UNIT 3 HISTORICAL REALISM

Contents

3.0 OBJECTIVES

Some philosophers of science in the later decades of the 20th century made attempts to envisage a picture of science and philosophy of science, which would be more comprehensive, by avoiding the extremes of both Logical Positivism and Historicism. They pay due importance to the historical, social and non-rational aspects of science, while maintaining the rational character and a sort of realistic picture of science intact. These postpositivist thinkers can be categorized as Historical Realist Philosophers of Science. This lesson seeks to familiarize the students with some of the salient contributions of some of the philosophers of science belonging to the school of Historical Realism.

3.1 INTRODUCTION

Some historians like, R. G. Collingwood, for whom "perception and history are identical" (1924, 204), argue for a realistic view of history. They tend to take 'history' as the exact description of what happened in the past. But there are strong reactions against this view; history necessarily involves interpretation of what, how and why something happened. It is never a clear description of the past as it all depends on who writes history. Critiques like Goldstein argue that historians cannot be taken to be as 'constituting history' (1976). In philosophy of science also the role of history cannot be exaggerated, as history of science is not a real description of what happened in the past. Historical Realism, the contemporary dominant school of philosophy of science, is said to be a mid-way position between Logical Positivism (LP) and Historicism, in viewing the role of history of science in envisaging science. The historical realists argue that both made the mistake of going to the extremes: LP absolutized science, while Historicism went to the other extreme of relativizing science and rendering it almost irrational. So the historical realists as opposed to Logical Positivism say everything in science is changeable, as nothing is final and absolute; however, against historicists, they show that these changes take place in a rational and responsible manner, and therefore 'anything' cannot go in science. They understand rationality in science in a non-traditional way and new criteria for rationality emerge from the scientific community. All these go to show the compulsory need and relevance of history of science to do philosophy of science.

We discuss some of the contributions of three philosophers of science of this school: Lakatos, Laudan and Shapere.

3.2 IMRE LAKATOS (1924-74): ENRICHING POPPER AND KUHN

Lakatos, born in Hungary in 1922, lived in a very disturbed times of the World War II. Though his mother and grandmother were murdered, he could escape. Pursuing a political career, by 1947, he became a powerful figure with the Hungarian Ministry of Education. He was nevertheless imprisoned in 1950; later he escaped to Vienna in 1956; thence to Cambridge, where he worked for his second doctorate under R.B. Braithwaite. Attracted by Popper's ideas he regularly attended his lectures. Lakatos' famous work, *Proofs and Refutations,* a collection of his articles in philosophy of mathematics, posthumously published in 1976. He challenges LP's claim of sharp distinction between *the context of discovery* and *the context of justification.* He started teaching in England. The government did not grant him citizenship, and so he remained technically 'stateless'. In 1974 he had a sudden death of heart attack.

Scientific Research Program (*SRP*)

Science is made up of many *Research Programs*, involving a series of theories. Scientific revolution consists in one research program superseding, not necessarily rejecting, the previous one. There are series of theories which are related to one other like $T_{1,}$ $T_{2,}$ T_3, T_4.... T_n, where each being an improvement upon the preceding one. Example: *Research Program of Copernican system.* In 1543, Copernicus gave us the theory of heliocentrism. Though it was rather crude, the basic idea of having the stationary sun at the center was correct. But other aspects like epicycles, circular orbits of the planets were not correct; let this be COP_1; Then came Kepler, who removed the epicycles and replaced the circular orbits with the elliptical ones; but Kepler could not say why planets move in ellipses; this we call $COP_{2.}$ Then Hookes explained the elliptical path with centrifugal force and this can be COP_3. Newton, with his mathematical maneuver, made it still better and let this be COP_4. Laplace made the theory even better, by explaining scientifically the stability of the solar system, which Newton could not do; in fact, he postulated a plumbing God. Laplace's theory can be COP_5. Thus the Copernican system reached its betterment with the contributions of many, each one improving the previous one. Science must be assessed in terms of such *SRP*, not of individual theories (Popper and logical positivists hold that a theory or a law is the basic unit of inquiry in science). *SRP* is much more comprehensive than a theory. (e.g. Instead of looking at individual kings, like *Karikalan, Raja Raja Cholan*, etc. of the *Chola* period of the ancient South India, we must take the whole of *Chola* period as one unit).

Two Parts of a *SRP*: i) *Negative Heuristic or Hardcore* - Every *SRP* has a core part, giving the very identity of the programme. It is the metaphysical presuppositions of the programme. Individual theories may be rejected but as long as the hard core is kept intact and the programme keeps going. It is the non-negotiable part that cannot be compromised or changed. It is forbidden to modify or reject it; since it forbids any change it is called negative heuristic. (Examples for the hardcore: Sun-centredness in the Copernican system; the mechanical view of the world in the Newtonian system). ii) *Positive Heuristic or Protective Belt* -

Positive heuristic is the changeable part of the *SRP* that protects the hardcore from being challenged. It allows changes to keep the hardcore intact. It consists of partially articulated sets of suggestions. It specifies the directions in which the research must proceed. It directs us how to take care of the anomalies and modify the research program. It also contains metaphysical principles. (E.g. Orbits of the planets, either elliptical or circular in the Copernican System).

Evaluation of a *SRP*: It is evaluated in terms of the nature of the problemshift. It is *progressive* if it is able to explain all the problems of the facts of the previous programme and to predict new facts. It is perfectly rational to pursue the new programme even if any one of the conditions is met with. A progressive research program is *theoretically progressive* if every successive theory has some excess empirical content and more predictive power than its predecessor and it is *empirically progre*ssive if some of its excessive empirical content is corroborated. Thus *SRP* seems to give a rational picture of science because at least some of the predictions must be established. A progressive research program is one, which is both theoretically and empirically progressive. A problemshift is *scientific* if it is at least theoretically progressive, and if not, it will be *pseudoscientific*. (Thus he does away with the falsification criterion to demarcate science from non-science). A *Degenerating* programme would be not only not giving new facts but also not explaining those of the previous programme. So it is not progressive both theoretically or empirically.

Rejection of a *SRP*: *SRP* is never rejected in haste even if it is degenerating and it is only shelved aside. According to LP, if a theory cannot be verified (for Popper, if not falsified!), it has to be thrown away. But Lakatos argues that we can know whether a research program is degenerating only by hindsight. For example, Newton initiated the particle theory of light. As a genius, he also knew the wave theory but he realized that the wave theory was not tenable for light. But by the crucial experiment conducted by Fizzau and Foucoult the particle theory was rejected. Einstein resurrected it. Hence it is rational to work on degenerative problems instead of rejecting it outright.

Proliferation of *SRP*: There is no possibility of inductively confirming a theory. There are lots of problems in induction philosophically, though it works in actual practice. The hardcore of a research program is may be false. We can know whether it is true or false only by inductively conforming. But since induction has problems, no amount of testing theories of research program can guarantee the validity of theory. It is irrational to assume that any particular research program is true for ever. So the truth of a research program cannot be absolutely guaranteed. If truth can be guaranteed, then it is enough to have only one research program. If not, then it is good to have many research programs and by comparing them accept what is better. We can only talk of comparative superiority not of absolute superiority of *SRP*.

Lakatos, Kuhn and Popper

Lakatos aims at a sort of a synthesis of Popper and Kuhn, as though grafting the revolutionary ideas of Kuhn on the Popperian tree; Popper gives him, so to say, the frame work and Kuhn gives him the contents. Going along with Kuhn, he saw that the basic unit of analysis in science must be much broader than a single theory. Lakatos' *SRP* is very similar to Kuhn's paradigm but Lakatos demands many *SRP*s at a given time. Paradigm, for Kuhn, gives the worldview but for

Lakatos, *SRP* does not give any worldview. Kuhn's normal science period has a dogmatic nature; the scientists in it cannot easily challenge the paradigm and try to absorb the anomalies into the existing system. But *SRP* rules out such dogmatism, as Lakatos combines it with the Popperian attitude of dropping a degenerating *SRP*, 'under certain objectively defined conditions'. Thus, the continuity in science in Kuhn's scheme is 'socio-psychological', while in Lakatos' framework it is 'normative' (Lakatos, 1978, 90). Further, he finds Kuhn's account of theory change (adoption of a new paradigm) to be not rational; further, it fails to distinguish actual science from pseudo science. But Lakatos, with the notions of 'progressive' or 'degenerating' problemshift, tries to make the Kuhnian account more rational, which would also demarcate science from non-science.

Lakatos called himself a disciple of Popper. In many ways he followed Popper; for instance, like Popper, he also argued for proliferation of theories and comparative superiority of theories. However, though Lakatos began as a popperian, slowly he moved on to critique Popper's views. His paper "Changes in the Problem of Inductive Logic' (1968) was actually a defence of Popper's view of inductive logic, while "Popper on Demarcation and Induction" (1974) was a serious critique of Popper's solution of Hume's problem. Popper and Logical Positivists saw an unbridgeable gap between the 'context of justification' and the 'context of discovery'. They all insisted that science and logic must be concerned only with the context of justification not with the context of discovery. Disagreeing with this, Lakatos proposes a new concept of philosophy of science, which dilutes any such distinction.

The unit of inquiry for Lakatos is not a theory but a *SRP*. Popper rejected a theory if it was not falsifiable, but Lakatos is not for any hasty rejection of *SRP*. Popper's falsification was proved to be untenable, as Duhem-Quine showed that any theory could survive falsification with ad-hoc modifications. Lakatos proposes a modified falsification: A theory can be considered falsified only when an alternative theory is proposed with the following features: the new theory has *more empirical content* than the falsified one; it is able to *predict more novel facts*, which were improbable or even forbidden by the first theory; it *solves all the problems solved by the previous theory*; and it has *more content that is corroborated* (1970, 116). Therefore, unlike Popper, Lakatos argues that a theory cannot be dropped even if it is falsified, unless there is an alternative theory is available. A theory can be dropped, as pointed out above, only when the whole of *SRP*, of which it is a component, becomes degenerative and gets rejected as a whole *SRP*.

Remarks:

i) Lakatos succeeds to a certain extent in integrating Kuhn's ideas of Science as a social enterprise with the Popper's normative methodology. Like Kuhn, Lakatos is convinced that science is always guided by a theoretical framework. But he makes his *SRP* normative, as Popper makes falsification.

ii) In the framework of *SRP*, a theory becomes a better theory by superseding the previous one. With this move towards betterment, Lakatos carefully avoids the issue of truth and verisimilitude of Popper's ideas.

iii) By making problemshift as the criterion for the demarcation of science and pseudoscience, Lakatos is not drawing a strict line between scientific and non-scientific theories, but he recommends a certain methodology, by which, one has to construct theoretically progressive problemshifts, and avoid going in for degenerating ones.

iv) Lakatos gives due importance to historical dimensions of philosophy of science. A methodology must study both successful and not-so successful episodes of history of science and look for influence of the 'external factors' (e.g. political or religious interference) in science. History of science is very essential to do a proper philosophy of science because, as he rightly declares: "Philosophy of science without history of science is empty; history of science without philosophy of science is blind" (Lakatos, 1971, 91).

v) *SRP* is better described as a theory of historiography, rather than a 'methodology of research programme'. For, it does not give us strict rules of practice; it is not very clear as to when to abandon a *SRP*. Critics have pointed out that if a methodology has not given instructions about the choice from competing research programmes, it is not really a methodology. Lakatos seems to give only a 'framework' or 'theory of historical appraisal' and not any 'scientific and practical methodology'.

v) Musgrave argues that 'hardcore' of *SRP* is not historically correct and methodologically effective; for example, the scientists before 1850 did not treat Newtonian gravitation law as a part of hardcore. The elements in the hard-core are also not refutable, but treated as the fundamental theoretical postulates or axioms of a theory. It is a sort of a convention amidst the scientists that makes them hold onto hard-core in spite of anomalies (Musgrave, 1978, 110). The role of the individual scientists is minimized, while the significance of convention is stressed more. Further, Lakatos does not elaborate how certain hypotheses are to be chosen for 'hardcore' category.

vi) Edwin Hung (1997, 403) and other critics point out: Lakatos insists that in a progressive *SRP* the successive theories must have more 'empirical content', but this is a vague concept, as in many of the cases, it is not possible to ascertain this. Also, he claims that the latter theory must have more explanatory power than the previous one, but he has not given a clear notion of explanation, say, whether it is a contextual or causal or edificatory theories of explanation. Finally, if Lakatos distances himself from the question of truth or nearness to truth (Popper's verisimilitude), why are the scientists expected to choose the progressive programmes and what would be the criterion to choose one programme from the other?

Check Your Progress I

Note: Use the space provided for your answers.

1) What is a *SRP* in Lakatos' scheme? What is its significance in understanding science? How is it evaluated?

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2) Compare and Contrast Lakatos' *SRP* with Kuhn's Paradigm.

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3.3 DUDLEY SHAPERE: TRANSCENDING CLASSICAL EMPIRICISM AND RATIONALISM

Shapere, one of the leading philosophers of science of our times, had his doctoral studies at Harvard and worked at several prestigious institutes. His famous works include *Galileo: A Philosophical Study* (1974) and *Reason and the Search for Knowledge – Investigations in the Philosophy of Science* (1984). He critiques both logical positivist and the post-positivist philosophies of science to arrive at a balanced understanding of science. He has taken it up as his life-vocation to delve into the philosophical foundations of science. He is known for his innumerable, even complicated, case studies from history of science to substantiate his position. He has taken philosophy of science as his life-mission. About the project of his recent works, *The Rational Dynamics of Inquiry* and *The Values of Knowledge*, he mentioned to me in a personal interview on 6th October, 2006, at his residence, in North Carolina, USA, "I mainly do it [writing the books] for myself; it clears up what I am".

Shapere's important ideas like methodology, observation, meaning and incommensurability in science, the notions of domain and goal success, the absence of specific doubt in science, the role of 'the given' in experiments, the need to learn how to learn etc. – all seem to be a well-connected web, as though they are different nodes in a fishing net. However this section discusses only two main contributions: the notion of observation and contingent interactional empiricism.

Observation as a "Concept Schema"

To understand the contemporary sophisticated science, Shapere argues, it is better that one treats the important concepts like *observation, meaning, reality, truth, knowledge*, and so on as 'concept schema', rather than individual concepts. For, the meanings of these concepts are not given once and for all as one individual concept; rather they develop over the years, with all related aspects. A concept schema implies that: i) it is formulated in terms of a 'framework' that remains reasonably stable over a significant period of time, or over contemporaneous areas of inquiry; ii) It is treated as part of 'an approach to inquiry' and the interpretation of its results.

Classical empiricism wrongly equates observation with sense perception. With the insistence of sense perception, classical empiricism is not only insufficient to understand science and its problems, but also it is largely irrelevant and even positively obstructing the process. For, even if all our knowledge were shown to be ultimately based on sense perception we would still not know or understand knowledge fully, as our sense perception covers only a limited section in the whole range of Electro Magnetic (EM) spectrum. The normal light, which is visible to our human eyes, is just one portion of the vast spectrum (0.4 – 0.7μm). Gamma rays, with extremely short wavelength as short as a billionth of wavelength of the visible light, are at the one end and at the other end are the radio waves, with trillion times higher wavelength of the visible light. "The eye" therefore, "comes to be regarded as a particular sort of electromagnetic receptor, capable of 'detecting' electromagnetic waves of the 'blue' to 'red' wavelengths, there being other sorts of receptors capable of detecting other ranges of that spectrum. This *generalized notion of a receptor or detector* thus includes the eye as one type" (Shapere, 1982, 505).

There is no 'pure' observation and all observations are theory-laden. Modern science does not hold "evidential as perceptual", because sense perception is often unreliable (seeing the half-immersed stick as bent) and incapable (in the areas of too small or too big in size or with the objects too near or too far) (Shapere, 2000). The conditions for something to be observed (observable) are: i) information is received by appropriate receptor; ii) that information is transmitted directly, without any interference, to the receptor from the entity" (Shapere, 1988b, 308); and iii) "The information is transformed by appropriate devices into humanly-accessible information which is (eventually) perceived by a human being" (Shapere, 1982, 517). This interpretation makes observation intelligible to humans.

What is observable / unobservable is, thus, determined by *a number of factors*, like: the instruments used; the theoretical knowledge which tells us the nature of interactions; the theoretical possibilities of detection of particular interactions, and how the particular interactions give information about its sources. Thus the concept of observation is not a single notion to be captured by a logical or a priroi analysis. It is a concept schema evolving over the years, intertwined with the methodology and background knowledge.

The Scientific Status of Unobservable in Modern Science: There are certain things that can never be perceived directly like the particles in the cloud chamber, as one can observe only the track of the particle. Modern cosmology teaches that the part of the universe will not be observable by us unless it enters our horizon, and "if the universe is infinite, that, at any given time, there will always be regions which are unobservable" (Shapere, 2000, 159). Particle Physics and modern cosmology encounters problems and theories for which observational or experimental tests appear impossible, even in principle. For instance dark matter and dark energy cannot be directly observed but can be known only from the effects they create. Classical empiricism might ignore all such entities and theories as unscientific as they are unobservable and untestable, but Science considers all these as legitimate objects of scientific study, though they are unobservable in principle.

Of course, Shapere does not permit any bizarre entity / theory to be treated as scientific. He gives guidelines to *distinguish between legitimate and wild / loose speculation in accepting something observable in science*: i) If that entity is logically and mathematically implied by something that is already observable or has observable consequences; ii) If it is needed for consistency considerations, even though it is not implied by the observable parts of the theory; and iii) If it provides answers to problems concerning the observable parts of the theory with which no other solution deals successfully. These guidelines of course are to be taken in spirit, not in letters. However, despite the liberality, it is by no means the case that 'anything goes' (Shapere, 2000, 159).

Rational Descendent of Classical Empiricism: Transcending Traditional Rationalism and Empiricism

Traditionally two major epistemological groups, *Empiricism* and *Rationalism*, have tried to clarify the issues related with knowledge and knowing. While empiricism maintains that all pieces of knowledge (concepts & beliefs) are rooted in experience, for their source and justification, rationalism argues that at least some knowledge is attainable by reason, independent of experience, without any interaction with the reality outside. *Problems with empiricism*: i) it fails to clearly clarify what is meant by pure observation, which does not need any interpretation, and to show how all the other non-observational beliefs are rooted in observation; ii) it fails to realize that sense experience does involve inference, as there is no pure 'given' available. If the importance of the 'given' in experience is stretched too far, one would land in 'solipsism', as one cannot justify believing in anything beyond one's own experiences; one can't speak of past or future, which are basically inferential in nature, going beyond the 'given' of here and now (Shapere, 1988b, 301); iii) Empiricism's claim, "all our knowledge is based on sense experience" – is it analytic (a matter of definition)? or empirical (a matter of fact)? In both cases it would be highly problematic: "if analytic, it can, on its own principles, tell us nothing about the matters of fact with which it seems to be concerned; but if it is empirical, it cannot be established with absolute certainty" (Shapere, 2000, 161). Therefore empiricism itself (like its conclusion) is an empirical doctrine, and so it can bring itself to a stage at which it outgrows itself. *Problem with rationalism:* i) It could not establish any substantive truths about reality, totally independent of any connection with the senses; ii) Even the compromise proposed by Kant to synthesize both empiricism and rationalism is also problematic; for, Kant's *a priori* intuitive forms of Space-time category and the Principle of Causality have been seriously questioned by the contemporary physics [See: Shapere, 1988].

Shapere views the knowledge-seeking process (science) as *Rational Descendant of Classical Empiricism:* it is empiricism, because we have to interact with the world to learn about it; and it is rational descendant as well, because we have to learn what it is to interact; with the help of the background information we have to learn to how to learn. It *is neither an aprioristic rationalism nor a sensory empiricism,* though it takes certain important aspects from both of them into consideration: namely, we bring some background information to interpret the data available, however that background information is changeable for specific reasons; *it is neither relativist nor foundationalist,* due to the fact that the observation–situation is infused with background information and there is 'the given' in the whole of inquiry; *it is both historical… and rational,* because even what counts as 'reason' too emerges over the periods of history, and finally it is far more concerned with content than with logical form, though logic is not excluded (Shapere 1995, 25-26).

Remarks

i) *Shapere's balanced approach:* Though Shapere does not take extreme positions his views deserve serious consideration; he evokes a lot of reactions from philosophers and philosophers of science, probably because he attempts at a balanced view between the positivists and the historicists. Not just a compromise, but he seeks to transcend both by inculcating the strengths, and avoids the weaknesses, of each other, offering "a coherent and often attractive vision of scientific inquiry" (Nickles, 1985, 310).

ii) *The Role and the Need for Background Information:* Shapere has shown, rightly so, as to how science bases itself on background information and at the same time preserves its rational character in terms of the 'given'. Modern science has taught us that we need 'to learn how to learn' about reality, how to think and speak about it, how to refer to what we study and how to judge the results of our investigation (Shapere, 2001, 200). The demarcation between the observable and the unobservable, the scientific and the non-scientific, scientific possibilities and impossibilities, scientific problems and pseudo-problems – all these "are not something given once and for all, but rather shift as our knowledge and understanding accumulates" (Shapere, 1978, 1000). Therefore, science is an enterprise that has evolved over generations, building on background information. This reveals the central importance of historical dimension in science.

iii) *Shapere on Observation:* As observation is not sense perception, Shapere argues that humans are needed only at the end of the process of observation, where it has to be interpreted. Jan Faye, however, argues that an observation as such needs some human observers. Observation involves some sort of beliefs and therefore what is done by an instrument is in fact only a measurement. If no such beliefs are involved in observation there is hardly any difference between a camera 'seeing', a scanner 'reading a document' and human observing. Since beliefs are involved in human observation, we are not merely seeing something, but are seeing that 'something is the case' and "this intentional component is that which elevates perception to observation" (Faye, 2000, 173).

In analysing the notion of observation, we suggest, he includes consensus in the scientific community as fourth condition. Perhaps, he thinks that the notion of background information takes care of this aspect. But I think it is so important in modern science that it needs a specific mention. This consensus is also one of the tools to overcome the experimenters' regress in modern science, especially when an experiment is done to decide whether an entity exists or not. The issue is: a correct result of an experiment is one that occurs when the experimental apparatus is functioning properly (and it uses proper method), but we check proper function of the apparatus by whether or not the experiment returns the correct result *(http://www.galilean-library.org/blog/?p=105).* If the results are positive one can conclude that entity/field/force in question exists; if negative, it does not exist. But there can be methodological or mechanical or mathematical errors and because of which the said entity is detected, or not detected. There seems to be no other way of checking it out independent of all these procedures. Such areas of investigations largely rely upon the consensus in the scientific community.

iv) *Shapere, a Seeker of Knowledge with Openness:* Shapere invites us to learn how to learn from nature. He comes across a genuine seeker of knowledge with much openness: “We must be prepared for the possibility that there are indeed more things in heaven and earth that are dreamt of in our present picture of the universe. Even other universes” (Shapere, 1987, 331).

Check Your Progress II

Note: Use the space provided for your answers.

1) How does Shapere enrich the notion of observation? What are its implications in understanding modern sophisticated science?

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2) Shapere claims to have transcended classical empiricism and rationalism to have a holistic picture of science. Is his claim justified? Explain.

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3.4 LARRY LAUDAN: SCIENCE – A PROBLEM-SOLVING ENTERPRISE

As Laudan he acknowledges in his prominent work, *Progress and Its Problems* (1977), he is always happy that he was taught by and / or to work with many stalwarts of philosophy of science, as Hempel, Kuhn, Feyerabend, Popper, Lakatos, Adolf Grunbaum and so on. This in a way makes it clear that all these people have influenced his thinking. He attempts to take the works of Kuhn and Lakatos further to have a better understanding of science and its methodology. In his *Science and Hypothesis* (1981) he traces the method of hypothesis from Galileo and Descartes to Peirce, to show the important role of hypotheses in the natural sciences and to study the philosophical efforts to analyze the structure of hypothetico-deductive explanation. His another important work *Science and Values (1984)* is not about ethics of science and scientists; it is about the cognitive values involved in science and its methodologies. He focuses on rationality in science, rather than morality in science, though the latter is also of great importance.

Empirical Problems in Science

All the questions about the functions of nature - why things fall to the earth, why offspring manifests the characteristics of the parents - and many such queries are empirical problems. He differentiates between *problems and facts*, between *solving a problem and explaining a fact.* Problems arise in a given context; the theoretical background information informs us what, and what not, to expect, and this in turn decides what is normal and peculiar. What is problematic in one domain of inquiry may not be problematic in another context. A scientific theory is a 'solution to an empirical problem'. Here one need not worry about the truth or falsity of the theory, because its ability to solve a problem at a given time is that which matters and it may even turn out to be ineffective to solve later. Science is nothing but a 'problem-solving system'. Science, therefore, does not aim at truth, but only on problem-solving ability.

Science solves empirical problems, roughly in terms of explaining the phenomena. Science has to explain not only the usual phenomena but also anomalies. If an empirical problem *p* has been solved by a theory, then for other theories in the relevant domain, which cannot solve the problem, *p* becomes an anomaly. So unless we have a theory to explain a phenomenon, it will not be considered an anomaly. [According to Newton's theory, there was some discrepancy in determining the orbit of Mercury; they postulated the presence of another unknown planet to explain the discrepancy of Mercury, but unfortunately this planet was never discovered. The discrepancy was not considered as an anomaly, until Einstein's general theory of relativity explained the discrepancy in 1916]. Solving an anomaly, however, is only a secondary aim of science. In fact, anomalies are not in nature, but they reveal the lacuna in theories; "Anomalies are anomalies for theories. They are symptoms of diseases – not disease of nature, but diseases of theories" (Edwin Hung, 408). Thus empirical problems can be either problems of explanation or anomalous problems. The progress of science can be assessed in terms of the problem-solving effectiveness of theories (Laudan, 1977, 68).

Conceptual Problems

In science conceptual problems are more significant than empirical problems. Empirical problems are related to experiments, observation etc., but conceptual problems are richer. More than empirical problems, conceptual problems enable science to grow. When a theory is proposed to solve some empirical problems, very often they end up creating some conceptual problems, which can be either *internal* or *external*: "Conceptual problems arise for a theory, T, in one of the two ways:

i) When T exhibits certain internal inconsistencies, or when its basic categories of analysis are vague and unclear; these are *internal conceptual problems*. [E.g. Bohr's model of atomic theory can be an example for the internal conceptual problem; his model involved the picture of classical electrons, yet he spoke about their radiating energy in discrete quanta, an idea given by new quantum physics much later].

ii) When T is in conflict with another theory or doctrine, T', which proponents of T believe to be rationally well founded; these are *external conceptual problems* (Laudan, 1977, 49). [E.g. When Copernicus proposed the heliocentric theory, it had external conceptual problem, as it was inconsistent with the prevailing Aristotelian theory of geocentrism. Conceptual problems can also arise from *differing worldviews of the scientists*. [E.g. When Newton proposed the gravitational theory between the sun and the planets, his critics like Leibniz and Huygens were not ready to accept it because they could not understand the notion of 'action-at-a-distance', as they were engrossed with the Cartesian worldview of action-through-contact]. Further, conceptual problems can also arise due to *the difference in the methodologies*. [E.g. problems due to LP's inductive method or Popper's Hypothetico-deductive method].

Research Tradition (*RT*)

In order to improve upon the notions of Kuhn's paradigm and Lakatos' *SRP*, Laduan proposes 'Research Tradition' (*RT*), which provides science with ontology and methodology.

Like a paradigm, *RT* specifies the kinds of fundamental entities to be used in theories, and it defines its own empirical problems. However the difference between paradigms and *RT* is: the replacement of one paradigm by another is like a gestalt switch, sudden and abrupt, and also like a psychological conversion, whereas the *RT* changes step by step, as they have hard-core, which does not easily give in to changes. Similarly, unlike Kuhn's paradigm, there can be more than one competing *RT* can exist. *RT* can evolve over time, and sometimes two traditions can get amalgamated (Laudan, 1977, 104).

The *efficiency and adequacy* of a *RT* can be assessed at a given time or can be done over a period of its lifetime. The *RT* with the most problem-solving efficiency is accepted; however other traditions are not rejected immediately; they also can be taken for further pursuit, because they may be able to solve it in future. Scientists may decide to pursue a *RT* though they may not accept it and there can be several *RT*s at a time: "while it is only reasonable to accept one research tradition at any one time, it is not unreasonable to pursue several research traditions simultaneously" (Edwin Hung, 412). For Kuhn there can be only one paradigm; Feyerabend insists that scientists work in different paradigms for science to be progressive; and for Lakatos it is better to be with the progressive *SRP*, though it is not irrational to stay with the degenerating *SRP*; but Laudan by cleverly distinguishing between accepted tradition and pursuing tradition, has achieved a sort of compromise between all the three methodologies.

Remarks

i) To say that science aims only at solving the problems may not be a right description. Scientists do expect and believe that theories give some sort of truth or insights about the nature and structure of the world. Only for outsiders science may appear just to be a problem-solving activity and one will not know what scientists do and how they look at science. Problem-solving may be one of the important aspects of science but this fails to capture the richness of what science can and does accomplish. Moreover, in science many problems are not yet solved (may be, never) like the origin of the universe.

ii) One may question that by solving problems science does not actually make progress though one may get better insights. By solving a problem 4-3=1, what has one accomplished?

iii) Laudan does not give any criterion to show what is, and what is not, a satisfactory solution. Also the problem-solving effectiveness is not a quantitative measurement; Further, solving an empirical problem is in fact to explain the problem. But he does not explain what a scientific explanation or a theory is, nor the relationship between them. Without making all these elements clear his methodology is rather empty (Hung, 1997, 413).

iv) Laudan agrees that there is no theory-neutral language or theory-free observation. But the theory-ladenness does not lead to the famous problem of incommensurability. For he explains that the assumptions to understand a problem and those to solve it are different. Different people can propose different theories to solve a problem, but the understanding of the problem may be common. For instance, about the nature of light, particle theory (Newton), longitudinal wave theory (Huygens) and transverse wave theory (Young and Fresnel) were proposed, but since all shared the common problem about light, these theories were comparable. But since Laudan has not analysed what an explanation is, and theory is, we cannot understand cross-theoretical explanation, and thereby the problem of incommensurability is left unaddressed.

Check Your Progress III

Note: Use the space provided for your answers.

1) How does Laudan distinguish between empirical and conceptual problems in science? What are the advantages of the latter ones?

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2) Compare and Contrast Laudan's *RT* and Kuhn's *Paradigm*

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3) Is Laudan's RT more adequate than Lakatos' SRP in understanding science? If so, how? And if not, why not?

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3.5 LET US SUM UP

The approaches of historical realist philosophy of science have been explained with the help of the salient features of Lakatos, Shapere and Laudan. Each one has tried to enrich the picture of science and the role of history of science in doing philosophy of science. Lakatos' *SRP*, Sphere's notion of observation as *concept schema* and Laudan's *RT* are sincere attempts to show how science can be rational, while still being faithful to the socio-historical and non-rational factors. This lesson has discussed some of their merits and demerits.

3.6 KEY WORDS

Unobservables in Science : It refers to the entities, fields, events or phenomena which cannot directly be observed (e.g. electron, magnetic field, radio waves etc). Scientific realists claim that they exist in reality, independent of us, while antirealists deny it, claiming that they are only convenient tools to deal with nature.

Scientific Research Programme : It is the basic unit of science according to Lakatos. Each programme has unchangeable hardcore and changeable protective belt.

Research Tradition : According to Laudan science is made up of research traditions. Though it is similar to Kuhn's paradigm, it does a better job to maintain the rational character of science.

3.7 FURTHER READINGS AND REFERENCES

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