Abstract

Scientific progress is a fact of history. The instances of this fact can be traced from Ptolemy to Copernicus, Newton to Einstein, Wave theory of light to Corpuscular theory. Priestley to Lavoisier, etc. However, the fact of scientific progress entails an enquiry into the pattern of scientific progress which pattern further necessitates an examination of the position of truth in the onward march of history of science. For, understanding of the position of truth follows from the understanding of pattern of progress. The present topic: ‘Scientific Progress and the Problem of Realism’ is an attempt to understand the pattern of scientific progress and the status of truth in the changing scientific or theoretical discourse. However, the pattern of progress depends on the nature of theories. In other words, nature of theories indicates the pattern of progress and, in its turn, the pattern of progress indicates the position of truth in it.

Accordingly, the research embodied in this thesis is carried out on the views of five considerably different philosophers of science: Karl R. Popper, Thomas S. Kuhn, Imre Lakatos, Larry Laudan and Stephen Toulmin. The present work is comprised of the following eight chapters:

1. Introduction
2. Understanding Theory and Theory-change
3. The Aim of Progress and the Falsifiable Hypothesis.
4. The Status of Progress in Paradigm-shift
5. The Research Programme and the Pattern of Progress
6. The Research Tradition and the Character of Progress
7. The Structure of Progress in Evolutionary Change.
8. Critical Evaluation
In chapter-1, **Introduction**, we have tried to show how ‘truth’ problematises scientific progress. Though science is usually deemed to be objective, it possesses, especially at its fundamental level, the human elements also. The historical study of scientific activities reveals a different picture of science than that of its popular and widely prevalent conception.

In the second chapter, **Understanding Theory and Theory-Change**, we have discussed some elementary ideas about the nature of scientific theories and the different forms of scientific change. Here we have firstly dealt with the relation of truth to theory. A theory may be formulated with the aim of describing the natural world or predicting the future phenomena, or explaining natural facts and solving the problems arising thereof, etc. In this regard, there are two approaches to scientific theories: realism and anti-realism. According to realism the world is real and scientific theories have the capacity to exactly pinpoint its reality. In view of the same, different versions of realism have been brought out in this chapter to see the position of truth in scientific theories. On the other hand, various versions of anti-realism outlined in this chapter, hold that scientific theories do not aim at truth, but are rather conventions or fictions about nature. In essence they are instruments for predicting natural phenomena. Secondly, in this chapter, we have pointed out that there is a gulf between scientific rules and methods and the actual practice of science. Here the actual or historical way of doing science has convinced us that there does not exist any fact-independent theory or any such logic which necessarily culminates into a theory. This is a crucial finding about scientific theories entailing a foundational methodological shift. Thirdly, we have attempted to point out different terms and conditions of scientific progress. If $T_2$ better explains the phenomena than $T_1$, then it can be considered as progress. But there are instances of such revolutionary changes in the history of science when it is very difficult to understand as to whether the rejection of $T_1$ by $T_2$ is really progress or not. However, some elementary ideas of progress have been outlined in this chapter.
The third chapter of this thesis is titled **The Aim of Progress and the Falsifiable Hypothesis.** In this chapter, we try to understand ‘Scientific progress and the problem of realism’ on the basis of Popper’s falsificationist view of scientific change. The core of Popper’s view of scientific change is that a scientific theory is no more than a falsifiable hypothesis. Many hypotheses are fielded in astronomy, physics or geology, or for that matter in sociology, economics, or political science. But only those hypotheses can be deemed to be scientific theories which are falsifiable. For Popper such a hypothesis can be produced from any source such as mythology, metaphysics, religion or folklore etc. If such a hypothesis is falsifiable, it is scientific.

In Popper’s view, science can make progress through such hypotheses, by recourse to the method of ‘trial and error’. Scientists put their hypothesis on trial and if any error is found out thereof, the theory is refuted. Thereafter, the scientists do conjecture up another hypothesis. His book ‘Conjectures and Refutations’ is addressed to expound this method. A competing hypothesis or \( H_2 \) proposes a crucial experiment to refute the earlier theory \( H_1 \). However, the falsifying hypothesis i.e. \( H_2 \) which refutes the falsifiable hypothesis, i.e. \( H_1 \), is deemed to be of greater relevance in the ongoing scientific inquiry. In this process of falsification science makes progress. For Popper, such a progress aims at truth. Through falsification we reduce falsity from science: and reduction of falsity logically means an increase in the truth-content. So every step of falsification entails that we are proceeding towards truth. Popper says that falsification is a ceaseless process. In this process, we do not know when, where and how we arrive at the truth. However, what is assured is that our search is directed at the truth. Even if some steps sometimes go wrong, our direction towards the truth remains unchanging.

In the fourth chapter, **The Status of Progress in Paradigm-shift**, we have discussed Kuhn’s view of scientific change. For Kuhn, a fundamental scientific theory is no more than a paradigm. A paradigm is the construct of a scientist’s imaginative mind. A paradigm is a grand theory which is first
accepted by a scientific community and then every scientific activity of that community is determined by the accepted paradigm. Thus a paradigm is a closed framework whose change brings a total change in science. Theory$_2$ becomes acceptable on the rejection of Theory$_1$. Such a kind of radical change is christened as scientific revolution by Kuhn. For him, a revolution is just a replacement of one theory by another. So, in this transition, there is no increase of knowledge, it is only a shift of the outlook. Paradigms are incommensurable. So, the question of understanding progress through paradigm-shift does not arise at all.

However, the efficacy of a paradigm depends on its followers. Kuhn exemplifies this with the tools of a carpenter. The tools may work well if a carpenter is skillful. Paradigms are, likewise, tools in scientists’ hands by which they solve the puzzles about the natural world. It indicates that a paradigm does not aim at truth, rather it addresses itself to solving of scientific puzzles.

In the fifth chapter, The Research Programme and the Pattern of Progress, we have taken up ‘research programme’ view of science advocated by Lakatos. The phrase ‘research programme’ indicates that fundamental scientific products are not isolated theories, but rather a series of theories which Lakatos calls a ‘research programme’. This view is different from that of Kuhn and Popper. For Kuhn, there occurs a revolution and as a result the earlier theory is rejected. Popper holds that with falsifying hypothesis the earlier hypothesis is refuted and rejected. But Lakatos holds that there is no such instant rejection of the old theory. Every theory has its ‘relative autonomy’. A crucial experiment may declare anomalies of a theory, but the theory may not be rejected by the scientists. For Lakatos, auxiliary hypotheses make a protective belt which prevent the refutation of the core hypothesis. It is further strengthened by the heuristic power of a ‘research programme’. So, scientific change occurs not in the form of an instant revolution. It is rather a slow process. For Lakatos, the ‘degenerating problem-shift’ of the earlier theory and
'progressive problem-shift' of the later theory, constitute the real reason of or
ground for scientific change. However, in this view, a theory may discover
facts, but those facts are oriented under the influence of a particular 'research
programme'. So, increase in discovering of facts does not necessarily mean the
increase of truth-content.

In the sixth chapter, The Research Tradition and the Character of
Progress, we have deliberated upon research tradition view of scientific
change. The phrase 'research tradition' indicates that our discussion is based
here on Laudan's view that fundamental scientific theories are no more than
'research traditions' which determine all our scientific activities including all
the problems, even if they be metaphysical or worldview problems. According
to Laudan, since science is a problem-oriented enterprise, scientific change
occurs on the basis of 'problem-solving-effectiveness' of the traditions. A
research tradition with greater 'problem-solving effectiveness' supersedes that
tradition which is of less 'problem-solving-effectiveness'. So, it is an obvious
progress of science. But this progress is not committed to realism. For, a theory
aims at 'problem-solving', not at truth; a research tradition is evolved for the
purpose of solving the problems. In this regard, Laudan holds that the solution
of the problems does not necessarily mean attainment of truth. A solution is a
solution of our problem which is totally a human product.

In the seventh chapter, The Structure of Progress in Evolutionary
Change, we have worked out Toulmin's view that a theory-change is like an
evolutionary change. Every theory is an organism and scientific discipline is a
species. Every theory endeavours to survive in the intellectual environment. In
evolutionary change, a theory changes in terms of development from lesser to
greater perfection. So, there is a continuity in science – the new theory emerges
out of the old. This kind of change is an obvious progress. The goal of this
progress is not transcendental truth, but rather the truth that is conceived of in
the process of evolution of concepts. This progress is directed at the intellectual
ideals which are again changeable in the course of conceptual evolution.
In the eighth chapter, Critical Evaluation, we have made a critical evaluation and found that the ideas of science developed through the discussion of different views of five philosophers are quite unlike the traditional view of science. According to the traditional view of science, scientific theories are produced out of inductive generalizations. A hypothesis is formulated to account for the observed facts. From this general hypothesis we deduce a particular conclusion which is then tested through a crucial experiment. In this view, scientists are seen as piling up facts, generalizing them into laws, and again piling up more facts step by step in the laboratory. If you can infer the laws from the accumulated facts, you can deduce the facts again from the laws, and the content of the laws is nothing but the facts. For traditional view of science, science ultimately aims at discovering the truth. Successive generations of scientists have filled in more and more parts of the complete true story of the world. This is a cumulative process of progress.

Our present study of the five philosophers of science leads us to doubt the traditional concept of scientific progress. Firstly, the new ideas oppose the concept of cumulative progress. Popper, Kuhn, Laudan and Toulmin all recognize the phenomenon of scientific revolution. Revolution, as opposed to accumulation, rejects the past achievements, and thus does not add to the piling up of facts. Secondly, scientific progress does not occur methodically, especially not in the way of inductive method. In Modern Physics, theories like quantum theory, relativity theory, theory of subatomic particles etc. are not formulated by way of inductive generalization. They are created by scientist's imaginative mind. History of actual science reveals that science makes progress through the violation of the prevailing methods. If scientists obeyed the absolutistic mechanism of Newton, they could not have had the relativistic one of Einstein.

Another important part of scientific method is crucial experiment. As opposed to traditional concept of theory-change, our present understanding is that a crucial experiment cannot be decisive with regard to the acceptance or
rejection of a theory. There are several historical examples to support the contention that theories were not given up by the scientists despite the fact that crucial experiments brought out their anomalous character. The so-called facts are given to us in the light of our theoretical orientation. This is so mainly because observational facts on the basis of which an experiment is undertaken have lost their objective status. The theory-ladenness of facts leads us to the incommensurability of theories. As a result, we are not in a position to make a rational or methodical judgment on theory-change.

For the same reason, it is difficult to accept a realistic account of scientific change. Unlike scientific realism, it is quite untenable to maintain that the unobservable entities that theoretical terms indicate do exist. Many such theories were proved false and rejected by scientists. Even the most lenient version of realism asserting that science at least aims at truth though not achieving it, is also difficult to maintain in view of Kuhn's discovery of socio-psychical elements in scientific activity. For him and others like Laudan, Lakatos and Toulmin, scientific theories are but instruments for predicting the natural phenomena or for solving the problems experienced by us. And therefore, better theory means a better instrument. Realism, on the other hand, maintains that a better theory leads us to better description of the world.

From the discussion of different views of different philosophers we have concluded firstly that scientific progress is negotiated through the actual science of the past. Kuhn may not recognize 'better' theory, but his 'dominant' paradigm means some progress registered by the scientific community. He calls it sociological progress. Secondly, we see that in no version of scientific progress, are we bestowed with truth as such. Popper may show that reduction of falsity logically means progress towards truth. But until we understand the truth itself, it does not mean much. In falsification we can only know as to what is not true without knowing as to what is true. Thirdly, we see that scientific theories are the constructs of imaginative human minds. This account of science is radically unlike the popular conception of science, which maintains
that scientific theories are discovered by some sacred methods. This study helps us to realize that it is not scientific method, which guides men, but it is men who guide scientific research. i.e., scientific research is guided according to human thought. Fourthly, we see that scientific theories are not ideology-free. Kuhn’s ‘paradigm’, Popper’s ‘falsifiable hypotheses’, Lakatos’s ‘research programme’, Laudan’s ‘research tradition’ and Toulmin’s ‘intellectual ideals’ – all are but ideologies of scientific research. So, scientific theories are ideologically loaded constructs, not detached and neutral discoveries by rational calculations. Fifthly, we see that scientific progress occurs regardless of everything. Science dictates its won ways of change and progress. Standards of appraisal, logic of discovery; nothing is strictly obeyed by science in its onward march. Finally, when the theory changes, thereafter methodologists think over as to why and how the change has occurred. This postdictory thinking indicates that there is freedom in scientific research also.