UNIT 1 LOGICAL POSITIVISM

Contents

1.0 OBJECTIVES

This unit tries to elaborate on logical positivism as a philosophical movement in Western tradition in the nineteenth century and the beginning of twentieth century.

1.1 INTRODUCTION

Logical positivism as a movement is traceable to Analytical Philosophy. The development of science brought about rapid changes in Philosophy. The word ‘analysis’ refers to any philosophy which places its greatest emphasis upon the study of language and its complexities. Philosophical analysis is essentially the study of language, but it must not be confused with other important studies of language. Linguists, philologists, grammarians, lexicographers, etc., are also involved in a study of language. Their interest, however, is primarily in empirical investigation. They are interested in discovering facts about how our language is used; what meanings words have; how languages begin, change and die, etc. These are scientific questions about language which can only be answered through use of scientific method. The analytical philosopher uses the analytical method as a tool to settle philosophical questions.

1.2 HISTORY OF THE MOVEMENT

Just as science had to create its own technical vocabulary and introduce concepts (e.g., force, mass, atom) that are more precise than those supplied by common sense, so also, these philosophers argue, philosophy must develop its own vocabulary and set of concepts in order to resolve its problems. Other analysts such as 'ordinary language' philosophers disagreed with the 'artificial language' of the logical positivists. Their contention was that philosophical problems can be solved through natural language we all use to communicate with each other. In logical positivism we find united in a peculiar way the empiricism of Hume, the positivism of Comte and Mach and the logical analysis of Moore, Russell, Wittgenstein, Whitehead and Frege. The adherents of this trend of thought organised themselves into a philosophical group at Vienna in 1928. The group became known as the Vienna circle. The prominent members of this group were Moritz Sehlick, Otto Neurath and Rudolf Carnap. The Movement gradually spread across the world of philosophy. Hans Reichenbach founded a centre at Berlin. At Oxford A.J.Ayer was the advocate of this movement. The two principal aims of Logical positivism were:

1. To provide a secure foundation for the sciences.
2. To demonstrate the meaninglessness of metaphysics.

The method adopted to realize the aims of the logical positivism was logical analysis, specially of language. It is this method which mainly distinguishes this movement from the positivism and empiricism of earlier times. It is distinguished, from the empiricism of Hume. While Hume's empiricism is based on psychological analysis of experience, the logical positivists base their theories on logical analysis of it. While earlier positivists objected to metaphysical speculation either because it is unprofitable or because its truths cannot, be proved, the new positivists object to it because logical analysis of metaphysical language convinces them that all metaphysical propositions are meaningless. The logical positivists dismiss metaphysical questions themselves as non-sensical, so that the question of their solution does not arise at all.

1.3 THE CRITERION OF MEANING

Russell and Moore succeeded in bringing to an end the dominance of Idealism in British Philosophy. American pragmatists C.S.Peirce and William James were influenced by the writings of Russell and Moore. It was Russell's brilliant student Ludwig Wittgenstein through his influential work *Tractatus Logico – Philosophicus* argued that meta physical questions are from their very nature unanswerable. All meaningful discourse is empirical in nature. Metaphysics is not empirical, so it is not meaningful. The necessity of the propositions of mathematics and logic follows from the fact that they are *tautologous*, making no reference to the world. Since the sentences of metaphysicans are neither propositions of empirical science nor tautologies of logic or mathematics, they are nonsensical. Philosophy, Wittgenstein said, is primarily the activity of clarifying language; it is not a source of truth about the universe the way science is. The Philosopher's only, proper task in to show the person who is puzzled by a metaphysical question that it is meaningless and unanswerable. Language is the symbolic representation of facts experienced. It can be analysed into significant assertions called propositions, and all propositions can be shown by further analysis to consist of some elementary propositions. Every elementary proposition, is a picture of some atomic fact experienced. The world is composed of such facts, and can be completely analysed into them. The proposition, 'this book is blue', can be true only if a book is blue, can be true only if a book is experienced as blue. Logical analysis of the world of experience as pictured by propositions asserting the existence of the world brings us thus to facts (or objects related) as the ultimate constituents of the world. This position is different from that of Hume for whom experience is simple impressions (not propositions). Hume analyses experience psychologically and not logically and the impressions yield the knowledge of non-related sense objects (like blue colour) and not of any fact or combination of sense objects (like this object having a blue colour). For Wittgenstein, a proposition which does not refer to 'any' state of affairs i.e., any fact of experience is, therefore, no proposition at all. While the truth of a proposition requires that it should agree with reality the sense of a proposition requires that it should at least refer to possible empirical facts. The sense of a proposition is the method of its verifications. To understand a proposition is to know what is the case, if it is true, that is what facts it stands for which can be expected to be observed or experienced if the proposition is true. But the method of verifying the proposition is also to observe such facts. Hence the very experience which can verify a proposition is also that which constitutes its sense. The verification theory of meaning supplied the point of departure to the positivists of the Vienna circle. They utilized this theory for demonstrating the meaninglessness of metaphysics, as well as for clarifying the propositions of science. In England the most famous logical positivist was A.J.Ayer. Through his famous work *Language, Truth and Logic*, Ayer placed great emphasis upon "The Principle of Verification".

1.4 ELIMINATION OF METAPHYSICS

Metaphysical entities are beyond sense, experience (transcendental). All metaphysical statements do not meet the conditions of verifiability and therefore according to A.J. Ayer such statements are nonsensical. According to him philosophy is nothing but the analysis of language. The fundamental postulate of metaphysics is that there is a super phenomenal reality. Since protocol statements are verifiable in experience, no statements which are not reducible to empirically verifiable protocol propositions can possess any significance. Metaphysical propositions by their very nature purport to assert the existence of unverifiable, trans-empirical entities. They do not possess any sense. Such propositions are not propositions at all. They constitute a body of nonsensical expressions. In Descarte's assertion **'***Cogito Ergo Sum*' (I think therefore I exist), the 'I' refers to the existence of 'self' which is not empirically experienced. Similarly the metaphysical systems of Spinoza and Leibniz assert the existence of trans-empirical entities which are meaningless. Through his logical analysis of language Carnap points out two chief sources that give rise to meaningless sentences. Either the individual words of a sentence are non-sensical or the sentence as a whole becomes non-sensical. For example in the sentence, "Twas brilig and slithy toves", the words have no meaning but in the following sentences the individual words are meaningful, But the sentences are meaningless:

"Quadratic equations attend races".
"Caesar is a prime number".

Metaphysicians propound the first kind of non-sense chiefly under the misconception that to every word or phrase that can be the grammatical subject of a sentence, there must somewhere be a real entity corresponding. For as there is no place in the empirical world for many of these 'entities', a special non-empirical world is invented to house them. The metaphysician has to show an entity even to the world 'nothing'. He indulges in the second kind of non-sense, when for example, he speaks of ‘thing-in-itself’ lying beyond all experience. Everyone of these words ‘thing’, ‘in’ ‘itself’ ‘lying’ ‘beyond’ ‘all’ ‘experience’ possess meaning in other sentences and context. But as combined here they do not yield any sense, since no empirical verification is possible with regard to what is beyond all experience. Therefore as a knowledge of reality, metaphysics is meaningless.

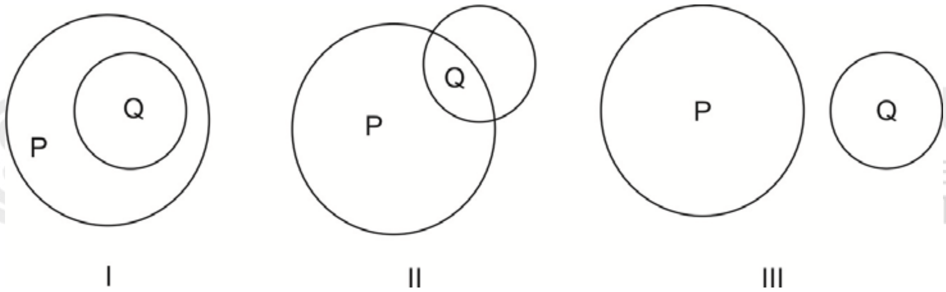
1.5 LOGICAL ANALYSIS OF SCIENCE

The function of Philosophy, according to the Logical positivists is to analyse the statements asserted by scientists, study their kinds and relations, and analyse terms as components of those statements. The logic of science according to Rudolf Carnup consists of two branches. One branch is called logical syntax or formal logic. The logical syntax analyses complex sentences of science into simple ones and discovers the laws governing the combinations of words into meaningful sentences. It enables us to realize the fundamental assertions of the different sciences, and their logical interrelations. The other branch of the logic of science is called semantics. The meaning aspect of the sentence is called semantics. It considers the relations of linguistic expression to objects designated by them. Semantic analysis of the language of science discovers, for example, that a term may designate a certain particular objet (e.g., the sun) or a certain property of things (e.g., iron) or a certain relation between things (e.g., motherhood) or a certain physical function (e.g. temperature). It also analyses synonymous terms such as *homosapiens* person and man. The results of sciences and their relevance to society are pursued by Philosophers.

1.6 LOGICAL POSITIVISM AND INTERPRETATION OF SCIENCE

As the positivists believe in observation and empirical verification they interpret the terms like ‘probability’, ‘induction’ and ‘laws of nature’ in their characteristic ways. There are three different kinds of probability in logical positivism.

1. According to Hans Reichenback probability lies between the two limits of absolute truth and absolute falsity. According to this theory no conclusion follows from any premise with absolute certainty, the latter can only imply the former to some degree of probability.
2. R.Von Mises advocates frequency theory of probability. It attempts to base the idea of probability on the observational frequencies of the happenings of a class of events. Probability can be asserted only on statistical observations and computation.
3. The third conceptions of probability are supported by Wittgenstein and Waismann. In this view probability is a kind of logical relation obtaining between two propositions between any two propositions P and Q there may be three kinds of logical relations. Using Euler’s circles these may be shown as follows.


P
Q
I
P
Q
II
P
Q
III

The early analytic philosophers like Bertrand Russell, G.E.Moore and C.D.Broad influenced many thinkers of the west. Some of the other thinkers who contributed to analytic philosophy are A.J.Ayer, Rudolf Carnap, W.V.O. Quine, Carl Hempel, John Wisdom, Gilbert Ryle, P.F.Strawson and J.L.Austin.

A.J. Ayer

The positivism of A.J. Ayer focused on two areas in Philosophy: 1) The Elimination of Metaphysics and 2) The Principle of verification. His book *Language, Truth and Logic* deals with the Principle of verification. Ayer intended it as a criterion of meaning, through which significant discourse could be distinguished from senseless combinations of words. He states the principle of verification in his book and attempts to clarify how it is to be understood and how it can be used to demonstrate the literal meaninglessness of metaphysical sentences.

Rudolf Carnap

Testability and Meaning is a shorter work of Carnap which appeared in Philosophy of Science in 1936 and 1937. In this he discussed the meaning criteria and the requirements of an empiricist language, the use of reduction sentences for analyzing assertions about dispositional properties, and physicalism as a basis for reconstructing the language of science. Two chief problems of the theory of knowledge, are the question of meaning and the question of verification. The first question asks under what conditions a sentence has meaning, in the sense of cognitive, factual meaning. The second one asks how we get to know something, how we can find out whether a given sentence is true or false. The second one presupposes the first one. If by verification is meant a definitive and final establishment of truth then no (synthetic) sentence is ever verifiable. We can only confirm a sentence more and more. Therefore we speak of the problem of confirmation rather than the problem of verification. We shall call a sentence testable if we know such a method of testing for it; and we call it confirmable if we know under what conditions the sentence would be confirmed. A sentence may be confirmable without being testable. The difficulties in discussions of epistemological and methodological problems are often due to mixing up of logical and empirical questions. Carnap attempts to formulate the principle of empiricism in a more exact way by stating a requirement of confirmability or testability as a criterion of meaning. Different requirements are discussed corresponding to different restrictions of the language.

W.V.O. Quine

W.V.O.Quine was a well known logician and analytic philosopher with positivist sympathies. His essay “Two Dogmas of Empiricism” appeared in *The Philosophical Review* in 1950. In his essay Quine challenges two doctrines which many people feel are central to logical positivism: 1) the analytic-synthetic distinction and 2) the belief that there are propositions which future experience can never cause us to reject as false. The analytic-synthetic distinction has a long history in modern philosophy. The distinction between analytic and synthetic statements can be found in the writings of Leibniz, Hume and Kant. According to Kant an analytic statement is one in which the predicate does not add anything new to the subject:

(E.g) a) A bachelor is an unmarried man
b) Iron is a metal

An analytic statement is limited to subject–predicate form. A synthetic statement is one in which the fact can be experienced:

(E.g) Water boils at 100 °c

But W.V.O Quine raises a question of whether there be a distinction between analytic and synthetic statements. He calls the distinction between analytic and synthetic statements as a dogma. The other dogma pertains to the belief that there are certain propositions which no experience can ever lead us to reject. He argues that although there may be propositions whose truth we would abandon only as a last resort, there are nevertheless no propositions which could not in principle by upset by future experience. Quine's view is supportive of a kind of empiricism without the above two dogmas.

Carl Hempel

The fundamental tenet of modern empiricism is the view that all non-analytic knowledge is based on experience. This thesis is called the principle of empiricism. According to the contemporary logical positivist, a sentence makes a cognitively meaningful assertion, and thus can be said to be either true or false. According to the empiricist criterion of cognitive meaning, or of cognitive significance, many of the formulations of traditional metaphysics and large parts of epistemology are devoid of cognitive significance. Hempel attempts to provide in detail the logic and methodology of empirical science and clarify and restate the basic ideas of empiricism. He wants changes in the empiricist criterion of meaning. These changes focus on the testability criterion of empirical meaning. The concept of testability which is to render precise the vague notion of being based – or rather baseable – on experience, has undergone several modifications which reflect an increasingly refined analysis of the structure of empirical knowledge. A sentence has cognitive meaning if and only if it is translatable into an empirical language. According to Hempel there are requirements for both complete verifiability and complete falsifiability in Principle. According to the requirement of complete verifiability in principle, a sentence has empirical meaning if and only if it is not analytic and follows logically from some finite and logically consistent class of observation sentences. According to the requirement of complete falsifiability in principle, a sentence has empirical meaning if and only if its denial is not analytic and follows logically from some finite logically consistent class of observation sentences.

John Wisdom

John Wisdom was a student of Wittgenstein. Through his articles and books, he has brought to Linguistic analysis an original and exciting new kind of philosophical procedure. He is not in agreement with Wittgenstein, A.J.Ayer and other logical positivists in rejecting metaphysics as non-sensical. On the other hand he tries to understand why metaphysicians feel compelled to talk in their linguistically odd ways. By putting stress upon the imperfect similarities between various kinds of statements in our language, he hopes to discover what is and is not valuable in the various attempts to solve metaphysical problems. Wisdom stressed the 'therapeutic' conception of philosophy. His articles, "Gods" in Philosophy and Psycho analysis and "Other Minds" reveal his emphasis on the analogy between philosophical and neurotic distress, contrasting them with other kinds of problems. Philosophers reason for and against their doctrines and in doing so show us not new things but old things anew. According to him a purely linguistic treatment of philosophical conflicts is often inadequate. Besides the latent linguistic sources there are others non-linguistic and much more hidden which subtly co-operate with the features of language to produce philosophies. Philosophical disputes can go on too long since there is something queer about philosophical reasons. Philosopher's chronic indecision, whether it takes the form of enthusiastic oscillation or melancholic inactivity, is due to the fact that besides the reasons revealed in the course of talking over the matter there are others which remain hidden.

Gilbert Ryle

In his popular book, *The concept of Mind***,** Gilbert Ryle tries to refute Descartes myth, prevalent among theorists that man has both a body and a mind; that body is in space, subject to mechanical laws and observable by sense-organs, whereas the mind is an opposite kind of private existence, being not in space, not subject to such laws and not observable by others. According to Ryle, mind- body relation is not that of a 'Ghost'(mind) in the machine (body). Mind cannot be analogous to a 'pilot' in a 'ship'. Dualists like Descartes commit a logical blunder in counting mind and body as two species of the same genus, 'existence'. Ryle uses plenty of similes and metaphors to counteract the effects of opposite metaphors lying behind the philosophical conception of mind as an occult and mysterious entity. The family of categories relating to the realm of mind may be divided into three broad classes: 1) terms like 'mind', 'spirit', 'self', etc. which suggest that mind is a kind of substance, 2) adjectival terms signifying some present (occurrent) quantities and acts belonging to mind e.g. 'conscious', 'alert', 'attentive', think', 'imagine' etc. and 3) Similar adjectival terms signifying some capacities and dispositions e.g., 'intelligent', clever, 'rational', 'critical', rash etc. Ryle argues that capacity or potentiality is a mythical entity. He is conscious, alert and so on means he is acting or behaving in particular observable ways. Ryle reduces the dispositions to occurrents, and all occurrents to observed outer activities and tries to do without terms implying, mental phenomena. It is supposed that 'thinking' is the cause of 'doing'. There is no internal evidence of our consciousness to show that the outer act is preceded by another inner act. Moreover if we suppose the necessity of a precedent mental act as the cause of the outer act, we must think of a second mental act preceding the first, and so on ad infinitum. So the supposition of a higher order of inner, mental causes for explaining the outer acts is untenable. Ryle questions the view that consciousness is the essence of mind. Feelings are nothing but bodily sensations. The categories signifying the private, inner, higher order of mental capacities, qualities and acts can be replaced by categories signifying physical processes. Therefore there is no mystical entity called mind. Mind 'can be replaced by the team 'person'.

J.L.Austin

Austin exerted great influence on his students through his writings. He agrees with other analysts the conviction that the study of language is of the greatest value in dealing with philosophical questions, Like Wittgenstein and wisdom he believes that a great deal of what philosophers have written is not so much false as it is misleading and confused. However, Austin's procedure for dispelling this confusion is unique. He displayed an amazing talent for articulating the subtle shifts of meaning which result from the most minute grammatical changes. He was clearly of the opinion that the study of grammar is philosophically important, and he attempted to demonstrate this in his later works. He believed that the time was not yet ripe for speculation in philosophy. We must first become as clear as possible about how our language operates before we attempt to settle philosophical problems or even speculate on whether any of them can be solved. Thus Austin never endorsed Wittgenstein's speculations about the ultimate fate of philosophy.

P.F.Strawson

One of the most discussed analytical philosophers of 20th centaury was P.F.Strawson. In his book *Individual***,** he attempts to show that certain general conclusions about the world can be gained from the analysis of how we speak. He argued that there was no real anti thesis between linguistic analysis and a certain kind of metaphysics. He distinguished two kind of metaphysics: that which only attempts to describe the conceptual boundaries on our language (descriptive metaphysics) and that which attempts to revise them (revisionary metaphysics). His essay "On Referring" challenges Russell's theory of descriptions. Strawson argues that Russell made at least two mistakes: He did not fully realize that a sentence can have a variety of uses, and he mistakenly thought that every meaningful sentence must be either true or false. According to Strawson, a sentence such as "The present king of France is wise" when used today, is neither true nor false, for the question of its truth or falsity does not even arise. Such a sentence presupposes but does not assert, that there is a king of France, and since this presupposition is false, the question of truth or falsity cannot be an issue. Russell's theory is unnecessary since the problem it was designed to solve does not exist. The sentence "The king of France is wise" was uttered from the beginning of the seventeenth century onwards, during the reigns of each successive French monarch; it was also uttered during the subsequent periods in which France was not a monarchy. There are also difference between different occasions of the use of this sentences. For instance, if one man uttered it in the reign of Louis XIV and another man uttered it during the reign of Louis XV, it would be natural to say that they were respectively talking about different people. If on the other hand two different men simultaneously uttered the sentence, then, they were both talking about the same person, and in that case in using the sentence, they must either both have made a true assertion or both have made a false assertion. This illustrates the use of a sentence. We cannot talk of the sentence being true or false, but only of its being used to make a true or false assertion. Strawson dealt at length "indefinite References" the problems in making "identification statements" and The logic of "subjects and predicates". The contextual requirement for the referring use of pronouns may be stated with the greatest precision in some cases (e.g. 'I' and 'you') and only with the greatest vagueners in others ("it" and "this"). This sentences may be classified into two classes: 1) those of which the correct referring use is regulated by some general referring-cum-ascriptive conventions (E.g. Pronouns which have the least descriptive meaning) and ii) those of which the correct referring use is regulated by no general conventions, either of the contextual, or the ascriptive kind, but by conventions which are ad hoc for each particular use.

1.8 CRITICISMS OF LOGICAL POSITIVISM

The positivists attack on metaphysics evoked vehement protests and counter attacks from the opponents of logical positivism. The counter attacks made the supporters of the logical positivists to defend their views in different ways. The verificational theory is criticized on many grounds. What is the meaning of verification when it is said that the meaning of a proposition depends on the method of its verification? if it means that the observational context is the criterion for the truth of proposition, then the historical statement and the statements about objects not yet perceived are meaningless. Faced by these difficulties some positivists admit that by verification should be meant verification in theory or principle and not necessarily in practice. If by verification, the positivists believe in the sense of conclusively proving some proposition to be true or false, there are statements which cannot be verified conclusively:

a) Arsenic is poisonous
b) This wire conducts electricity
c) There is other side for the moon.
d) Man is mortal.

The above statements can be verified in indirect ways. Schlick says that the statement. ‘Man is mortal’ is non-sensical, only an important type of nonsense. This makes Karl Popper remark that, ‘Logical positivism destroys not only metaphysics but also natural science’. According to Popper, even limited number of crucial observations can conclusively confute (i.e. falsify) if not establish a general proposition, and that a sentence should be allowed to be significant if it expresses something which can be confuted by experience.

A.J. Ayer rejects the falsification theory and defends his verification theory by introducing the concept of probability in the meaning of statements. The general propositions of science are significant because it is possible to observe facts which render them probable if not certain. He maintains, therefore, that verification, in the definition of meaning should include both strong verification and weak verification. In the case of strong verification it is possible to provide conclusive proof for the truth or falsity of a proposition. (E.g. All a priori analytic propositions). In the case of weak verification it is possible to provide a proof of probability of a proposition. (E.g. All synthetic propositions). Since all synthetic propositions are only probably true, they can be verified only in the weak sense. It is self-contradictory to say that propositions concerning syntax or logical principles possess significance and at the same they are some important types of non-sense. The logical positivist’s aim is to defend science, but by re-interpreting science to suit their principles they don’t defend the sciences. By sense-experience, positivists like Carnap mean introspection and even mystical experience also. This is deviation from the original stand point of the logical positivism. But in spite of its drawbacks, it made an impact on several fields of philosophy such as epistemology and ethics.

1.9 LET US SUM UP

In this unit we have seen the development of logical positivism as a development of philosophy of science in dealing with the question of verification and accuracy of facts and data.

1.10 KEY WORDS

Verification theory: the concept of probability in the meaning of statements. The general propositions of science are significant because it is possible to observe facts which render them probable if not certain.

1.11 FURTHER READINGS AND REFERENCES

Lakatos, I. "Falsification and the Methodology of Scientific Research Programmes." in *Criticism and the Growth of Knowledge*. Ed. Lakatos and I. Musgrave. Cambridge: Cambridge University Press, 1970.

Faye, Jan. "Observing the Unobservable." in *The Reality of the Unobservable*. Ed. E. Agazzi, and M. Pauri. Netherlands: Kluwer Academic Publishers, 2000. 165-175.

Popper, Karl. *Logic of Scientific Discovery*. London: Hutchinson; New York: Basic Books, 1959).

Longino, H. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton: Princeton University Press, 1990.

UNIT 2 HISTORICISM

Contents

2.0 OBJECTIVES

This lesson aims to discuss some of the salient features of Historicism (Social Constructivism) School of Philosophy of Science of the 20th century. The Introduction includes a very brief description of the trends of Historicism in general and how it differs from Logical Positivism in its approaches of doing Philosophy of Science. The following sections seek to familiarize the students with the salient contributions of Kuhn, Feyerabend and Hanson, some of the prominent philosophers of this school. [*Note*: Philosophy of Science in the 20th century can also be divided into Positivist and Postpositivist Schools. However, for our purpose, we divide the latter further into two groups: *Historicism* and *Historical Realism*, Unit 2 and 3, respectively].

2.1 INTRODUCTION

After the World War II most of the intellectuals became disillusioned with humanity's scientific growth. The historical outlook affected many spheres of humanities and new disciplines, like Historical Materialism, Anthropological Historicism, Eschatological Historicism and so on emerged. Historicism, a popular school of thought in Germany by the 19th century, looks at everything in terms of historical developments. Reacting against the normative view of knowledge and cognition of the Enlightenment period, it argues that *life and reality are nothing but history*. Taking the cue from J. G. Herder's *Outlines of a Philosophy of the History of Man* (1784) and G. W. H. Hegel's *The Philosophy of History* (1837), Historicism gives importance to the historical situatedness of each individual consciousness, which is shaped by *socio-cultural contextuality, contingency and perspectival nature of our existence.* Radical contingency is the distinguishing feature of human life. David Roberts maintains that "Our world . . . cannot be stable, centered, self-identical in the way that the metaphysical tradition led us to expect" (1995, 199) and even if we manage to reach the levels of metaphysics or science, we are still within the framework of history and contingency. The popular names associated with this school of thought are Leopold von Ranke, Wilhelm Dilthey, J. G. Droysen, Freidrich Meineckes, Benedetto Croce and R. G. Collingwood. The powerful critics of historicism are Friedrich Nietzsche, Walter Benjamin, Karl Popper etc. However Martin Heidegger, Edmund Husserl and Hans-Georg Gadamer engage themselves in a constructive approach to the whole ideas of historicism.

The impact of historical outlook towards knowledge enterprise affected philosophy of science also. In the beginning of the 20th century, Logical Positivists (members of the Vienna Circle) and Logical Empiricists (likeminded group from Berlin), insisted that Philosophy of Science should be precise and rigorous giving importance only to the logical and linguistic analyses of the scientific concepts and theories. Positivists like Carnap, Hempel, Reichenbach, Schlick, Popper etc. held scientists as 'little philosophers', incorruptible investigators who are maximally rational and worried about epistemological and ontological issues" (Klee, 1999, 199). But historicists, like Hanson, Feyerabend, Kuhn, Lakatos etc., tried to demythologise the logical positivists' view of science and to arrive at a picture that is more faithful to the actual historical developments and sociological factors of science. In short, one can say: "Hume thought science was inductive and irrational, Popper thought it was non-inductive and rational, and Carnap thought it was inductive and rational", and in contrast to them, "Kuhn seems to argue that science is both non-inductive and non-rational" (Ladyman, 2002, 94).

2.2 HISTORICISTS' CHALLENGES TO LOGICAL POSITIVISM (LP)

a) Rationality of Science – LP claims that science is rational, because it strictly follows scientific method (verification or Popper' s falsification). But Historicism argues that science is non-rational and there can be many methods in science; *b) Cumulative growth* – Science progresses cumulatively, where the latter theories are the betterment of the previous ones, with more empirical content; such progress is not available in any other enterprise, where knowledge grows only in a rough sense. But for Historicism growth is transformative and latter theories are not necessarily better than the previous ones; *c) Objectivity in Science* - Science is objective, while Historicism shows that science has got both subjective and objective elements; *d) Monopoly of Truth* - Science is the storehouse of truths. Historicism challenged this and showed that other resources are also reliable. *e) Reductionism of science* – All sciences can be reduced to physics, as there is a single set of fundamental methods for all of them. Historicism does not agree with this as there can be different methods for science and reductionism becomes more controversial with more growth in various domains of sciences; *f) Superiority of Scientific theories* - Scientific theories are superior to any other belief system as science is immutable. But Historicism argues that scientific theories do change and there is nothing special about scientific enterprise; *g) Dichotomy between the context of discovery and the context of justification* – This distinction is very important because a hypothesis may arise out of any sort of personal or social consideration, but it has to be justified on the basis of observational evidence; the context out of which it emerges is not relevant to philosophy of science as only its justification matters. But Historicism denies any such dichotomy; *g) Clear Distinction between observational terms and theoretical terms:* LP insists on the distinction of observational terms and theoretical terms (and thereby observational and theoretical statements also). The observational terms can be traced to some sort of observational experiences, while there is no such observational basis for theoretical terms. However Historicism denies this distinction because there is no 'pure' observation and all observations are theory-laden; *h) Weltanschauung (World view) of the scientists:* According to LP, the value-system, the passion, prejudices and the whole world-view of scientists have no role in science, as the scientists remain above all these elements. Historicism clearly shows that the *Weltanschauung* of the scientists has a crucial role to play in their science, by colouring and controlling the process of science. (*Weltanschauung* can be understood as the totality of background, upbringing, personal preferences, prejudices, and expectations etc. of the scientists); *i) Role of History in Philosophy of Science:* For LP, history of science is not necessary to do philosophy of science, while for Historicism history of science is important to do philosophy of science, because historical factors do play an important role in having an adequate picture of science.

Check Your Progress I

Note: Use the space provided for your answers.

1) What is the importance of historicist approaches in the intellectual enterprises in general and in philosophy of science in particular?

....
....
....
....

2) Explain some of the areas where historicist philosophers of science challenge LP?

....
....
....
....

2.3 THOMAS SAMUEL KUHN (1922-96): SCIENCE – A SOCIAL ENTERPRISE

Kuhn is given the credit of bringing Historicism into the Philosophy of Science. He received his Ph.D. theoretical physics from Harvard University in 1949. Soon he became interested in the history of science. His world-shattering work, *The Structure of Scientific Revolutions* (SSR), in 1962, evoked controversial discussions in extremely diverse fields. It has been translated into twenty languages. In 1956 he joined the University of California at Berkeley; he moved on to Princeton University and later to MIT. He suffered from blood cancer and he died rather young in 1996. Some of his papers both on the history and the philosophy of science are given in *The Essential Tension*, 1977. His ideas can be seen in two broad categories: *Early Kuhn* and *Later Kuhn*, focusing on the important Kuhnian concepts like *Paradigm*, *Incommensurability and Theory Choice.*

Early Kuhn (Till late 1970s)

Science - a Cycle of Normal Science and Revolutionary Science**:** Science is basically a long period of *normal science*, occasionally interrupted by crises, which lead to short periods of *revolutionary science*. In the Normal Science period the main preoccupation is puzzle-solving activity. All scientists work as collaborators, not as innovators, applying the known solutions to the problems at hand. When the existing theories get into conflict with the fresh observational data, anomalies arise and mostly anomalies are overlooked. A normal scientist must learn to ignore them, or else she can't carry on with her research: "The scientist who pauses to examine every anomaly he notes will seldom get significant work done" (Kuhn, 1962, 82). But when anomalies grow too many and too strong to tolerate, a crisis sets in, leading to a revolution, where a new paradigm is chosen. Once that is accepted again another period of normal science starts, until anomalies appear, which would ultimately lead to a revolution.

Paradigm - A Primary Concept

Paradigm is almost synonymous with a scientific community, ensuring both the logical and physical closeness. It is a sort of world-view of the community. [E.g. Aristotelian physics, Copernican astronomy, Newtonian physics, Ptolemaic astronomy, the phlogiston and the Oxygen theories of combustion, the caloric theory of heat, particle physics, quantum physics]. *Paradigms are constitutive of science*: Each paradigm has its own problems, its solutions and methodology. It binds the scientists so deeply that the scientists belonging to different paradigms "disagree about what is a problem and what is a solution; they will inevitably talk through each other when debating the relative merits of their respective paradigms" (Kuhn, 1970, 109). *Paradigms are constitutive of meaning*: Paradigms determine the meanings of the terms used in scientific theories. Finally, *paradigms are constitutive of subject matter of discourse*. Within a paradigm there is a strong consensus-thinking. Kuhn demands a very strict adherence to the paradigm on the part of the scientists. They would do anything to be faithful to it, "even in the face of contradictory evidence" (Ladyman, 2002, 119). [Note: With critiques of the notion of paradigm, Kuhn preferred, with his 2nd edition of *SSR* (1970), a *'disciplinary matrix'* to 'paradigm'. The disciplinary matrix includes these important elements: i) symbolic generalizations, ii) models, both ontological and heuristic, iii) values, and iv) exemplars – which are essential for the scientific community to obtain or validate genuine knowledge].

Incommensurability

During revolutionary period scientists suffer from incommensurability (i.e. *communication breakdown*). It arises due to the rejection of an old theory, the changes in the problem-field, the standards of solution and even some of basic scientific concepts. The scientists from both Aristotelian paradigm and the Copernican paradigm may speak of the center of the universe but they mean different realities; for, the former mean the earth, while the latter the sun, which are apart by 150 million KMs. Kuhn says that there is no way in which the communication breakdown can be bridged because the interpreter will have to live in two worlds and he will end up in mental asylum.

The Essential Tension

There is a tension as a scientist essentially needs flexibility and open-mindedness to progress; but at the same time 'convergent thinking' and the rootedness in the given tradition is also needed: "Only investigations firmly rooted in the contemporary scientific tradition are likely to break that tradition and give rise to a new one" (Kuhn 1977, p.227). As the convergent thinking is instilled in the fresh minds through the students' text books, it is very difficult to be innovative as that would go against paradigms. Edwin Hung's analogy of railway tracks: "The rails in one sense constrain the movements of the train, but in doing so guide it smoothly in a definite direction" (Hung, 1997, 358). Being an enthusiastic innovator and a faithful traditionalist at the same time is precisely, as Kuhn puts it, the *essential tension*.

Later Kuhn (Early 1980s Onwards)

In the latter part of Kuhn's career there is a shift to the language considerations of science. From the essays in *The Road since Structure*, a collection of his essays produced between 1970 and 1993, published posthumously in 2000, we learn the four fundamental themes emerging out (Kuhn, 2000, 1-9): i) Science is undoubtedly a cognitive empirical investigation of nature, endowed with a special sort of 'progress'. But this progress is not towards the fullness of truth, but progress in ever-improving technical puzzle-solving ability; ii) Science is basically 'a social enterprise', where the scientists work within the community and only occasionally they move out of it to find solutions for certain anomalies; iii) Modifying the earlier notion of scientific development as a series of long period of normal science, occasionally punctuated by short periods of revolution, now Kuhn maintains that *science is period of development within a coherent tradition divided occasionally by periods of 'speciation'* (like the biological evolution of species of Darwin's theory), into two distinct traditions with somewhat different areas of research; and finally; iv) He distinguishes between *commensurable languages* (where translation is possible, between two languages, and therefore, what is said in one language can be said in another) and *incommensurable languages* (where only paraphrasing is possible between the languages), giving *a linguistic twist to the understanding of incommensurability.*

Theory Choice in Science

When scientists decide from various theories, Kuhn argues that they don't go by rational and epistemic considerations. There is no neutral algorithm or systematic procedure for theory choice, which takes place not only by the shared (or objective) criteria but also by "idiosyncratic factors dependent on individual biography and personality" (Kuhn 2002, 429). The non-epistemic factors are also of philosophical importance. Kuhn identifies five, among many other, important characteristics of a good scientific theory: *accuracy, consistency, scope, simplicity and fruitfulness of the theory*. He thinks that they are individually important and collectively sufficiently varied to make a good choice. Each creative discipline is characterized, among other things, by different sets of shared values. Kuhn prefers to call the shared criteria as *values, rather than rules*. Along with these values there are many personal or subjective criteria shaping theory choice: one's previous experience as a scientist, the duration of her research, extra-scientific persuasions (like philosophical or religious convictions), one's personal preferences, for instance, one may prefer originality to coherence (and therefore readiness for risks), while another may prefer vice versa and end up not taking risks. Thus an adoption of the new theory cannot be regarded as conscious choice on the part of that person. So declares Kuhn, "*No process quite like choice has occurred*, but they are practicing the new theory nonetheless" (2002, 436; emphasis mine).

Popper and Kuhn

Kuhn, in his paper, "Logic of Discovery or Psychology of Research" (1977), compares and contrasts his views with those of Popper. Some of the commonalities between them: i) both focus on the dynamic nature of science, rather than the strict logical structure of science; ii) both give equal importance to facts and the spirit of actual scientific life and thereby turning to the actual history of science and resulting in similar conclusions; iii) both emphasize the revolutionary process of scientific growth; iv) both reject the cumulative growth of science; v) both of them seriously doubt the possibility of any neutral observation language; vi) both agree that the aim of scientists is to arrive at explanatory theories; and finally vii) both of them give due importance to the concept of tradition in the enterprise of scientific knowledge. However, there are also *dissimilarities between them*: i) Popper makes falsification a regular and frequent occurrence, while Kuhn sees the need for this only at revolutionary periods, which occasionally take place; ii) Kuhn' idea of normal science, where most part of the actual science lies, is missing in Popper's framework; a beginner in science is primarily trained to work in normal science not to throw away the existing theories outright! iii) Kuhn does not agree with Popper's sharp distinction between context of discovery and context of justification; iv) For Popper the method of science is the method of falsification, and Kuhn sees no such single method; and v) For Popper science is non-inductive and rational, while for Kuhn science is non-inductive and non-rational.

Remarks

i) Logically and philosophically Kuhn's ideas may not be very attractive yet they are very persuasive; ii) In Kuhn's scheme paradigm a very important concept, but unfortunately, there is no clear understanding of it. Kuhn is vague and inconsistent with regard to the use of paradigm. Masterman enlists twenty-one various uses of the word in Kuhn's 1962 edition of *SSR*. Also it is not clear about the nature of the influence of the paradigms, whether psychological or logical, upon its members; iii) Kuhn's idea of theory-choice abolishes the idea that science is guided by a scientific method. Given this idea Lakatos labels Kuhn's science as "a matter of mob psychology" (Lakatos, 1970); and iv) Kuhn has been strongly criticized for his Incommensurability, as it is likely to land science in irrationality and relativism. Kuhn at the second phase prefers to look at incommensurability *metaphorically* and in terms of *linguistics*. With the change of theories not all the terms change in their meaning. While most of the meanings remain the same only some of the terms change in their meaning. "The terms that preserve their meanings across a theory change", says Kuhn, "provide a sufficient basis for the discussion of differences and for comparisons relevant to theory choice" (Kuhn 2000, 36), and therefore, "Incommensurability thus equals untranslatability" (Kuhn, 1990, 299). Since there can be no perfect translation, among scientists there is no side-by-side or point-to-point comparison; a scientist has to learn from scratch as a learner of a new language does.

Check Your Progress II

Note: Use the space provided for your answers.

1) Write a short note of Kuhn's notions of: a) Paradigm, b) Normal Science c) Revolutionary Science

....
....
....
....

2) Kuhn speaks about *Essential Tension*. What is the tension he refers to? Explain what is essential about it?

....
....
....
....

3) "Kuhn's view on theory choice leads to mob psychology in science" – Do you agree with this accusation? Substantiate your position.

....
....
....
....

2.4 PAUL K. FEYERABEND (1924 - 94): LIBERATOR OF HUMANITY FROM SCIENCE

Feyerabend was born in Austria, in 1924. His studies (Physics) were interrupted by the World War II, in which he served an infantry officer in the German army. A bullet injury in his spine caused severe damages which troubled him till his death. After the war he switched over to philosophy of science. He spent a year in working with Karl Popper and for the rest of his life he lived in the USA. Strongly criticizing the positivists' view of science, he argued that their science was neither unique nor rational. He propagated this conviction, mainly in his celebrated works: *Against Method* (1975) and *Science in a Free Society* (1978). In this section, his significant ideas regarding the non-rational aspects of science and his sincere invitation to free human society from the clutches of science are presented.

Method(s) in Science Denied

Science is claimed to be rational because of its one (allegedly) special method. But history shows that there is no *the* method, suitable for all the domains of science. Feyerabend shows how Galileo systematically went against each of the rules of the methodological monists and this is a strong sign for the need for *methodological radicalism* and *theoretical pluralism*. Scientists violated the rules and even chose the opposite rules; they ignored the demands of rationality. Often these violations were *factual*, *deliberate* and even *absolutely necessary* for further growth in science. When a new theory is proposed it need not have all the empirical support as theories often obtain clarity only after a prolonged usage. To become empirically successful they need non-rational and non-sensical acceptance in the first place. Theoretical pluralism and methodological pluralism are preferable as they don't impose rigid rules on the scientific community and it is necessary for the growth of science, because, "Variety of opinion is necessary for objective knowledge" (1975, 46).

Epistemological Anarchism – Need not Lead to Chaos!

Anarchism, Feyerabend argues, is a requirement for any intellectual enterprise and he calls himself 'anarchist'. Anarchism may be objectionable in politics but certainly not in epistemology and this epistemological anarchism is needed to give the society the right picture of science. This is the aim with which he wrote *Against Method* (1999, 228). The absence of fixed rules in an anarchistic science will not land science in chaos. We need to trust in the well-ordered nervous system that the humans have developed over the millennia and this will save us from chaos (1999, 230). He does not encourage a chaos-like situation, in both theoretical pluralism and methodological pluralism.

Demands of Empiricism Rejected

Radical empiricism insists upon two conditions – *Consistency Condition* and *Meaning Invariance*. Feyerabend explains them as follows: "i) Only such theories are then admissible in a given domain which either contain the theories already used in the domain, or which are at least consistent with them inside the domain and ii) Meanings will have to be invariant with respect to scientific progress; that is, all future theories will have to be phrased in such a manner that their use in explanations does not affect what is said by the theories, or factual reports to be explained" (1999, p.926-7). He finds serious fault with both these criteria. Episodes from the history of science show that both these conditions have been violated, especially at those crucial points where great scientific revolutions took place; for instance, the relativity theory is shown to be violating both the conditions of consistency and meaning invariance. The first criterion, the *consistency condition*, increases the tendency to retain the older theory even in the face of contradictory observational evidence. A new theory is rejected if it goes against the prevalent theories; thus the age and familiarity become the basis for the theory elimination and "Had the younger theory been there first, then the consistency condition would have worked in its favour"

(1975, 36). Against the condition of 'meaning invariance', he maintains that 'contextual theory of meaning', by which, meaning of a term in a theory is determined by the context in which it occurs. For example, gravity was understood as physical force in the Newtonian theory of gravitation, while theory of relativity treats it as geometrical force. This meaning variance aspect leads to incommensurability.

A Strong Version of Incommensurability

Two competing theories are incommensurable. No common standards to evaluate their merits. Positivists argued that with the use of 'statements of purely observational language, uncontaminated by theoretical preconceptions', one can compare two theories. But since there is no pure observation and the meaning of the observation-terms of a theory is embedded in the theory, two theories can never be compared. This fact of incommensurability leads to a strict subjectivity in the realm of theory choice. Since there is no logical way of comparing various theories, we are left only with the "aesthetic judgments, judgments of taste, metaphysical prejudices, religious desires, in short, what remains are *our subjective wishes*" (1975, 285). Thus the notion of incommensurability shakes the claims of rationality in science.

Feyerabend – A Great Humanist

Feyerabend cautions humanity not to be carried away by scientism, the tendency to absolutize science. To ignore science is irrational, similarly to absolutize science is equally irrational. Being taken up by one-sided growth of science lot of harm is done to humanity and environment and therefore humanity is to be liberated from the clutches of science. Throughout his life his he voiced out his deep concerns for humanity and its liberty, in politics, science and in all intellectual pursuits. That is why he wanted the world to remember him basically as a simple and ordinary human being, who valued love the most. He wrote in his autobiography, on 11 February, 1994, just a couple of weeks before his demise: "My concern is that after my departure something remains of me, *not* papers, *not* final philosophical declarations, but love… That is what I would like to happen, not intellectual survival but the survival of love" (1995, 181).

Remarks

i) There are mixed reactions about Feyerabend's contributions. On the one hand, people like Gonzalo Munevar (1991) declares Feyerabend to be most important thinker of the 20th century, while on the other, there are people to call him 'a playful and childish thinker' who allows 'anything' to go (Schnädelbach, 1991);

ii) Feyerabend is against only the traditional understanding of rationality, which ignores subjective or rhetorical elements like judgement, emotions, intuitions, reasonableness etc. But he makes it clear that all these are essential components of scientific progress;

iii) It is encouraging to see that he does not reject metaphysics as meaningless. Not only the theoretical terms, but even the observational terms need theoretical background to understand. As Newton-smith has it, "… it is not that our observational judgments may have an ideological component, our observational judgments have no components that are not ideological" (1996, 139). That is why, Feyerabend is also convinced that "*a good empiricist must be a critical metaphysician*" (1998, 944).

iv) True, big scientists have produced very important theories by violating the well-cherished rules of their times and all scientists are not always rational in all the matters. But only a few that too the trend-setters of modern science fit Feyerabend's description; as Laudan says, "It is not scientific charlatans he is describing; rather… the figures he is writing about have always been considered as the folk heroes of our scientific culture" (Laudan 1989, 302), like Kepler, Copernicus, Galileo and Einstein, who come across as persistent 'cheaters' in the game of science, as they always seem to go counter-inductively, just not bothering about even the glaring falsifying evidence. Violation of rule is only an exception and but to make this exception a rule, that science always progresses, or has to progress this way, is a far-fetched claim. [Laudan's analogy: Just because a few cases of cancer spontaneously got cured without any medication, can one say, cancer does not need any treatment at all? Further, "To move from the alleged failure of two or three methodological rules to the presumption that all methodologies are hopeless is *to engage in just that sort of naïve inductivism about which he is otherwise so abusive*" (Laudan, 1989, 305-306)].

v) Feyerabend's idea of strong incommensurability is also problematic. If two theories don't have any point of comparison at all, we will not even know that they are completely different. Shapere proposes 'the chain-of-reasoning connections' between successive theories and the usages of the terms in them, which help us to compare them. At successive stages some properties or the other of the terms are dropped or added for specific reasons (Shapere, 2001, 199). For instance, from the times of Faraday and Thomson till today's quantum theory the idea of electron has changed greatly, but still we know that all these have been referring to something called 'electron'. The continuity and comparability of the usage is not due to some common descriptions or common reference, rather, "the rationale for saying that we have referred to the same thing all along is given by the linkage of reasons which gives continuity to the history" (Shapere, 1989a, 429) and thus incommensurability can be softened.

Check Your Progress III

Note: Use the space provided for your answers.

1) Write a short note on 'Epistemological Anarchism".

....
....
....
....22) What are the two major conditions of the Classical Empiricism that are challenged by Feyerabend? Explain.

....
....
....
....

2.5 NORWOOD RUSSELL HANSON (1924-67): CHAMPION OF THEORY-LADENNESS OF OBSERVATION.

N. R. Hanson, an American philosopher, a versatile personality – a baseball player, a heavyweight boxer and trumpet player, a daring fighter plane pilot and a creative writer in philosophy and history of science - served as a marine fighter during the World War II. He had his studies in Chicago, Oxford and Cambridge. He became the first university lecturer in philosophy of science. He has made significant contributions to the fields of philosophy of science, history of science, epistemology and aerodynamics. His well-known work, *Patterns of Discovery* (1958), clearly argued for the theory-ladenness of observational account. His eventful life was tragically cut short by a plane crash on a mountain near Cortland, New York, with ten of his books in progress.

The Relevance of 'The Context of Observation'

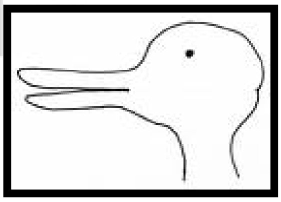
Hanson challenges the views of Logical Positivism (LP) in his very important book, *The Patterns of Discovery*. LP, focusing only on the finished products of science, seems to pay no attention to the *context of discovery*, as they think only the *context of justification* is important for philosophy of science. But Hanson argues that since all observations are theory-laden, this distinction between the contexts cannot be very sharp. He explains it with an example: Kepler and Tycho Brahe watch the sunrise; as Kepler believes in heliocentric universe and Brahe believes in the geocentric universe, do they see the same sun or different things? Traditional people would say, following the sensory core theory, that both see the same thing but interpret it differently but Hanson argues that both see two different things. For, interpretation is part and parcel of observation and 'seeing' already involves conceptions and theoretical frameworks (1967, 4-5).

Hanson explains this better with the examples employed by Wittgenstein in the *Investigations*; for instance, the picture of duck/rabbit or faces/vase. Seeing a picture as rabbit and seeing the same picture as a duck amounts to seeing two things. In seeing as such there is no interpretation involved. The change from rabbit to duck takes place fast and spontaneously. What changes is the organization of what one sees. 'The organization is neither an element in the visual field nor anything that registers on the retina; rather it is the way in which elements in the visual field are appreciated'. Such an appreciation involves theories. Thus what we see is influenced by the theories we hold. Hanson argues, therefore, that *seeing is always seeing that* and 'that' is something depends on the background one has. It is not the eyes or the camera that see things, but the people see and they always see with background theories and "there is more to seeing than meets the eyeball" (Hanson, 1998, 341).

Causality is Theory-laden

Hanson denies the traditional, metaphysical type of cause-effect relationship. Following Hume, Hanson sees causal relationship as psychological, with no necessary connection between them. Causality is human way of understanding the functions of nature, rather than a feature of nature itself. We find causality a convenient tool to explain natural phenomena, to simplify and facilitate inferences. The causal connections are limited to rare and accidental happenings. Causes are found with effects, not because of some cosmic bonds that keep them together, but because our theories connect them.

Logic of Discovery



After careful analyses of case-studies in history of science, Hanson comes out with a pattern of discovery: To solve a problem at hand, first a workable hypothesis is proposed. This must fulfil some expectations, like it must have initial plausibility for solving the problem, be coherent with the existing background assumptions, logical and empirical methods of testing. So for him the logic of discovery is 'inferring novel hypotheses' from problematic situations. He agrees that discovery of hypothesis involves ingenuity, creativity, insight and imagination but along with these psychological factors, there are also some logical aspects involved in the process of proposing a particular hypothesis. There are some reasons to propose hypothesis, *A*, rather than *B*. Testing a hypothesis is different from 'plausibility considerations' which help us to decide whether to propose a hypothesis or not. So the plausibility is also determined based on some evidence. For instance, to explain the velocity of Mars, Kepler considered a non-circular orbit, rather than taking into account the colour of Mars or the presence of other planets etc. He rejected many such factors, and decided upon the orbit of Mars as a plausible hypothesis. To choose this one as a plausible one, he had some reasons, not just psychological factors.

At the time of proposal, one cannot demand 'true' hypothesis, but one can look for 'plausible conjectures'. There is a distinction between 'reasons for accepting a hypothesis' and 'reasons for proposing the hypothesis in the first place'. To show that the context of discovery is not purely ruled by psychological factors and there are reasons to show why a particular hypothesis is considered worthy of testing, following C. S. Peirce, Hanson proposed *logic of abduction*, which investigates the norms used in checking whether a hypothesis is worth considering. [*Abduction* refers to the process of arriving at an explanatory hypothesis for a case at hand; we deduce *P* (e.g. it has rained) from *Q* (e.g. the ground is wet), because *P* is sufficient (or almost sufficient), but not necessary for *Q*. Peirce describes this kind of logical inference as 'guessing', that comes prior to induction and deduction].

Remarks

i) Hanson stirred a lot of controversy and debates in the philosophical and scientific circles, though he could not gain disciples. He seems to be more interested in critiquing others rather than developing his own system of well-thought out logical systems. ii) If Hanson treats causality as mere conjunctions as Hume does, he has to answer all the objections raised against Hume; for instance, how to differentiate accidental conjunctions and more regular law-like relationships between cause and effect? iii) Regarding the logic of discovery, he seems to have mistakenly conflated plausibility arguments (which help us to choose one from many available hypotheses) with discovery as such. Further, though it is meaningful to distinguish the 'plausibility considerations' in proposing a hypothesis from the procedure of confirming it; but it is not clear whether they are merely subjective prejudices and psychological beliefs of the scientists and whether or not they have any legitimate role in science. So, though he gave us the patterns of scientific discoveries, he could not work out logic of discovery.

Check Your Progress IV

Note: Use the space provided for your answers.

1) "Observation cannot be separated from interpretation". Discuss this claim with reference to Hanson's ideas on observation.

....
....
....
....

2) What is the 'logic of discovery' of Hanson. Do you agree with it? Explain.

....
....
....
....

2.6 LET US SUM UP

Historicist philosophers of science have challenged the rational and objective picture of science, proposed by the logical positivists. Kuhn, Feyerabend and Hanson and others argue that no methodology or criteria for rationality is to be thrust upon science; rather they emerge from the actual practices of the scientific community. They insist on the need for socio-cultural, historical and moral factors to understand science and to do philosophy of science. However, with this approach, one may make science totally relative and irrational if one is not cautious. This is perhaps taken care of by the historical realists (See: Unit 3), who treat science as social enterprise while upholding its rational character as well.

2.7 KEY WORDS

Incommensurability: It simply means ‘communication breakdown’. Since historicists stress the ‘contextual theory of meaning’ of the terms in a scientific theory, they argue that the followers of different scientific paradigms suffer from the problem of incommensurability in understanding each other.

Theory-ladenness of observation: There is no ‘pure’ observation; no observation is theory-free. Human observation is not like the recoding by an instrument. It is not that we see something and then interpret, but our seeing itself involves interpretation, as our seeing is coloured by our background theories. It is not that ‘eyes’ see, but ‘we’ see.

2.8 FURTHER READINGS AND REFERENCES

Anderson, G. *Criticism and the History of Science: Kuhn’s, Lakatos’ and Feyerabend’s Criticisms of Critical Rationalism.* Leiden and New York: Brill, 1994.

Brown, H. *Rationality*. London: Routledge, 1988.

Feyerabend, P. *Against Method.* London: New Left Books, 1975.

------------ *Philosophical Papers*. Vols. 1 and 2. Cambridge: Cambridge University Press, 1981.

------------ “How to Be a Good Empiricist – A Plea for Tolerance in Matters Epistemological.” in *Philosophy of Science – The Central Issues.* Ed. Martin Curd and J.A. Cover. New York & London: W. W. Norton & Company, 1998.

Friedman, M. “Kuhn, and the Rationality of Science.” in *Philosophy of Science.* Vol. 69 (2002). 171-190.

Gutting, G. Ed. *Paradigms and Revolutions. Applications and Appraisals of Thomas Kuhn’s Philosophy of Science.* Nortre Dame, IN: University of Nortre Dame Press, 1980.

Hanson, N. R. “Notes Toward a Logic of Discovery.” in *Perspectives on Peirce: Critical Essays on Charles Sanders Peirce*. Ed. Bernstein. New Haven: Yale University Press, 1965. 43–65.

------------ *Patterns of Discovery*. Cambridge: Cambridge University press, 1958. Also New York: Cambridge University Press, 1967.

------------ *What I Do Not Believe, and Other Essays*. Ed. Toulmin and Woolf, (Dordrecht: Reidel, 1972).

------------ “Observation.” in *Introductory Readings in the Philosophy of Science.* Ed. E.D. Klemeke. Et al. New York: Prometheus Books, 1998.

Horwich, P. Ed. *World Changes - Thomas Khun and the Nature of Science*. Cambridge, MA: MIT Press, 1993.

Hoyningen-Huene, P. *Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science*. Chicago: University of Chicago Press, 1993.

Klee, Robert. Ed. *Scientific Inquiry – Readings in the Philosophy of Science.* New York: Oxford University Press, 1999.

Kuhn, T. S. *The Structures of Scientific Revolutions.* Chicago, IL: University of Chicago Press, 1970.

------------ *The Essential Tension - Scientific Tradition and Change.* Chicago, IL: University of Chicago Press, 1977.

----------- “Remarks on Incommensurability and Translation.” in *Incommensurability and Translation: Kuhnian Perspectives on Scientific Communication and Theory Change*. Ed. Rema Rossini Favretti. Et. al. Cheltenham, UK: Edward Elgar, 1999. 33-37.

----------- *The Road Since Structure: Philosophical Essays.* Ed. James Conant and John Haugeland. Eds. Chicago and London: University of Chicago Press, 2000.

------------ “Objectivity, Value Judgment and Theory Choice.” in *Philosophy of Science – Contemporary Readings.* Ed. Yuri Balashov and Alex Rosenberg. London & New York: Routledge, 2002.

Ladyman, James. *Understanding Philosophy of Science.* London & New York: Routledge, 2002.

Lakatos, I. “Falsification and the Methodology of Scientific Research Programmes.” in *Criticism and the Growth of Knowledge.* Ed. by Lakatos and I. Musgrave. Cambridge: Cambridge University Press, 1970.

Lakatos, I. “Popper on Demarcation and Induction.” in *The Philosophy of Karl Popper.* Ed. Paul Arthur Schilpp. La Salle, Illinois: Open Court, 1974.

------------ and E.G. Zahar. "Why Did Copernicus's Programme Supersede Ptolemy's?" in *The Copernican Achievement*. Ed. R. Westman. Los Angeles: University of California Press, 1976.

Laudan, L. *Progress and its Problems*. Berkeley: University of California Press, 1977.

Schnädelbach, Herbert. "Against Feyerabend," in *Beyond Reason*. Ed. Gonzalo Mune′var. Netherlands: Kluwer Academic Publishers, 1991. 433-448.

Roberts, D. David. *Nothing But History: Reconstruction and Extremity after Metaphysics*. Berkeley: University of California Press, 1995.

Salmon, Wesley. "Rational Prediction." in Martin Curd and J.A. Cover. Eds. 1998. 433-444.

Shapere, Dudley. "Evolution and Continuity in Scientific Change." *Philosophy of Science*. 56 (1989a). 419-437.

----------- "Reasons, Radical Change and Incommensurability." in *Incommensurability and Related Matters*. Ed. Paul Hoynjingen-Huene and Sankey. Netehrlands: Kluwer Academics Publishers, 2001. 181-206.

Stove, D. *Popper and After: Four Modern Irrationalists.* Oxford, Pergamon Press, 1982.

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_l; 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?

……
……

………
………………………………………………………………………………………

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

………
………
………
………………………………………………………………………………………

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?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………………………………………………………………

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

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………..………………………………………..

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?

....
....
....
....

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

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

....
....
....
....

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 READING AND REFERENCES

Collingwood, R. G. *Speculum Mentis.* Oxford: Clarendon Press, 1924.

Faye, Jan. "Observing the Unobservable." in *The Reality of the Unobservable.* Ed. E. Agazzi, and M. Pauri. Netherlands: Kluwer Academic Publishers, 2000. 165-175.

Goldstein. *Historical Knowing.* Austin: University of Texas Press, 1976.

Laudan, Larry. *Progress and Its Problems – Towards a Theory of Scientific Growth*. California: University of California Press, 1977.

----------- *Science and Hypothesis.* Dordrecht: Holland, 1981.

----------. *Science and Values – The Aims of Science and Their Role in Scientific Debate*. California: University of California Press, 1984.

Lakatos, I. “Falsification and the Methodology of Scientific Research Programmes.” in *Criticism and the Growth of Knowledge.* Ed. Lakatos and I. Musgrave. Cambridge: Cambridge University Press, 1970.

----------- *The Methodology of Scientific Research Programmes: Philosophical Papers.* Two Vols. J. Worral and G. Currie. Ed. Cambridge: Cambridge University Press, 1978.

Palter, Robert. “Philosophic Principles and Scientific Theory.” *Philosophy of Science.* 23 (1956). 111-35.

Shapere, Dudley. “The Concept of Observation in Science and Philosophy.” *Philosophy of Science.* 49(1982). 485-525.

----------- “Unity and Method in Contemporary Science.” in *Scientific Knowledge.* ed. by Janet Kourany. California: Wadsworth Publishing Company, 1987.

----------- “Rationalism and Empiricism: A New Perspective.” *Argumentation* 2 (1988). 299-312.

----------- “On the Methods of Science.” in *The Creation of Ideas in Physics.* Ed. Leplin. Netherlands: Kluwer, 1995. 13 – 27.

---------- “Reasons, Radical Change and Incommensurability.” in *Incommensurability and Related Matters.* Ed. Hoyningen-Huene and Sankey. Netherlands: Kluwer Academics Publishers, 2001. 181-206.

UNTI 4 KEY ISSUES IN PHILOSOPHY OF SCIENCE

Contents

4.0 OBJECTIVES

The unit tries to dwell on the key issues in philosophy of science such as induction, observation, perception, hypotheses, generalization which are very crucial in understanding the issues in philosophy of science.

4.1 INTRODUCTION

Philosophy of science is interpreted as a critique of science. Another interpretation is that it is an inductive metaphysics. The third interpretation is that it is a pragmatic of science. As a critique of science it analyses the language of sciences; the semantics and syntax of scientific language is analysed. As an inductive metaphysics, it uses the inductive method of science, but unlike science it focuses on the study of transcendental entities also. The key issues in philosophy of science include scientific method, discovery of theory in science, structure and validation of scientific theory and scientific explanation. As pragmatics of science philosophy of science tries to relate the findings of the scientists to the human welfare and upliftment.

4.2 DISCOVERY OF THEORY OF SCIENCE

The philosophy of science considers the various sciences as finished products of a historical process. The historical order of development is determined by curiosity, accident, or the pressure of necessity. Science explains, while philosophy tries to understand. All scientific theories can be traceable to the acceptance of four matters of facts: That something exists; that something can be known; that there is something which matters; and that something makes sense and can be reflected upon. The above four matters of fact correspond to four branches of philosophy; Ontology or the theory of being, deals with what exists; Epistemology or the theory of knowledge, deals with what can be known; the theory of value, sometimes called axiology; Logic. Since scientific knowledge is empirical, there are three problematic steps to be examined; the step from any experience at all to experience of a world of one's own; the step from experience of that world to knowledge of it; and the step from knowledge of that world to knowledge of a world in common.

4.3 PERCEPTION, THOUGHT AND LANGUAGE

In order to understand the transition from experience to knowledge, it is necessary to put oneself in a position of experiencing. For this purpose Edmund Husserl recommended a process called 'bracketing'; this means for getting all that one has learned in order to take an unprejudiced look at what is presented. Phenomenologically the objects perceived are intentional objects. The world of phenomena reveals the properties, configurations, process, sequences etc., of the objects perception. Perception means a grasping of something through the senses (perception = sensation + interpretation). However the perceptual experience of the world is incomplete because of the limitations of our sense organs. Any scientific theory is structured on the basis of this incomplete sense data. Thought is a mechanism for the synthesis of al full world out of the bits and pieces of experience. It is regarded as a second convenient hypothesis (the external world was the first). Concepts are a set of hypothetical entities which correspond to percepts. Concepts function through recognition, identification, and representation. Concepts have ontological status. They also evoke a habit of expectations. They are functional entities. Any language has the following three essential ingredients; the sign, the thing of which it is the sign and the person to whom it is a sign of that thing or in other words sign, object and the interpreter. A set of signs having understood meanings constitutes a language. The realms corresponding to object, sign and interpreter are percept, term and concept which can be connected in the following way;

All languages begin as ordinary languages, under the pressure of the immediate necessity of communication. Some percepts have corresponding concepts and terms. But it is possible to have some terms and concepts without corresponding percepts. The language of science is a standard language. It has its own special vocabulary, referring to particular kinds of obejcts and process. A language which is being used to talk about the world is called an object language. The language which we use to discuss this first language is then called a meta-language. For instance, the sentence, "The sentence, 'Copper Sulphate is solvable' is a metalinguistic philosophic remark mentioning a scientific sentence (belonging to the object language) which actually says something about Copper Sulphate.

The Correlation of Perception, Thought and Language

Starting from perception science proceeds to the construction of conceptual schemes whose order reflects the order of perception and links these with specialized languages for the purposes of making predictions. Language thought and percept can stand alone. In the condition of awareness, in our aesthetic experience we are able to concentrate on perception to the exclusion of language and conceptual thought. In logic two systems are said to be isomorphic if every element of one system can be matched with a unique element of the other and vice versa. A rule linking thought and perception can be found in concept formation – it is the rule which covers the use of language for the expression of thought and the description of perception. A rule linking thought and perception can be found in concept formation – it is the rule by which perception stimulates thought and thought recognizes and represents objects of perception. In the correlation of perception, thought and language the following kinds of relation are relevant; logical and grammatical relations in language, spatial and temporal relations in perception, whatever psychological theory calls for in thought.

Classification

The relation between the term and the object to which it refers in perception maybe thought of as a one-to-one relation, but this is obviously a gross over simplification. To begin with, words do not exist as single entities but as collections of utterances and inscriptions, each one a particular use of the word on a particular occasion. A distinction has been made between the word 'type' which is embodied on each such occasion and the word 'token' which is its concrete physical embodiment as an individual sound or mark. The token is a sign in the original sense; the type belongs to language on a more abstract level. Aristotle developed a theory of universals in the things. According to this theory everything was a combination of two elements, form and matter, the matter accounting for the things being a real thing in the world, and the form accounting for its being the kind of thing it was, and thus p[laying the parts of the universal. The forms were arranged in a hierarchy of definition by genus and species, as is still done for the animal and plant worlds, everything having its place in a logical order. What science aims at is the development of concepts which will stand for any individual in a particular class, on the assumption that there is a similarity between the members of the class which entails a similarity in their behavior under similar circumstances. We may distinguish four different senses of similarity, in descending order of usefulness for purposes of classification. The first may be called genetic similarity that is between objects having similar origins; The second structural similarity, between objects having similar constituent parts, or similar relations between their parts; The third is the functional similarity, between objects having similar behavior.

Definition

The class of actual objects or events to the members of which a term applies correctly is called the denotation of that term and while the term denotes the objects in question, the objects constitute a definition of the term. On the most primitive level a term may be defined by pointing out something to which it applies, that is by showing its meaning, and this procedure is known as ostensive definition. (Ex. 'zebra' is meant animal or striped or four legged.) Terms can be defined away by means of other terms, but there will be at lease some terms left for which no such definitions are available. A list of the properties which an object must possess if it is to be included in the denotation of some term specifies the intention of the term. The more restricted the denotation, the more detailed the intention. The extension of a term is the class of all possible objects, past or future, known or unknown, which if they existed would belong to its denotation; the connotation of a term is specified by a list of the properties which the members of its denotation happen to have in common including those properties which constitutes intention. Definitions of terms by reference to other terms belonging to the same language systems are internal definitions, which go outside the language are external definitions. Where a term is defined by means of other terms the original term (the *definiendum* – that which is to b e defined) is eliminable in favour of the term or terms used to define it (the *definiens).* A contextual definition is an explicit definition of a context or class of contexts in which the term defined occurs. The decision to call the element of atomic number 100 '*fermium'* was a stipulative definition both in the internal and external senses – internally because it enabled scientists to replace circumlocutions such as the one above (or the next element after '*einsteinium'*) by the term fermium and externally because there is an actual substance which is named fermium. In lexical definition, the definition of a term is derived from a dictionary. In a historical order of definition theories were put together rather unsystematically, depending on accidents of discovery. But in the heuristic order of definition new concepts are introduced in the most appropriate places. The introduction of a formalized language brings about the logical order of definition.

4.4 GENERALIZATIONS, HYPOTHESES, LAWS, PRINCIPLES AND THEORY

A scientist records his observation through a protocol sentence which asserts that something is in fact the case. A protocol sentence can be reached after something is in fact the case. A protocol sentence can be reached after a finite number of observations and it must be intersubjectively corroborated. An empirical generalization "All 'A's are 'B'" is arrived at after every individual observation:

This A is B
This A1 is B

.. All A's are B

One protocol sentence "A1 is not B" (contrary instance) is enough to ruin the empirical generalization. An empirical generalization might be defined as any sentence whose contradictory has the form of a protocol sentence. Sometimes sentences of the form, "If A then B" will also be protocol sentences. Sentences about electron are given the status of 'hypothesis' since electron is not observable. Hypothesis always contain theoretical terms, since any universal sentence containing only observation terms would necessarily have a protocol type sentence for its contradictory. Not all sentences containing theoretical terms or propositions about theoretical constructs, are hypothesis – only those from which empirical generalizations follow. The truth or falsity of a sentence does not affect its logical classification, and tests of truth or falsity on empirical grounds don't belong to logic. A hypothesis may become a generalization through the refinement of techniques of observation. Generalizations emerge naturally after a number of particular observations, while hypothesis have to be invented. Anybody can make the jump from 'many' to all but it takes a genius to jump, ass J.J. Thomson did from the discharge of electricity in gases to the electron. Every sentence of science falls into one or another of these categories; protocol sentences, empirical generalizations or hypothesis.

Laws, Principles and Theory

A true empirical generalization, either affirmative (All A's are B) or conditional (If A, then B) is called a law, which is accepted as true. The logical status of the scientific law depends on its being a generalization and nothing else, but its historical status depends on what scientists of the period believe and this reflects what we mean by scientific law. There are no immutable laws of nature as only 'accepted generalization' is defined as a law. The distinction between hypothesis and empirical generalizations suggests a distinction between two different kinds of scientific law, one corresponding to empirical generalizations which are accepted as true and the other to hypothesis which are accepted as true. The law of conservation of energy is a hypothesis accepted as true since energy is not observed, but rather the penetration of bullets is observed. Principles are hypothesis accepted as suitable starting points for theoretical work. All generalizations accepted as true have the status of laws, and all hypotheses accepted as true have the status of principles.

A theory is set of universal propositions asserted by means of a corresponding set of universal sentences. These sets are isomorphic with one another. A theory is constantly changing; new laws are discovered, old ones discarded or forgotten. Scientific theory, finally constitutes a particular outlook on the world. The term comes from the Greek '*theorein*' – to look at; Scientific theory means knowledgeable out look. There are other outlooks of the world also apart from the scientific outlook of the world.

The Structure of Theory

Protocol sentences, empirical generalizations and hypothesis have empirical content. But a scientific theory has a logical structure which can be abstracted from all empirical content and studied in isolation. A theory is a structure of sentences without any accompanying scheme of constructs. The structure of the theory deals with the systematic internal organizations of theory. In the analysis of the structure of theory we have to abandon empirical truth and introduce a new kind of truth called logical truth. Formal logic is one which is concerned more with the relations of sentences rather than the content and meaning of sentences. A set of sentences in which the truth of the last (the conclusion) follows from the truth of the others (the premises) is called an argument and every inference may be expressed in an argument. Deductive logic serves for propositions and hence is often called 'propositional logic'; it is also called sentential logic. Sentential logic does not look as the internal structure of sentences but their external relations. Predicate logic deals with the internal structure of sentences. Set theory which is a recent development is due to Boole who contributed to the logic of classes. Sentential logic and predicate logic are both very ancient disciplines. The first was developed without using symbols by Aristotle and the second by Stoics. The present formulation the both the logic are due to Frege, Russell and Whitehead. In a formalized language system a calculus means a tool of calculation. The sentences from which calculation begins are called axioms. Any sentence arrived at according to the rules, starting from the axioms, is called a theorem, and the series of sentences starting with axioms and ending with the theorem, which exhibits the steps in the process is called a proof of the theorem. Pure logic is not interested in the empirical content and therefore it is an uninterrupted calculus. The concern with content provides the calculus with an interpretation by following the rules of correspondence. A rule of correspondence is as kind of definition. It establishes a relationship between the language we use to talk about the world and the language we use to exhibit purely logical truths. Sometimes the same calculus may have more than one interpretation. The calculus of which the kinetic theory of gases is an interpretation (based on the domain of gas molecules) is the same as that of which the theory of elastic collisions in Newtonian mechanics is an interpretation (based on the domain of homogeneous spherical objects whose masses and elastic module are such as to allow them to undergo collision without permanent deformation and without fracture); it is only that the two calculi have the same form, but they are the same calculus. Therefore it is possible to have the same model for two different calculi. In the structure of a theory, measurement is used as a tool to explain the empirical phenomena. Measurement is a mathematical formalism in which what is qualitatively observed is given in quantities. In measurement a set of numbers operationally generated means nothing unless it is taken as indicating a relationship between aspects of the world, which in their theoretical setting are concepts. A measurement does not establish as connection between theory and the world; it establishes as connection between two theories, as connection between the numbers and what they stand for.

Validation of Theory

In Scientific theory the scheme of constructs is the customary interpretation of the logical calculus. The calculus has been developed to a point, where given suitable techniques of measurement, all the resources of mathematics may in principle be brought to bear on the solution of scientific problems. The truth of the calculus depends deductively on its axioms and is asserted only hypothetically. In the validation of theory we inquire how such a hypothetical system can be grounded in observation in such a way as to render it reliable as an instrument of explanation and prediction. There are three indispensable qualifications which any sentence in the theory ought to possess. The sentences should be: (a) formally correct (b) relevant; and (c) reliable. Both discovery and structure of theory discuss at length the formal correctness and relevance of the sentences to scientific theory. The meaningfulness of a sentence lies in its verifiability. But the criterion of verifiability prevents universal statements from having any meaning, since all that can be confronted in experience is particular. Therefore the criterion was modified in the direction of confirmation rather than of verification. The introduction of conformability raised the question as to how much evidence was required in order to say that a sentence was actually confirmed, and this led to the notion of degrees of confirmation. This development gave rise to an important new branch of inductive logic. The logical problem of induction is inferring a universal statement from a number of particular instantiations of it. But the inductive arguments may be strong or weak, depending on the probability of their conclusion. A successful scientific theory is one which is practically useful for the society. The method of arriving at truth in science has the following pattern: hypothesis, deduction and test. The scientific method has the following stages before arriving scientific laws: observation, analysis of empirical data, hypothesis and laws. Scientific method as a methodological inquiry aims at the reliability of explanations. It is also leading to intellectual exercise tying down of abstract logical systems to empirical contents. In this sense it is relevant to the validation of theory.

4.5 SCIENTIFIC EXPLANATION

There are events taking place around us. These events evoke curiosity in us and therefore naturally we ask, "why at all the events are taking place the way we observe them?' The common man can explain the events from his own perspective. But the scientific explanations are different from the explanations of the common–sense. Scientific explanations not only explain the present occurrence of events but also predict the future occurrence of events. Some philosophers of science find asymmetry between explanation and prediction. But there are some who oppose such asymmetry between explanation and prediction. Those who hold the symmetry thesis believe that scientific explanations not only explains the present occurrence of events but also control the future events. Explanation of events and description of events are not the same. Those who describe the occurrence of events merely describe the state of affairs and do not go beyond it. Empirical phenomena which are explained can be classified as (a) physical (b) Biological and (c) Social. The methodology adopted to explain the physical phenomena is not the same as the methodologies to be followed to explain Biological and Social phenomena. The explanations offered by the scientists will also be questioned by the emergent evolutionists like Lloyd Morgorn. According to the emergent theory the constituents of objects will lead to the 'emergence' of 'novelties' and hence the explanation is inadequate. The explanation must incorporate the novel qualities of the objects for better understanding of the events around us. In scientific explanation the case to be explained is called *Explanandum* and the premises or the statements such as Laws from which Explanation is deduced is called *Explanan.* There is a logical relation between *Explanan* and *Explanandum.* The explanation of individual events is different from the explanation of Scientific Laws. Inductive and deductive are the two patterns of Explanations. Inductive pattern is invariably connected to the probabilistic kind of explanation. There are many kinds of deductive pattern of explanation.

There are four kinds of Explanations; (1) Deductive (2) Probablistic (3) Teleological and (4) Genetic.

Deductive Explanation

In the deductive kind of explanation the *explanan* is a universal law from which Explanation is deduced for an *Explanandum.* Ex. Why the addition of the odd numbers always ends up with a square?

1,3,5,7,9,11……

$1 = 1^2$

$1= 3 = 2^2$, $1+ 3+5 = 3^2$, $1+ 3+ 5+7 = 4^2$ etc….

Here the *explanandum* is explained from an *explanan* which is a universal law of mathematics.

Ex. Why there is moisture on the outer surface of a glass tumbler whenever we pour ice water? Here the *Explanan* in the premise is a law in physics (law of thermodynamics). When we pour ice water into a glass tumbler the atmospheric water vapour comes into contact with the cooler part of the tumbler. The water vapour transforms into droplets of water and hence there is a moisture on the outer surface of the tumbler.

Ex. Why the percentage of Catholics committing suicide was more than the protestants during the last quarter of 19th Century in England? Here the *Explanandum* to be explained is related to historical fact. Therefore the *Explanan* is a historical evidence from which explanation is deduced. In the deductive pattern of *explornation* the relation between *explanan* and *explanandum* is logical. Therefore this kind of explanation fulfills the rules of deductive logic.

Probabilistic Explanation

In the case of deductive explanation, the explanation is deduced from the *explanan* which is an invariably established law of science. The empirical validity of the premise is not verified. The validity of the *explanan* is taken for granted. Only the *explanandum* has the observational element. But in the probabilistic explanation there is a 'jump' from some cases to all cases, i.e., from 'particular' to 'universal.' Inductive generalization is interpreted as probabilistic explanation. When there is a jump from some to all or from particular to universal there is only 'inference' and not 'certainty.' Ex. When we observe clouds causing rain in the 'present,' we 'predict' that there will be rain preceded by clouds. But sometimes there may be clouds not followed by rain. In this circumstance we have to admit that there is no necessary relation between clouds and rain. So also if a physician prescribes a 'drug' for the present aliment we cannot say 'certainly' that in future also the same drug will cure similar ailment. The drug may 'probably' cure similar ailments in future. The 'causal' relation we observe between two sets of circumstances in the present may or may not be true in future. Under these circumstances we can not claim that there is certainly for the future occurrence of events. Hempel's covering-law-model of explanation tries to establish a kind of logical necessity between 'explanation' and 'prediction.' But probabilistic explanation does not support any kind of necessary relation between explanation and prediction. The future occurrence of an event is only probably true. Some of our observations of clouds followed by rain in the present will hold good for the future only probably.

Teleological Explanation

Empirical statements which are 'purposive,' are called teleological statements 'why do we have lungs?" The answer should give the purpose of the lungs in our body – the inhalation of air so that Oxygen can be utilized in blood circulation. Similarly all parts of our body have specific functions t perform. The teleological or functional aspect is relevant not only to the parts of our body but also to several natural or artificial objects around us. These objects have got specific functions to perform. In certain cases the purpose will be achieved in future. The growth of paddy crops will lead to the yield of the grains of paddy. Therefore the 'biological development' of paddy crop is in the process of achieving a purpose. However we cannot say that any biological process will lead to only one purpose. Same biological function may lead to achieving several purposes. A particular biological structure has the function for a particular purpose. However the same purpose can be achieved through different structures. For example for the movement from one place to other different living creatures have different structures. Man, cow, bird, snake and fish have different structures for achieving the purpose of 'movement.' There is no '*termini'* for the biological functions. In other words what is '*terminus*' for a particular biological function is the 'beginning' for several other biological functions. For example the 'corn seeds,' which is the terminus for a particular function, may lead to several other biological developments. The corn seed eaten by birds and goats may lead to different kinds of purposes. In the case of physical and chemical phenomena purpose is invented by human beings. Most of the cosmic and astronomical phenomena are 'accidental' in nature. Man carves out a 'purpose' in a 'purposeless' natural phenomenon.

Genetic Explanation

Some of the questions can be answered only if we have the facts relating to the 'history' of a phenomenon. For example, "why is there Indo-Pakistan conflict which resulted in three wars between the two countries?" The answer can be given by tracing the history of India, partition of the country on the basis of religion, the earlier invasions of India by the Arabs etc. In other words explanation of this kind is based on the analysis of the genesis of the problem. Any phenomenon whether it is physical, biological or social has its own evolutionary history. Unless we have the facts of the past of a process the explanation will not be adequate. The present circumstances or factors which may be seemingly the cause of a particular phenomenon may not be sufficient in offering in adequate explanation. Therefore Genetic explanation plays a important role in the explanation of social phenomenon in particular.

Explanation of Biological phenomena

Explanation of physical phenomena and the methodology adopted to do so is not sufficient to the explanations of biological phenomena. Mechanistic interpretations of biological phenomena hold well when 'biological processes' are understood in terms of 'physical' and 'chemical' concepts. In other words 'reductionism' is followed in understanding biological processes. But reduction of biological process into physical and chemical process will lead to an explanation which is inadequate since biological phenomena are 'organismic' in nature. The whole is more than the sum of the parts in organismic biology. The lower order of a biological system 'conditions' the higher order functioning. Each system such as 'digestion,' 'blood circulation' and 'brain' are too complex in nature. Each complex system is facilitated by the lower order functions. Each complex function has purpose. All the individual systems perfectly coordinate in such away that the human beings or any other biological organisms exhibit 'holistic' activities. Mechanical explanations however are not contradictory in the explanations of biological phenomena. Mechanical explanations are complemented by teleological explanations in the complete understanding of the biological phenomena.

4.6 METHODOLOGICAL PROBLEMS IN SOCIAL SCIENCE

Physical and chemical events can be explained by following universal laws which are nomothetic in nature. Historical phenomena which are individualistic and unique can not be explained on the basis of the laws governed by nomothetic sciences. Social sciences are 'ideographic' in nature and therefore the methodology adopted to explain such phenomena is different. Some of the methodological problems that arise when we explain social phenomena are: (a) controlled inquiry, (2) subjective nature of social subject matter, (3) knowledge of social phenomena as a social variable, (4) value oriented bias in social inquiry and (5) cultural relativity and social laws. Controlled inquiry: unlike in physics and chemistry wherein we can create experimental conditions at our will to conduct study, it is not possible to create experimental conditions in the study of societies which consist of the groups of human individuals. They are all free thinking individuals having ‘conscious’ goals of their own. Moreover historical phenomena are ‘unrepeatable’ whereas physical or chemical events can be repeated in the laboratories. Therefore ‘controlled inquiry’ is not practical. However there are surveys conducted in societies by using some variables to find out some facts.

Subjective Nature of Social Subject Matter

The observation of social phenomena and the observation of physical or chemical phenomena are not the same. Human beings have got subjective attitude which may not be revealed in their overt behavior. J.B. Watson’s behaviorism points out that man has got no ‘inner’ or ‘subject’ side for his behavior other than his overt behavior. But a man can ‘pretend’ outwardly that he is a happy individual while inwardly he is sorrowful. In this context a social scientist will not succeed in collecting complete data to draw conclusions.

Knowledge of Social Phenomena as a Social Variable

If the individuals come to know before hand that they are subject to questioning by social scientists for a specific inquiry they may sometimes feed the scientists with false data thereby distorting the outcome of such inquiry.

Value-oriented Bias in social inquiry

Social scientists are biased when reporting an event. It is not possible to get unbiased information about social phenomena. In fact in the very selection of phenomena for study the individuals are not free from value-orientation. To frame universal laws on the basis of such biased inquiry is meaningless.

Cultural relativity and social laws

Physical and chemical laws are universal in nature; but it is very difficult to arrive at universal social laws because of cultural variations in the society. Each social, religious and political group has its own laws. There are no uniform civil or moral laws universally applicable for all the societies. Therefore explanations of social phenomena by following universal laws are not possible.

Requirements for scientific explanation

There are logical and epistemic requirements for scientific explanation. The logical requirements consist in having premises (*explanans*) which are ‘more general’ than the *explanandum.* The premises must contain at least one universal law. The epistemic requirements consist in the premises to be true; the premises must be ‘known to be true.’ Both logical and epistemic requirements are necessary in scientific explanations.

4.7 LET US SUM UP

We have seen many crucial issues of the philosophy of science in this unit.

4.8 KEY WORDS

Teleological Explanation: Empirical statements which are ‘purposive,’ are called teleological statements.

4.9 FURTHER READINGS AND REFERENCES

Ruben, D. H. Ed. *Explanation.* Oxford: Oxford University Press, 1993.

Salmon, Wesley. *The Foundations of Scientific Inference.* Pittsburgh: University of Pittsburgh, 1967.

Putnam, Hilary. “Beyond Fact / Value Dichotomy.” *Critica* 14. 3 -12. [Reprinted in *Realism with a Human Face.* Ed. Conant. Cambridge: Harvard University Press, 1990].