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SCIENCE AND SUBJECTIVITY: UNDERSTANDING OBJECTIVITY OF SCIENTIFIC KNOWLEDGE

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Introduction

There is an epistemological optimism, inspired by the Western renaissance, leading to the faith that man has power to discern the certain knowledge. The essence of this view lies in the doctrine that 'truth is manifest' which implies that truth may perhaps be veiled, but it may reveal itself. If it does not reveal itself, it may be revealed by us. Removing the veil may not be easy, but if we once got the naked truth before our eyes, we have the power to see it, to distinguish it from falsehood, and to know that it is true. There is no problem to recognize the truth. Truth is only to be unveiled and discovered. If this is the nature of truth, then the question arises how we ever fall into error. In

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this regard, Cartesians appeal to the theory of conspiracy: the idea that various evil influences perverted our originally pure and innocent mind. And this is science which through its methods and techniques ensure to prevent the conspiracy and to discover the manifest truth. The only thing we need to do is to use the scientific methods.

This is the traditional understanding of the nature of science which gives us the idea that scientific knowledge is free from any kind of human attitude and strictly based on observations, experiments, logical analyses of its concepts and so on which give us the bare facts of the real world. According to this view, human attitude is associated with human sciences; but as far as natural science is concerned there is no scope for any subjective elements. Scientific knowledge is purely objective, and it is an objective description of the real structure of the world.

But the recent philosophical insight into the nature of science gives us a different idea in this regard. Scientists are men and social beings; therefore, no scientist is beyond his psychology, ideology and sociology which have significant impact on his thought. All these factors produce influences over scientific decisions, such as decisions about when a phenomenon is recognized as a problem, what the methods are for solving the problem, what the methods are for justification, how different theories are to be compared, when the research comes to end, etc. This line of investigation will clearly show that scientific knowledge possesses one kind of subtle subjectivity in its nature. However, this kind of subjectivity is not like that of Berkley's, rather it is understood in terms of scientist's human attitudes, conceptual framework, specific interest, background knowledge, all of which influence his thought. For this reason, a scientist may think of the world differently than what it really is.

Scientific Theory and its Subjective Origin

Scientific theory may emerge from any idea - the theory becomes scientific only if it is prepared for a critical and empirical examination. Any kind of source may be the background of scientific knowledge. We have to give up the idea of ultimate source of our knowledge and no source has the overwhelming authority. Scientific knowledge may be generated from any humanistic ideas which are mixed with errors, prejudices, dreams, and hopes. Thus, Popper says that any product of human mind - such as myth, metaphysics, stories, guesses or whatever– may be the valid source of scientific knowledge. Knowledge is thus an adventure of ideas. These ideas are produced by us, and not by world around us. (Popper, 1965, p.95).

This is the first step of our knowledge adventure. The second step is to try to eliminate error from those products by criticism, and that criticism may be as severe as possible at any given time. This point of view indicates that to produce a theory and to criticize it by the available knowledge apparatus of the time are dependent on the totality of human ability and the human conditions in which scientists work for science.

So, scientific adventure aims not only to produce theories, but the essential part of its aim is to criticize those theories. Criticizing ideas may also emerge from any source. In this way science exposes theories and counter theories to a fiercest struggle for survival. This is a struggle to falsify the previous theory by the new theory. This implies that theories must be falsifiable – a theory to be scientific needs to be empirically falsifiable. To be empirical, falsification must be done on the basis of basic observational statement. But a question can arise: is observational statement really objective? A phenomenon could be observed and interpreted from different points of view

depending on the scientists' position in the knowledge situation of his time. Interpretation of a phenomenon depends on some other theory; this other theory again depends on some yet other theory and in this way, it goes *ad infinitum*. At this point scientists *decide* to stop somewhere to settle for an accepted basic observational statement as an arbiter of falsification process. If any basic observational statement which supports theory-2, for instance, goes counter to the theory-1 (the previous theory), then it is to say that theory-1 is falsified by theory-2. Question arises that how much objective the observational statement is. There are many human elements in scientists' decision to stop at certain position to settle a basic statement –this is human decision, not a logical end.

Krajewiski has also pointed out the human subjectivity in scientific decision. He argues that the investigation starts from a hypothesis. After that, hypotheses empirically deduce the testable consequences and these consequences are put in an experiment. If the test gives positive result, the candidate hypothesis is accepted, though this decision is never final. If the test gives negative result, the candidate is rejected. Here the experimental design depends again on some other hypothesis. So, in this competition, all parties start from hypotheses. (Krajewski, 1977, p. 71). Creation of hypothesis is a subjective involvement.

For Popper, growth of the theories in science should not be considered as the result of the collection or accumulation of observations. On the contrary, observations and their accumulation should be considered as results of the scientific theories. So, science itself throws new light on things; that it not only solves problem, but it creates many more. In this way we look out for new observations. (Popper, 1965, p. 27). Theory is produced from the imaginative mind of scientist, and then we observe according to the theory. Our observation needs

to be interpreted. So, without theory we could not orient ourselves in the world. We observe as our theory suggests. For instance, the Marxists literally observe class struggle everywhere, for their theory suggests that history of mankind is the history of struggle between classes. The Freudians observe everywhere repression and sublimation; the Adlerian sees how feelings of inferiority expresses themselves in every action and every utterance. These show that all observations are designed by their theory. (Pitt, 1987, p. 53).

Popper declares that nothing can be built on pure data, because there is nothing as pure data; there is nothing simply 'given' to us uninterpreted. All our knowledge is interpreted in the light of our expectation and our theories. (Popper, 1983, p. 102). Theoretical entities, such as electric field, magnetic field, gravitational field – all are hypothetical constructs. They are metaphysical and speculation of scientists' minds. So, nature of the world becomes different with the difference of the scientists' thought. What is oxygen to Lavoisier is dephlogisticated air to Priestly. No experiment could solve their controversy. So, Hanson says that two observers do not see the same thing. Observing a protozoon – amoeba, one saw one celled animal, but the other a non-celled animal (Hanson, 1958, p. 4).

Moreover, there is general skepticism about the viability of logic of discovery, because most of us cannot conceive that there might be rules that would lead us from laboratory data to theories as complex as quantum theory, general relativity, and the structure of DNA. Today's science virtually involves in theoretical entities and the process that are inferentially far removed from the data – that is, the construction of inference goes beyond the data. There might be rules which lead scientist from 'tracks on a photographic plate' to the claim about 'the line structure of subatomic particle' is just impossible. The

theories that are replete with unobservable entities are grandiose ontological frameworks. This ontological construction is dependent on human ability and personality. Scientific discovery depends upon some happy thought, no maxims can be given which inevitably lead to discovery. (Laudan, 1980, pp. 179-181). Every discovery contains a creative intuition as says Bergson.

We can find human element in scientific thought when we look at a scientific problem and the way to solution. When we first encounter the problem, we do not know much about it. At best we have only a vague idea as to what our problem really consists of. How, then, can we produce an adequate solution where we do not have adequate understanding about our problem? Obviously, we cannot. We must get better acquaintance with the problem. But, how do we? For Popper, we can do so by producing an inadequate solution, and by criticizing it. Only in this way can we come to understand the problem. For, to understand a problem means to understand its difficulties; and to understand difficulties means to understand why it is not easily soluble - why the more obvious solutions do not work. We might therefore produce additional more obvious solutions. These solutions must be criticized in order to find out why they do not work. In this way we become acquainted with problem and we may be able to produce solutions that are better than the earlier ones – provided that we have the creative ability to produce new guesses, and more new guesses. (Popper,1979, p. 260). So, this is again human ability and situation to see a problem and create its solutions.

In this regard, we can consider another point about scientific knowledge, that is, background knowledge. To produce some solution or its criticism we need some preconceptions that will regulate us. In isolation we cannot say anything. We cannot start from nothing. However, such

background knowledge is no more than the subjective acquisition of previous knowledge. If we suspect that the uncritical acceptance of any part of our background knowledge is responsible for some of our difficulties, then our background knowledge may well be challenged at any particular time. But this challenge depends again on the scientists' subjective position about ideology, history and so on.

Objectivity in Terms of Falsifiability

If scientific discovery emerges from scientist's imaginative mind, how do we conceive of the term objectivity in it? Considered the conception of falsification as propounded by Karl Popper, the idea of objectivity of a theory comes from the idea of falsifiability of it. For him, personal ability to produce any idea is personal, but knowledge produced in such a way becomes objective knowledge if it becomes falsifiable. Conjecture (producing theory) is human, but refutation is objective. This is the demarcation between science and non-science (religion, mythology, ethics, poetry, etc.). Science is empirically open to criticism, whereas others are not. There are two possible attitudes towards any assertion or tradition. One is to accept the assertion uncritically. The other possibility is critical attitude, which may result either in acceptance or in rejection, or perhaps in a compromise. This second approach makes science objective.

A subjective stance may mould theory-production; but criticism of that theory is objective. Verification is never complete, but falsification is conclusive. A theory may be produced from any source, be it myths, prejudices, fairy tales, religions. But the theory becomes objective only after the theory is put forward to criticism. Popper holds that our conjectures (theories) are produced from the expectation of a solution of a problem – expectation for regularities. We have

the propensity to look out for regularities and to impose laws upon nature. This propensity leads us to the psychological phenomenon of 'dogmatic thinking'. In this way we expect regularities everywhere and attempted to find them even where there are none, and we stick to our expectations even when they are inadequate. In this situation, without a trial, our theory will remain myth. Only a critical discussion can make the conjecture a proper scientific theory, that is, objective knowledge. (Popper, 1965, p. 49). So, falsifiability is the criterion of objectivity; for, falsifiability makes sense of criticism. Without being falsifiable a theory could not be put forward to criticism. So, science is myth-making activity; but the myth becomes objective knowledge when it adopts critical attitude. So, objectivity is understood as criticality.

Paradigmatic Nature of Scientific Understanding

There are different levels of scientific theories. Some theories are so fundamental in scientific thought that scientific community acknowledges them as supplying the foundations and guidelines for further practice. Such kind of theories expounds the body of accepted theories and illustrates many or all of its successful applications with exemplary observations and experiments. Aristotle's *Physica*, Ptolemy's *Almagest*, Newton's *Principia* and *Optics*, Franklin's *Electricity* Lavoisier's *Chemistry*, Lyell's *Geology* and many other works are in this kind. They serve, for a time, implicitly to define the legitimate problems and methods of a research field. This level of theories is sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. And they are sufficiently open-ended to leave all sorts of problems. This kind of theories are no more than the framework of understanding the nature which Thomas Kuhn calls paradigm. Men whose research is based on a shared

paradigm are committed to the same rules and standards for scientific practice. (Kuhn, 1970, pp. 10-11).

Paradigm is the primary element of scientific thought which offers a model of scientific tradition and activity. Paradigm is way of looking at the world, broad quasi-metaphysical insights or hunches about how the phenomena in some domain should be explained. Paradigm is distinguished from hypothetico-deductive theory. For, in hypothetico-deductive theory premise is fixed, and we know what it is all. On the contrary, paradigm is a 'way of seeing', where the more we articulate the paradigm, the more we know what it is. It is a metaphysical model that more or less comprises the scientific community's belief about nature.

However, scientist's subjective attitude would be found in the creation of paradigms and in making choice between them. It is found in the question: what is the process by which a new candidate for paradigm replaces its predecessors. For Kuhn, a new interpretation of the nature first comes in the mind of one or a few individuals. It is they who first learn to see science and the world differently. Their ability to make the transition is facilitated by two circumstances. One, they are the people whose attention has been invariably and intensely concentrated upon a crisis provoking problems. Two, they are men so young or new to the crisis ridden field where practice has made them less committed. (Kuhn, 1970, p. 144). So, these aspects of scientist's attitude, built in the changing situation of history, are responsible for the creation of new paradigm or new insight about the natural world.

Now let us consider the question of theory choice. In what process members of scientific community leave the old theory and accept the new? Investigation in this line will reveal another part of human attitude associated with scientific

decision. For, this shift of the scientific community is regulated not by reason, but by will. Because the situation changes into so complex that it goes beyond reason to make rational justification. Feyerabend says that history generally and the history of scientific revolution in particular, is always richer in content, more varied, more many-sided, livelier, and subtler that even the best philosopher and the best methodologist can never imagine. History is full of accidents, conjectures, and curious juxtaposition of events. It demonstrates to us the complexity of human change and the unpredictable character of ultimate consequences of any given act or decision of men. In this condition, it cannot be believed that the naive and simple-minded rules which methodologists take as their guide are capable to account for such a maze of interactions. (Feyerabend, 1975, p. 19).

In this situation, scientific community's shift from one paradigm to another could not be determined by methodological guidelines. One of its reasons is the competing paradigms are completely two different worldviews. They produce the problems and solutions from entirely different positions. So, what is a significant question for one may not be problem at all for other. What is solution for one may not be solution at all for other paradigms. It is because no paradigm can solve all the problems it defines, and no two paradigms have the same set of unsolved problems. In this position, a scientist rejects old and accepts the new only on the basis of (scientifically enriched) human attitude and because of this attitude a scientist may adhere with the old paradigm. Kuhn says that since old paradigm is the background of the new, the new accepts many concepts and apparatus from the old. But the new seldom employs the borrowed elements in quite the traditional way. Within new paradigm, the old concepts and experiments fall into a new relationship. For example, what

Ptolemy meant by 'earth' was a fixed position. Correspondingly, innovation of Copernicus was simply to move earth. It was a completely new way of regarding the problems of physics and astronomy – one that necessarily changed the meaning of 'earth' and 'motion' (Kuhn, 1970, p. 150).

Kuhn holds that a few candidates for paradigm may have few supporters. Moreover, on occasions, supporter's motive may be suspect. Nevertheless, if they are competent, they will improve it, explore its possibilities and show what it would be like. And as that goes on, if the paradigm is once destined to win its fight, the member and strength of the persuasive arguments in its favor will increase. More scientists will then be converted, and the exploration of new paradigm will go on. Gradually, the number of experiments, instruments, articles and books based upon the paradigm will multiply. Still more men who are convinced of new view's fruitfulness will adopt the new mode of practicing normal science until at least a few elderly hold-outs remain. (Kuhn, 1970, p. 159). This kind of transfer of allegiance from one paradigm to other is called a conversion experience that occurs on the basis of man's choice.

There is another point: how a paradigm is first created and then accepted by any or a small group of scientists. This is also a human process. In scientific research, there are some such situations when articulation of paradigm does fail to assimilate certain anomalous phenomena. They are neither anticipated nor can the paradigm provide such rules to absorb them. For Kuhn, the awareness of such anomalies is necessary precondition for the emergence of new paradigm. For example, Quantum mechanics was born from variety of difficulties surrounding blackbody radiation, specific heat, and the photoelectrical effect. (Kuhn, 1970, p. 67).

However, when the awareness of anomaly has lasted so long and penetrated so deep, then scientists take a different attitude towards the existing paradigm. The willingness to try anything, the expression of explicit discontent, the recourse to philosophy, and to debate over fundamentals - all these occur in this situation. In this situation, no paradigm can dominate over the research field, and any paradigm can seek to dominate. The situation becomes so intolerable that scientists sometimes desert their field of operation. Kuhn calls this situation 'period of crisis. For instance, Lavoisier begins his experiments on air in the early 1790's, there were almost as many versions of the phlogiston theory as there were pneumatic chemists.

However, the humanistic point here is Kuhn's claim that this crisis is not of science, but of scientists. The failure goes not to science, but to scientists. There is a human propensity that when a paradigm remains dominant, failure is attributed to the experimenters; because dominance of the paradigm ensures that there must have been some solution. But when a paradigm is under attack, failure goes to the paradigm because that time paradigm loses its glory. It is very similar to the position of powerful and weak person. People generally get inclined to consider a mistake of powerful person as correct in some or other sense, whereas a correct of a weak person is considered wrong in some or other sense. Kuhn, in this regard, says 'a failure that was previously been personal may then become the failure of the theory under test'. But it is really that this failure reflects not on the paradigm, but on the man – the man committed to the paradigm. Then his colleagues see him as 'the carpenter who blames his tools'. (Kuhn, 1970, p. 80). In the same way credit of the dominant paradigm goes really to its adherents. In history of science there are many instances that failed paradigm got victorious in the hand of the genius.

However, in the period of crisis there occurs a proliferation of paradigms all of which claim dominance. In this situation scientist decide for one on the basis of their personal choice and attitude. Yet some of the scientists may adhere to the old - decision behind this is again the same. Actual victory depends on the ability of the scientist adhered to the paradigm.

Subjective attitude is clearly found when scientists decide to hold on a new paradigm in the face of old. About this situation Feyerabend points out that new theory is less competent; so, if it is to succeed the only way is to resort to means other than arguments. Then irrational means are applied by the scientists. They use different means as propaganda, emotion, ad hoc hypothesis, and appeal to prejudices of all kinds. However, use of these irrational means is based on nothing but on a blind faith until they have found the auxiliary science, the facts, the arguments, turn the faith into sound knowledge. (Feyerabend, 1975, p. 154).

He says that no discovery comes with full-fledged adequacy at the start. Only in some future research through ad hoc hypotheses which opens up the possibilities, theory becomes matured. For instance, Copernicus who invites a counter induction as opposed to Ptolemy's which becomes successful for scientific progress, acted simply on faith. Galileo provides support to Copernicus by his new dynamics and new instruments, but psychological trickery, propaganda do inhere in this support. The new dynamics removes the inconsistency between the motion of the earth and the conditions affecting ourselves, and those in the air above us. But the new dynamics, by which he offers supports to Copernicus, was not adequate to follow according to scientific method. (Feyerabend, 1975, p. 103). In this way theories become clear and reasonable only after their incoherent parts have been used for a long time.

Such unreasonable, unmethodical foreplay thus turns out to be an unavoidable precondition of clarity and of empirical success. (Feyerabend, 1975, p. 27). This is how scientific research is motivated and guided by many of human attitudes.

Objectivity in Terms of Community Behavior

The above discussion follows that emergence of paradigm, period of scientific crisis, comparison between two paradigms, decision for new paradigm – all includes personal, social and community attitude. So, in what sense do we conceive of objectivity in scientific research? In what sense do we conceive of common standard in scientific decision? To find out the answer, we need understand the distinction between mature science and normal science. Thomas Kuhn distinguishes two levels of scientific knowledge: mature science and normal science. Mature science comprises of paradigm or fundamental theory, whereas normal science is those scientific activities that are guided by certain paradigm. The mature science is concerned with different paradigms whereas normal science is concerned with the activities within the paradigm. The scientists who work under a certain paradigm share the common rules, methods, techniques and concepts provided by the paradigm. However, the scientific community that adheres to the paradigm obeys the same guidelines. This situation is considered as objective situation within the community – though outside the community this is not.

The paradigm determines what aspect of nature scientists should report on, what determines about any phenomenon to be a problem, what motivates the scientists to pursue, what suggests to scientists at what point to conclude, etc. Kuhn holds that paradigm does all things for normal science. Research cannot go with confusion. Thus, paradigm provides a vision for normal science. But this vision of normal science is drastically

restricted vision. This restriction is born from confidence and obedience to the paradigm. This position of scientific community is considered as objectivity within paradigm. (Kuhn, 1970, p. 26).

In normal science, scientists perform testing, verification or falsification. These activities are objective, but objective only so long as the paradigm itself is taken for granted. Here testing is like puzzle-solving or like a chess playing. A chess player who tries out various alternative moves in search for a solution. It happens only with problem stated and the board physically and mentally before him. When a group of scientists holds common method, vision and approach suggested by a paradigm, then their conclusion, arguments, reasoning - all will be seen objective among them. But when their discussion goes beyond their paradigm then we could no objectivity could be found among them. For, every group of scientists is committed to their own paradigm; therefore, their reasoning will be relative to their paradigms. So, objectivity could be understood only within the community of scientists who are commonly committed to the same paradigm.

Scientific activity, in normal science, is puzzle-solving activity. Paradigm determines what is puzzle and when it is solved. Puzzle means the special category of problems that can serve to a way of solution. Solution of 'jigsaw-puzzle' and cross-word puzzle' resembles the problem of normal science. The really pressing problems, such as a cure for cancer, or design for a lasting peace, are often not puzzle at all; because they may not have any solution. Whereas puzzle means there must be some solution. There must also be rules that limit both the nature of acceptable solutions and the steps by which they are to be obtained. In jigsaw-puzzle all the pieces must be used, their planeside must be turned down; they must be interlocked until no holes remains. These are among the rules that given

the jigsaw-puzzle solution. Thus, paradigm is taken as guarantying the existence of solution to every puzzle generated by apparent discrepancies between it and observations (Watkins, 1965, p. 27).

Research activities in normal science, such as observing the phenomena, identifying the problem, accepting the solution, specifying the way of solution and many other activities like these are determined by a shared paradigm. The people who are committed to this paradigm feel a sort of objectivity in their works, but in reality, their activities are relative to their own paradigm.

Rationality Understood as Sentiment

To understand the subjective part of scientific knowledge, we should see the deep nature of knowledge in its basic form, that is, conception of the world. There are many such conceptions or philosophies about the world. Each presents itself as a candidate for belief. A philosophy, if to be accepted, must generate what James calls the 'sentiment of rationality'. The term 'sentiment' indicates that rationality is one kind of intellectual satisfaction. So, rationality is no more than a powerful instrument to satisfy our intellectual thirst – which may not objectively describe the reality. Any conception which influences a person to feel that it is a reasonable position to take up will be recognized as rational. If a philosophy cannot generate this sentiment of rationality, its prospects are slim. To do this it must satisfy two basic human needs: theoretical and practical. Theoretical needs are what we require to know, and practical needs are what we require to act. No philosophy can hope to generate the sentiment of rationality, if it flies in the face of these needs, if it proposes a conception of the world in which these needs would be radically and ubiquitously frustrated and denied. A philosophy, must come to terms with

whatever needs define us as knowing and acting animals. (James, 1966, p. ix)

So, William James holds that philosophy consists in giving first place not to the truth of philosophy, but to the conditions (in us) of its acceptability. The point is that we, not nature, must authorize what we think about nature. His point is that true philosophy generates sentiment of rationality, if philosophy does not generate the sentiment of rationality, they will not be accepted; in which case it would be pointless to raise the question of their truth (for, truth is no more than one kind of sentiment). So, James says 'you can say of (an idea) either that "it is useful because it is true" or that "it is true because it is useful". Both these phrases mean exactly the same thing. (James, 1966, p. x).

No philosophy can hope for acceptance if it proposes no provision for the defining capacities of human nature. One such human capacity is to believe on incomplete evidence and to act on such belief. Faith is the ability and the willingness to believe and to act where doubt is still possible. Therefore, a view of the world which makes no provision for faith will not generate the sentiment of rationality. So, philosophy refers not to nature, but to the human nature. (James, 1966, p. x). The concept of the world must squire with facts of human nature. So, humanism is primary in his view - supernaturalism is derivative and naturalism is ruled out.

The right to believe on insufficient evidence, to exercise the will to believe, was currently denied and castigated by some philosophers speaking in the name of science. They claimed that it is man's duty not to believe when the evidence is insufficient. But question of rights and duties are not scientific questions. They are ethical questions. There are, therefore, questions which must be decided by reference to the

facts not of nature, but of human nature. If the 'will to believe' is to answer the notions of rights and duties, then no veto can be placed on it by science; since it is the business of science to settle what is the case, not what ought to be the case. We do have a right to adopt a believing attitude even when the evidence is not sufficient. He the shifts centre of reference from appeal to the intellect to emotions that stir the heart which is marked out by the term 'human nature'. (James, 1966, p. xii).

This is humanism of the sentiment of rationality. Philosophical conceptions must generate the sentiment of rationality by leading us to satisfactory results. So, when you raise philosophical questions, you must consult not nature but human nature for your answer. For, James, truth (or falsity) is a property of beliefs, judgments, assertions, ideas. The question is not 'what beliefs are true?' but 'what do we say of a belief when we say that it is true?'.

James wants an answer to that question in terms of human nature. The usual answer was in terms of notion of arguments between a belief and its object: 'a belief is true' means it agrees with its object. Sometimes, it was said that a belief is true when it copies its object. But James cannot settle for 'agreeing' in the sense of 'coping', because he would be left with a necessary reference to something falling outside of believing mind. If you say that a true belief about the moon is one that agrees with moon, in the sense of 'coping' the moon, you have by implication defined the notion of truth by reference to something what falls outside the self. James retains the notion of 'agree with' but uses it in the sense in which we say 'milk agrees with me'. So, a true idea is one which in the final analysis 'agrees with' the mind which holds it.

To say that a belief is true is to say that it enables the mind to work properly as a knowing and acting being. So, a true belief is one upon which the mind can act satisfactorily. Thus, the facts by reference of which the answer is given to the question, 'what is truth', falls within the human mind. It is mind where ideas lie, and where their successful working occurs. (James, 1966, pp. xiii-xiv).

Conceptual Influence on Scientific Knowledge

We will find the same approach in scientific discoveries. New theories are accepted as true when it works successfully in solving the problems. For, Laudan science is essentially a 'problem-solving' activity. Aim of scientific research is solving the problems and nothing else. But solution of the problem does not necessarily mean the achievement of truth. For, scientists work on problems, but problems are not purely objective; rather problems arise when scientists experience or feel the tension between thought and the world. Problem and its solution both are constructed within a 'research tradition'. Theoretical orientation of the research tradition presses a scientist to see the things in a certain way. Accordingly, he may feel some sort of discomfort to organize his previous ideas about the world. This discomfort of a scientist's mind is considered as problem. When a 'research tradition' suggests to the scientist in a certain comfortable way to perceive the phenomena, then he declares his comfort as solution. Laudan says that anything about the natural world that strikes us as odd or otherwise in need of explanation consists an empirical problem. (Laudan, 1978, p. 15).

No problem is problem until a scientist feels it as a problem. So, empirical problem cannot be deemed to be purely objective problems, because empirical problems are themselves theory-oriented. Unless our theoretical framework indicates

any phenomenon as a problem, the phenomenon remains unproblematic. Empirical problem is empirical in the sense that it is about the world. Otherwise it originates only in the human mind, when he encounters the world in a certain way. This is why fall of apple was a simple event to us but was a great and important problem to Newton.

Problems are different from facts and solving a problem cannot be reduced into explaining a fact. For Laudan, a problem need not accurately describe a real state of affairs. All that is required is that it would be thought to be an actual state of affairs by some agent. There are many facts about the world which cannot pose empirical problems simply because they are unknown. Even many known facts do not necessarily constitute empirical problems. To regard something as an empirical problem, we must feel that there is a premium of solving it. In the history of science, many things are well-known phenomena, but have not been felt to be in need of explanation or clarification. It was known since the earliest time, for instance, that most trees have green leaves. But such a fact becomes an empirical problem only when someone decided that it is sufficiently interesting, important and deserving explanation. Therefore, problem which was once recognized may cease to be a problem at all latter on. For instance, the staggering problem 'how the earth took its shape' within the last 6,000 to 8,000 years remained no longer a problem to be solved. (Laudan, 1978, pp. 48-50).

There are many kinds of scientific problems: conceptual problem, intra-scientific problem, normative problem, and worldview problem – these are the problems science aims at solving. Scientific advancement means the solutions of these problems. But these are problems only when they are felt as problem by scientist who is a human being.

One of the richest and healthiest dimensions of science is that science grows through time. The standards by which something is counted as solution change with time. What one generation of scientists accepts as a perfectly adequate solution may often be viewed by the next generation as a hopelessly inadequate. This variation occurs also from epoch to epoch. In physics, Aristotle cites the problem of fall as a central phenomenon for any theory of terrestrial mechanics. Aristotle himself sought to understand both 'why bodies fall downwards' and 'why they accelerate in fall'. Aristotelian physics provides answer to these questions, which were taken seriously for over two millennia. For Galileo, Descartes, Huygens and Newton, Aristotle's view was not really a solution to the problem of fall at all, for they failed utterly to explain the uniform character of the fall of a body (Laudan, 1978, p. 25). So, solution is always a solution of the time.

We may have two different theories that claim to have solved the same problem, and yet we can say that one is better solution than the other. For instance, philosophers of science have been very troubled by the relationship of Galileo and Newton's theories of fall and the data thereof - they were unable to say whether both theories explained the phenomenon of fall. It is surely more natural historically and more sensible conceptually to say that both theories solved the problem of free fall - one perhaps with more precision than the other. It redounds to the credit of both that each provided an adequate solution to the problem of fall. (Laudan, 1978, p. 24). Two different theories become scientific due to their ability to solve the problem, though in different ways – no matter the solution is true or false. So, problem and solution in science are humane.

Objectivity as Problem-solving Effectiveness

Since the aim of science is problem-solving, scientific research means to create problems and to propose solutions. Though both acts are humane, yet the objectivity in these acts is believed when the solution becomes sufficiently effective. It is human nature to consider anything as objective if it shows effectiveness in solving the empirical problems. But effectiveness does not necessarily mean 'objective'. This point is established in Laudan's view of research tradition. In his view there are two types of theories in science: specific theory and grand theory. Specific theory connects the empirical problems, whereas the grand theory embodies huge conceptual divergence, it is the primary tools for understanding, which Laudan calls scientific research tradition. Research tradition provides guidelines part of which constitutes ontology. So, way to feel problem and way to understand solution – all are the potential suggestions of research tradition.

However, such a research tradition may be enormously successful in generating fruitful (specific) theories and yet flawed in its ontology and methodology. Equally a research tradition might be true, and yet unsuccessful at generating theories that were effective problem-solvers. Thus, when we reject a research tradition, we are just making a tentative decision not to utilize it for the moment because there is an alternative to it that has proven to be a more successful problem solver. So, this decision is based not on objectivity but on effectiveness. However, there are many instances in the history of science that the successful theories have become highly suspect, which may suggest that logic rather than success is the final arbiter of the theories. In other words, historians of science see that such theories – though they show success – are linked to an unsuccessful research tradition, and vice-versa. Rumfort's theory of heat conduction and

convection was far superior to any alternative theories of thermal flow in fields available in the period from 1800 to 1815. Nonetheless, few scientists took Rumfort's theory seriously because the research tradition in which he worked had been discarded by the emergence of a rival research tradition. (Laudan, 1978, p. 83).

So, research traditions should not be judged in terms of truth or falsity. For, research traditions are historical creations. Since they are created for solving the problems, they have merits or demerits with regard to that purpose. Research traditions are articulated in a particular intellectual milieu, and like all other historical institutions they wax and wane. Just as surely as they are born and thrive, so they die and cease (Laudan, 1978, p. 96). So, their life is like the life of man. They are part of human life.

For Toulmin, scientific judgment may not be subjective, yet it recognizes the full 'relativity' of its concepts and standards of evaluation accepted as if authoritative for the time being in different milieus. The actual issues of science may be authentically factual, but scientists in different periods with different backgrounds may deal them in their own different ways. This diversity is confined not only to historical epochs or national styles, but we may find differences between the research centers and schools, even in the same country at the same time. There are Cambridge geneticists and Edinburg geneticists, Columbian operant psychologists and Harvard operant psychologists, etc. There may well be substantial differences between the explanatory goals of different men working in the same discipline. (Toulmin, 1972, pp. 246-250).

Human intellectual position determines scientific problems and its style of solution. Therefore, we find the same object which produces different problems to different scientists. The

same type of object will fall within the several different sciences depending on what questions are raised about it. The behavior of muscle fiber, for instance, can fall within the domains of biochemistry, electro psychology, pathology, and thermodynamics; since questions about it can be asked from all the four points of view. (Toulmin, 1972, p. 518).

So, in what way a problem is raised in scientist's mind. Toulmin says that a problem is a situation where our current scientific ideas fall short of our intellectual ideals. Problems are recognized locating and specifying the intellectual gap between our current capacities and the explanatory ambitions defined by the scientific community about natural order. In short,

Scientific problems = Explanatory Ideals – current capacities

Consequently, solution means to arrive at the goals defined by those ideals. Thus, scientific problems and explanatory ideals are very closely related to human imaginative mind. (Toulmin, 1972, p. 150). Fall of apple is observed by many people, but it had been a scientific problem to Newton when his imaginative mind defines some explanatory ideals relating to this phenomenon.

So, problem is the gap between current capacities and ideals, whereas solution is equilibrium between them. Such kind of equilibrium could be achieved through an evolutionary process. It has a directional tendency – called orthogenesis – which works not only in biology but also in epistemic development. Orthogenesis is a press between epistemic subject and epistemic object, and there is an evolution in their relation. So, the equilibrium between them is not 'absolute', but 'pleasing' to the mind. When human mind becomes pleased with the point of equilibrium, he feels to have achieved the reality. Reality is the 'sense of reality'.

Hermeneutic Consciousness

To understand human attitude in scientific knowledge, it is significance for us to understand hermeneutic dimension of thinking. In hermeneutics, understanding is no more than interpretation. However, this is a necessary condition of human thinking – no matter scientific or non-scientific. The essential reason of this insight is clearly stated in Friedrich Schleiermacher's view of human understanding. For him, 'all understanding consists of the two moments: understanding the utterance as derived from language, and fact in the thinker.' (Schleiermacher, 1998, p. 8) In other words, understanding entails two things: language and thinker. There can be no understanding without thinker and without words no one can think.

However, both factors - language and thinker - are unlimited. As for language or concept, its meaning is not just a concrete and finite totality in itself, rather its meaning is related to so many factors of and in so many ways with earlier concepts that we cannot imagine. The concepts that we have from the philosophy of Heidegger for instance, have long and wide range of related concepts. Therefore, it is not possible to understand Martin Heidegger if one fails to reckon with the two-thousand-years' history of the West. (Abulad, 2007, p. 16). So, every concept by which we build our present understanding has long historical legacy. What kind of influence we get from any particular part of the line of legacy is impossible to be determined. Different background knowledge constitutes different present knowledge. This kind of relativity applies also to scientific knowledge. What could be for physics if there would not have been Newton in 17th century? This legacy also has an essential influence on thinker's psychology, which leads

to a sort of subjectivity. An individual thinker is not just a limited entity within himself free from influence of time; rather his context is wider than the individual and extends to a whole society, even an entire epoch. So, scientist thinks according to his background conceptions about the world.

Another important insight about hermeneutic consciousness is found in Hans-Georg Gadamer's idea of *fusion of horizons*. This concept is based on the idea of intentionality as presented by Husserl. According to this idea, consciousness is always consciousness-of-something. In the past, we used to think of subject-object dichotomy. That is, an object exists there neutrally, where a subject has an active role to know it in its reality. This dichotomy implies that subject and object are independent to each other – they have independent existence of their own. But the idea of intentionality denies such a claim. According to this idea, there is no subject (thinker) without the object (thought of object), and there is no object without the subject. Subject and object are inevitably linked, so that one cannot be there without other. This relational context can be broken only through cessation of knowing activity- as the relation between text and reader could be broken only through cessation of reading activity. A text is text only to a reader; one is a reader only if a text is being read. There is an I-Thou relationship in any act of understanding (including scientific understanding about nature). (Abulad, 2007, p. 18).

Moreover, in the collision of I and Thou there occur a *fusion of horizons*. A reader is not a *tabula rasa* – not a 'pure or presuppositionless consciousness,' as Husserl thinks. This hermeneutic dimension includes scientific thought also. Scientist and the world are not independent from each other. A

scientist possesses many preconceptions about nature, and thereby he seeks to understand the world. When a scientist interact with the concrete state of nature, then both of them – scientist and nature – get influenced by each other. World is like what is understood by scientist through his available concepts; and scientist's thought is what he gets from the world. So, there is fusion between data of the world and concepts of the scientist; this fusion produces a third position. What occurs in scientific knowledge is that every encounter of scientist with the world takes place within a historical consciousness. This encounter involves the experience of a tension between scientist and world previously constructed. This kind of understanding about the world is 'historically affected consciousness' (Gadamer, 1998, p. 306); consciousness whose quality is history, better yet historicity, not simplistic being what it is once for all, but it is an evolved and evolving consciousness.

Therefore, scientific knowledge is neither just a creation of scientist's mind nor a real state of the world; rather it is subjective understanding of objective world.

Conclusion

In the philosophical position discussed above objectivity is understood in different terms, such as falsifiability of theory, common community behavior in shared paradigm, satisfactoriness to intellectual thirst, effectiveness for problem solving or equilibrium between thought and nature. It implies that scientific knowledge is relative to human condition – the condition may be psychological, historical, ideological or conceptual. A deep subjective mode of scientist is essentially involved in science in its nature. Moreover, the world as object and the scientist as subject both are infinitely complex. So,

there is possibility to construct infinite number of different views about the world – not objectively one.

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