist in the originality of their thinking and operation.

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8. Ibid. p.57.

Moreover, Popper seems to be bent upon exposing the myth of paradigm. Kuhn assumes that at a given point of time a particular paradigm rules the day whereas Popper observes that it is historically false. In a particular area instead of one there are a host of theories vieing with each other to gain the ground. He refers to the alternative paradigms in connection with the problem of matter i.e. the continuity theories, the wave theories, the quantum theories, and the long drawn controversies therein.

Thus, Popper seeks to fortify his thesis that man through his sustained effort to explore and understand reality proceeds through trials and errors, educates himself through omissions and commissions and this amounts to the progressive approximation to truth.

CHAPTER - V

CONCLUSION

Popper's Philosophy of Science is based upon the following presuppositions. (i) All science, for that matter all philosophy is cosmology, (ii) genuine epistemology is that which takes into account the growth and development of knowledge, (iii) science develops through a process of conjectures and refutations. Popper claims that these methodological doctrines not only apply to natural sciences but apply to social sciences as well.

Let us examine these presuppositions one by one. Let us first examine the claim that all science and philosophy are cosmologies. What does Popper mean by cosmology? In answer to this, Popper may say that cosmology is a world-view. But this will not help him much. As a matter of fact, science cannot be treated as cosmology. Physics for example is not cosmology, for the simple reason that cosmology talks about the totality where as physics does not do so. A physicist surely talks about matter and the material universe but it does not talk about non-material objects. If totality consists of both matter and non-matter then a physicist does not talk about totality. Similar is the case with a chemist and a mathematician. A mathematician for example, in a very general

sense talks about numbers. But numbers are not the be-all and end-all of the world. Can one say that a mathematician talks about the entire world? Can one say that a mathematician offers a cosmology? Unless one is a Pythagorean one cannot say that the basis of the world are the numbers. As a matter of fact, Philosophers and philosophically minded scientists develop cosmologies out of scientific theories. Cosmological theories like the world is basically material, the world is basically mathematical in nature, have been advanced. What is the relationship between these cosmologies and the respective scientific theories? Do the different scientific theories entail these cosmologies?

In answer to this it can be said that cosmologies are not the necessary part of the scientific theories. They are the adjuncts to it. The Newtonian mechanics might be operating in the physical world but it surely does not operate in the world non-physical. This is how Kant was right in pointing out that the Newtonian mechanics operates only in the world of phenomena but does not operate in the world of noumena. To extend the Newtonian principles to the world of noumenon is to commit a mistake. The totality surely means both the phenomena and the noumena taken together.

It will be difficult to agree with Popper that all science is cosmology. He uses science in a very broad sense. Instead, he should have said that scientific theories generally inspire particular world views. There is a difference between a scientific theory entailing a cosmology and a scientific theory inspiring a world view. It is not clear what Popper means by saying that all science is cosmology.

Further, Popper argues that all philosophy is cosmology. In this connection too, we wish to point out that Popper is not clear what he means to say. In his observations on ancient Greek philosophy Popper mentions that the ancient Greek philosophy was all cosmology. These cosmologies gave rise to scientific thinking in Europe. Popper goes a step ahead in pointing out that the only culture based on science and scientific temper is the West European culture. Again it is not clear what Popper seeks to establish. There is a sense in which it can be said that metaphysical systems present a world view (Weltanchauung). This is true about different metaphysical systems. But all philosophy is not metaphysics. Therefore, it is wrong to say that all philosophy is metaphysics and all philosophy gives us a cosmology. Moreover, this is false as a matter of fact that the only culture based on scientific foundation is the west European culture. Here

Popper seems to be very narrow minded. We wish to point out in this connection that the essence of scientific spirit consists in critical reflections. If this is taken as the essence of scientific spirit then there are many cultures in the world including ancient Indian and Chinese culture which are based upon scientific spirit. If by scientific spirit it is meant only the sophisticated technology this might be the case that accidentally sophisticated technology developed in the west European countries including the U.S.A.

It seems that Popper uses 'Science' in a very wide sense when he says that all science is cosmology. It can be pointed out in this connection that it is possible to mention and justify two different world views with the help of the same scientific and philosophical theory. World views, ideas and attitudes can be independently maintained without relating it to scientific or philosophical theories.

Popper's anti-inductivist spirit owes its origin to his theory of falsification. Popper replaced the positivistic doctrine of verification by the doctrine of falsification. The doctrine of falsification contains in germinal form Popper's anti-inductivist doctrine. Verifiability is not the essential feature of a scientific theory. A scientific theory

does not acquire credibility by being verified rather it acquires credibility by being falsified. Falsifiability again endows dynamism to science. A single instance to the contrary falsifies a scientific theory and brings in its train a fresh one. His doctrine of Conjectures and Refutations can be treated as an upshot of the doctrine of falsifiability. How do we falsify a theory? Does falsifiability occur on its own? Do we come across the contrary instance in a natural manner? Two different answers can be given to these questions. (i) One may come across the contrary instance that falsifies the theory in a natural manner. In other words, the contrary instance may just occur and be noticed by the working scientists. (ii) The scientist might throw a conjecture which ultimately may come out to be a contrary instance and consequently might falsify the theory.

Let us now turn to Popper's anti-inductivist doctrine. Does it mean that the scientist never uses induction? Does it mean that a scientific theory does not involve logically, induction? Popper argues that inductivism is a myth. In other words, according to Popper, genuine scientific discovery does not take place through the straight jacket process of observation, experiment, hypothesis and formation of a theory. This is not how discoveries in sciences take place. Popper points

out that genuine discovery in sciences take place through bold process of conjecture and refutation. The scientist throws a conjecture, hazards a guess and the guess continues to reign until it is refuted. The refutation takes place either by another conjecture or by falsification through a contrary instance. We wish to point out that Popper is equally unclear on this point. We wish to suggest that there are two issues involved, (i) the psychological issue, and (ii) the logical issue. (i), Relates to the genesis of scientific knowledge, and (ii) relates to logic of scientific knowledge. How does scientific knowledge originate is a genuine question in psychology and sociology of knowledge. The psychological make up together with training help the individual scientist to develop a particular scientific theory. This is of interest to the psychologist. Similarly the social and cultural milieu including the intellectual climate of the period might inspire a working scientist to develop a particular scientific theory. This is of interest to the sociologist of knowledge. But what is involved in a scientific inquiry is of interest to a logician. To the question, whether scientific knowledge involves observation, experiment and formulation of hypothesis as different logical stages, the answer is yes. In other words, observation

and experiment, hypothesis, theory and law are logically involved in the concept of scientific knowledge. Scientific knowledge, qua scientific knowledge, has to be amenable to observation and experiment. It must involve the concepts of hypothesis and should be formulated in form of theories and laws. If the inductivist argues that scientific knowledge always grows through the process of observation, experiment, formation of hypothesis, theory and law then Popper is right. But is it the case? Do the inductivists maintain that scientific knowledge always grows in this manner? Are the stages to be regarded as different steps in psychology of scientific knowledge or they are different stages logically implied in the very idea of scientific knowledge? There are passages in Mills's System of Logic which point out clearly that the so called different stages of induction are really involved in the very idea of scientific knowledge. Therefore, Popper's stricture on the inductivists is not acceptable in the light of this comment. Can Popper deny that scientific knowledge logically involves the idea of observation, experiment, hypothesis, theory and law? It will be difficult on the part of Popper to do so. Scientific knowledge without the idea of observation, experiment, hypothesis, theory and law is no scientific knowledge at all.

What then is the status of conjecture and refutation in scientific knowledge? Let us now turn to it. Is it the case that a scientific theory is just a conjecture, a guess work without any theoretical basis? To this, our answer is 'no'. A scientific theory is not just a bold conjecture. In other words, a scientific theory is always supported by both experimental and demonstrative evidences. A physical theory like that of an Einstein's or a Newton's is not just a guess work it is a piece of sophisticated theory and its refutation does not consist in just pointing out a counter evidence. To refute a scientific theory is not just to point out a counter evidence but to disprove it either through mathematical demonstration or through experimental evidences or by both. Even the so called conjectures and refutations have to be substantiated by demonstrative and evidential support. In other words, we wish to point out in this connection that a scientific theory is not just a case of conjecture and its refutation is not <u>just refutation</u>.

If Popper is advancing his doctrine o conjectures and refutations as a watch word, as a maxim of scientific discovery then there is no disagreement with him. A watch word, a maxim, or a directive always helps us in our adventure. The spirit of adventure is very much necessary in

scientific endeavour. A scientist should be ambitious to refute and reject the existing theories and establish his own. We wish to point out in this connection that Popper's doctrine of conjecture and refutation may well serve as a directive. It does not describe the logic of scientific knowledge. Scientific knowledge does not consist of mere conjectures and refutations. Though Popper accuses the inductivist of psychologism yet he himself falls a victim to it. Instead of describing the logic of scientific discovery he describes nay, prescribes the maxims for scientific exploration. This is to do either psychology or sociology of science but not to do the logic of it.

Let us now turn to the dispute between normal science and revolutionary science. Popper maintains that normal science is a danger. To work within a paradigm is slavish. In fact, Popper does not entertain the idea of paradigm in the sphere of science. Kuhn, on the other hand, makes distinction between revolutionary and normal science. According to Popper, revolutionary science is a normal feature. According to Kuhn, revolutionary science is an unusual feature, it takes place very rarely. We wish to point out in this connection that both Popper and Kuhn have been partial in their understanding of scientific inquiry. Popper seems to have

been convinced that scientific activity consists of a series of revolutions and this is not true as a matter of fact. Similarly, Kuhn seems to be maintaining that there is a water tight compartment between normal science and revolutionary science. We wish to point out that the gap between normal science and revolutionary science does not exist at all. If there is a gap at all it is logical but not factual. Further, revolutionary science grows out of the so called normal science. The so called paradigms are not really paradigms. A working scientist while working within the so called paradigm does not simply follow the dictum. He seeks to explore, analyse and bring out the implications of the existing scientific theories. Further, he might develop mathematical demonstrations or point out the evidential supports for the existing theory. To do this is not simply to work within the four walls of the paradigm. The so called paradigm is extended, its boundary lines are modified and changed in the light of further investigations. Popper is unnecessarily afraid of the danger of the normal science. The so called normal science is not insipid and static and the so called revolutionary science is not fresh and completely new at every stage. Though Popper starts with a bold claim that he is explaining the growth and dynamics of scientific knowledge yet he fails to take note of this.

There is an overtone of anti-positivism in Popper. According to Popper bare perception cannot give us knowledge. On the other hand, the positivists reduce all knowledge to a set of singular observational statements. This ultimately leads the positivists to solipsism. If ultimately all statements have to be reduced to observational ones then one has to fall back on subjective experience. Subjective experience becomes the basis of objective knowledge. How do we establish this objectivity? Either we have to accept that the so called objectivity is really subjectivity in disguise or interpersonal communication is logically ruled out. However, the positivists were faced with this dillema. On the other hand, Popper will not subscribe to the positivistic position. Popper would accept a framework or conceptual model which is pre-scientific in nature. In this sense, Popper is a Kantian but with a difference. For Kant, the categories or the models are fixed for all time to come. They are static in nature. But for Popper, they are dynamic. The categories or the model of scientific knowledge goes on changing, growing and developing from time to time. Dynamism, growth, falsifiability and refutability are the chief characteristics of knowledge.

Let us characterise Popper's philosophy of science in general. Is he a realist?, an instrumentalist?, an opera-

tionalist?, or an idealist? Realism, instrumentalism, operationalism and idealism are doctrines regarding the cognitive status of scientific theories. Realism is a doctrine which claims that scientific theories are real descriptions of facts. They are either true or false. Popper is not a realist because he believes in plurality of models and frameworks. There is no limit to conjectures and refutations. A conjecture is a framework or a model and there can be infinite number of it. It goes on increasing with the advancement in scientific knowledge. Popper is not an instrumentalist. Instrumentalism is a doctrine which claims that scientific theories are not real description of facts. They are devices, directives or maxims to look at facts and the world. Popper is not an instrumentalist for the simple reason that he does not treat scientific theories as mere instrumental devices. Let us see whether Popper is an operationalist. Operationalism is a doctrine which claims that scientific theories and concepts are operational in nature. That is to say, a scientific theory ceases to be valid if it does not have any operational value for the scientist. Operationalism is a kind of idealism for the simple reason that it does not treat scientific theories as real descriptions of facts. But at the same time it is different from Kantian brand of idealism. The Kantian brand of idealism is static. On the other hand, there is an

element of dynamism in operationalism. Popper comes closer to the operationalism of P.W. Bridgeman. Operationalism is not very explicit on the nature of the potency of the agent in scientific enquiry. For the operationalist, concepts or ideas are meant for operation or use. On the other hand, there is an implicit assumption regarding the potency of the agent in Popper. The assumption is as follows: Human mind contains infinite potentialities. This potentiality manifest itself in various cognitive forms in understanding the world. This in turn, expresses in an unending series of conjectures and refutations.

Let us now turn to Popper's view of social sciences. He gives the semblance as if the conjecture-refutation model applies to social science theories too. To be consistent, he should apply the same model both to natural and social sciences. On the other hand, Popper throws over board the totalitarian and absolutistic theories of state and society advocated by Plato, Hegel and Marx. He rejects totalitarianism as a theory of social explanation as well as a creed for social change. Instead, he treats both society and social theories as open ended and recommends piecemeal social engineering in lieu of total and revolutionary social change. Popper is right in saying that the totalitarian theories are

not theories in the proper sense of the term. But did the protagonists of totalitarian theories treat their theories descriptive of societies? Did Plato, Hegel and Marx treat their social theories on par with theories in natural sciences? In answer to these questions, it can be said that not only the social theories of Plato, Hegel and Marx but large number of social theories are not empirical in nature. These theories are metaphysical in nature. Like any other metaphysical theory the social theories of Plato, Hegel and Marx presents before us a synoptic picture of human society. These theories come closer to poetry, music and painting. In fact, they do not describe the actual situation but highlight certain aspects the individual and society and draw our attention to it. Popper's criticism rests on the assumption that these theories are descriptive of human society. This is true that the social theories of Plato, Hegel and Marx have been misunderstood. This is equally true that Popper has failed to appreciate the social theories of these thinkers. On the one hand, Popper treats all philosophy as cosmology and on the other he rejects the absolutistic theories of society. It goes to suggest that Popper is not very clear what he means by cosmology and cosmological theories. The confusion is worse confounded when he introduces the doctrine of falsifiability and refutation.

The cosmological or absolutistic theories by their very nature cannot be refuted. In other words, it is odd to talk of refutation of cosmological/metaphysical theories. These theories run out of fashion, get out-moded, but never get refuted. The social theories of Plato, Hegel and Marx may run out of fashion, may be outmoded but cannot be said to be refuted. We wish to suggest in this connection that these social theories are bold conjectures which can never be refuted by contrary instances. A theory in natural science may be refuted by coming across a contrary instance but no contrary instance can refute the social theories of Plato, Hegel and Marx. One can approve or disapprove the social theories of these thinkers but one cannot reject or refute them. Popper fail to take note of this point.

Popper seems to have accepted methodological individualism in lieu of methodological holism. We wish to suggest in this connection that Popper is inconsistent. What does Popper mean by methodological individualism? Does he think that concepts, individual attitudes and beliefs are adequate to explain social phenomena? Does he mean to say that social phenomena can be reduced to and be explained in terms of individual ones? Does he mean to say that individuals are primary and society is secondary? It seems that Popper gives

primacy to individuals and concepts related to individual attitudes and habits. This explanation of Popper's is not acceptable to us because of the following reasons. It is a fact that society consists of individuals. Take away the individuals, there is no society. But this does not go to prove that society can be adequately, completely, exhaustively described in terms of the actions of the individuals. We wish to suggest in this connection that an adequate description of social phenomena requires concepts which refer both to individuality and collectivity. If the totalitarians committed the mistake of describing society and social phenomena in collective terms, Popper commits the opposite mistake of describing society in terms of concept that refer to individuals alone. Moreover, there are certain social situations which can only be explained by referring to the groups, societies, communities and their form of life. Consider the following instance. Suppose somebody dies by hanging himself. Is it a case of suicide?, a ritual sacrifice? How do we decide this question? Can we decide this by taking into account the motive of the individual alone in exclusion of the society or the form of life, the individual lives? Our answer is that in order to decide whether it is a case of suicide or a ritual sacrifice one has to take both the motives

of the individual and the form of life. The form of life is determined by what is known as society, by collectivities, by communities. Popper has not taken note of this fact.

Further, Popper talks of three worlds, i.e. (i), the world of nature, (ii), the world of mind, and (iii), the world of ideas. The world of nature is studied by natural scientists. The world of mind or the subjective world is studied by the psychologists. The third world or the world of ideas is of utmost significance to other social scientists. These world of ideas are autonomous in the sense that they give rise to unending series of consequences not intended by the agents. We will illustrate this by the following example. Suppose, somebody sells a house in the busy market place in a very high price and all on a sudden the price of houses in the town goes up. May be, the intention of the initial seller was not to spur the hike in the price in the town. But ultimately his selling of the house led to it. How do we understand it? If Popper accepts the validity of this third world of ideas then he cannot disagree with Hegel and Marx. Both Hegel and Marx will agree with Popper that ideas, concepts or categories are self-generating and autonomous. Where is the disagreement between Hegel and Marx on the one hand and Popper on the other? We wish to suggest that the acceptance

of the third world of ideas by Popper is incompatible with his criticism of Plato, Hegel and Marx.

Popper accuses both Plato, Hegel and Marx of historicism. According to him, all these philosophers have tried to predict the course of events in the human history. We wish to point out that Popper is also wrong in this connection. Historicism is not the same as predictability in natural sciences. Both Plato, Hegel and Marx distinguished between explanations in terms of causes and explanations in terms of reasons. Causal explanations operate in natural sciences. Hegel and Marx have employed explanations in terms of reason in their study of society. Instead of pointing out these two types of explanations, Popper has unnecessarily accuses Plato, Hegel and Marx.

Popper seems to be allergic to the ideas of total change. Instead, he recommends piecemeal social engineering. But this is not acceptable without a pinch of salt. This is true that problems of different groups living in a society may not be of the same type. Therefore, any imposition from above, any standardization is bound to create more problems than to solve it. Before introducing any social change one has to take into account problems faced by different community

and groups. Piecemeal social engineering based on diagnosis of particular groups will surely go a long way to deliver the goods. But there may be occasions where total structural change becomes imperative. Total social change is not opposed to piecemeal social engineering; rather they are complementary. We wish to suggest in this connection that Popper in his assessment of Plato, Hegel and Marx has been one-sided. Take the instance of the degenerate caste system in the present day India. Any sensible social reformer will surely suggest total structural change of Indian society in respect of caste system. By this, we do not suggest that there is only one method of curing the social disease. To improve any social situation one has to make all-out efforts. It has to be multi-directional instead of being unindirectional. Neither the sources of the malady nor the cure are of the same type.

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