CHAPTER III

CRITIQUE OF POPPER ON

THEORY DEPENDENT OBSERVATION
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3.1 Analysis of Foundational Problems

This section analyses the questions concerning the process of conceptualization. Popper’s attitude towards the starting point of science, observation of facts, formation and verification of the hypothesis are presented and analyzed.

3.1.i Science Starts with Problems

Popper starts his philosophical discussions in philosophy of science by refuting the claims of inductivist philosophers. For inductivist philosophers Science starts from pure observation and this point has been criticized and refuted by Popper. Popper makes two fold criticisms against inductivists. First place Popper reject the inductivist idea that science starts with pure observations. In the second place, Popper following Hume questions the justification of induction (In the previous chapter; the inductivist claim of pure observation and the opposite view, theory dependent observation has been discussed and in the first chapter criticisms against induction discussed in detail.) Popper considers induction as a myth. In popper’s own words, “Induction, i.e. inference based on many observations, is a myth. It is neither a psychological fact, nor a fact of ordinary life, nor one of scientific procedure.”1 Rejecting the notion that science starts with observations; Popper proposes that science starts with problems. He further builds his philosophical concepts of
falsification from this point. For him science starts with a problem and it proceeds in a method of trial and error. He argues,

> The natural as well as the social science always start form problems, from the fact that something inspires amazement in us, as the Greek philosopher used to say. To solve these problems, the sciences use fundamentally the same method that common sense employs, the method of trial and error. To be more precise, it is the method of trying out solutions to our problem and then discarding the false ones as erroneous. This method assumes that we work with a large number of experimental solutions. One solution after another is put to the test and eliminated.²

To explain his concept clearly Popper explains how a group of physics students responded to a fundamental question of induction. A group of students came to visit Popper. Each of them was given a sheet of paper and a pencil. They were instructed to ‘observe’ and write down what they ‘observe’. The students asked what Popper was asking them to ‘observe’. Popper uses this question of the students to make it clear that the science does not start with pure observation and he further argues that there is nothing called ‘pure observation’. The question of the students is most relevant in the field of science. Observation is always directed or selective. Popper argues, “It needs a chosen object, a definite task, an interest, a point of view, a problem.”³ To put this observation, we need a language and this descriptive language
in turn presupposes similarity and classification with the property words. When they
are used; that presupposes interests, points of view and problems. Popper quotes Katz
in order to make clear how the observations in animals are theory dependent. “A
hungry animal divides the environment into edible and inedible things. An animal in
flight sees roads to escape and hiding places…Generally speaking, objects
change…according to the animal.”\(^4\) Popper argues that what we observe with the
animals is applicable to scientists. Animals are guided with their needs, the charge of
the instant and their expectations while they observe the nature. The scientists in the
same way are guided while they are making an observation. According to Popper they
are guided by, “his (their) theoretical interests, the special problem under
investigation, his conjectures and anticipations, and the theories which he accepts as a
kind of background: his frame of reference, his horizon of expectations.”\(^5\)

3.1.i.a Inborn Expectations

Popper examines that frame of reference or the conjecture with which a
scientist starts will have been preceded by observations. The observations must haven
the ones for which the conjecture was formulated to explain. Those observations in
fact must have been preceded by a conjecture or a problem. Those observations on the
light of the conjecture might not be explained thus there was a need for a new
conjecture. Thus according to Popper, going backwards through conjectures and
observations we reach more and more primitive theories and myths. He argues that in
the search one may end at ‘inborn’ expectations. Here the individual makes a clear
distinction between ‘inborn expectations’ and ‘inborn idea’. To him ‘inborn ideas’ are
absurd. He argues that all organisms have inborn reactions or responses. Some responses are adapted to awaiting events. Popper calls these responses as ‘inborn expectations’. Understanding the close connection between expectation and knowledge, he calls ‘inborn expectation’ as ‘inborn knowledge’. To Popper this knowledge is however not ‘valid a priori’. He argues,

Thus we are born with expectations; with ‘knowledge’ which, although not valid a priori, is psychologically or genetically a priori, i.e. prior to all observational experience. Once of the most important of these expectations is the expectation of finding a regularity. It is connected with an inborn propensity to look out for regularities, or with a need to find regularities, as we may see form the pleasure of the child who satisfies this need.⁶

Popper here makes very clear that the ‘inborn knowledge’ which is psychologically a priori is not the same as the ‘law of causality’ of Kant which is part of our mental outfit and valid a priori. Popper argues that his concept of ‘inborn knowledge’ is not only psychologically a priori but logically. It is prior to all observational experiences. Popper says the ‘inborn knowledge’ is not valid a priori because the expectations may be proved to be wrong. He analyses that Kant has mistaken when he admitted that the expectations are valid a priori. Popper argues that Kant was right when he said, “Our intellect does not draw laws form nature but imposes its laws upon nature”⁷ but Kant was wrong in maintaining that these laws are a priori and necessarily succeed. Popper on the other hand argues that, “Nature very often resists quite successfully, forcing us to discard our laws as refuted; but if we live we may try again.”⁸ Thus Popper argues
that with our ‘inborn expectations’ we start our scientific process; here we are faced with some problems and a tentative solution to the problem is proposed in the form of a conjecture or hypothesis.

3.1.ii Conjecture or Hypothesis

According to Popper the imaginative mind of a scientist out of his amazement about a problem confronted by him, proposes a tentative solution to the problem and Popper calls this tentative solution, a ‘conjecture’ or a ‘hypothesis’. Popper says, “Bold ideas, unjustified anticipations, and speculative thought, are our only means for interpreting nature: our only organ, our only instrument, for grasping her.”

3.1.ii.a Scientific knowledge is doxa

Analyzing Bacon’s theory of induction, Popper points out two methods of acquiring knowledge discussed by Bacon. Popper puts it as,

(1) ‘the spelling out of the open book of Nature’, leading to knowledge or episteme, and (2) ‘the prejudice of the mind that wrongly prejudges, and perhaps misjudges, Nature’, leading to doxa, or mere guesswork, and to the misreading of the book of Nature.

The first method according to Bacon provides us with the knowledge (episteme) of the Nature. His concept is deeply rooted in the belief that pure observation is possible and alone can provide true picture of the Nature. It is already mentioned that the concept of pure observation is fallacious, so the concept of episteme which Bacon
shares with Aristotle is no more valid. Popper argues that, “…Our science is not knowledge (episteme): it can never claim to have attained truth, or even a substitute for it, such as probability.”¹¹ Popper further argues that the second method of Bacon which he rejects saying that it will lead to doxa, mere guess work; is the real starting point of science. Bacon says that in order to gain episteme one needs to get rid of all anticipations. Popper in his analysis of Bacon argues that Bacon’s ‘anticipations’ have almost the same meaning as ‘hypothesis’. Popper says, “We do not know: we can only guess. And our guess are guided by the unscientific, the metaphysical (though biologically explicable) faith in laws, in regularities which we can uncover-discover.”¹² So according to Popper the imaginative and prejudiced mind of a scientist formulates conjectures or hypotheses. To popper they “are the means by which we probe into the unknown.”¹³ These conjectures or hypotheses act as theories in science and their validity is tentative, they are regarded as true as long as they are not refuted.

### 3.1.ii.b No Logical Method to Arrive at a Theory

Analyzing the act of conceiving a theory Popper argues that there is no logical method of reaching a theory. Popper argues that the question, how a new idea occurs to a man is similar in the case of art, sports or science. He thinks this is of great interest to empirical psychology but it has nothing to do with logical analysis. He argues that logical analysis deals with ‘justification or validity’ but not with ‘questions of facts’. The inductivist philosophers take induction as a logical method of reaching a theory. With his concept of conjectures Popper rejects this view. He says, “…there is no such thing as a logical method of having new ideas, or a logical
reconstruction of this process.” He further argues with Bergson that every discovery contains an irrational element or a creative intuition. He quotes Einstein to strengthen his position.

…search for those highly universal laws…from which a picture of the world can be obtained by pure deduction. There is no logical path leading to these…laws. They can only be reached by intuition, based upon something like an intellectual love of the objects of experience.15

3.1.iii Theories

According to Popper, “The empirical sciences are systems of theories. The logic of scientific knowledge can therefore be described as a theory of theories.” For Popper a bold conjecture acts as a theory in the field of science. A bold conjecture is highly universal compared to a normal conjecture. He rejects the quasi-inductivists claim that science starts with observations which formulate theories of less degree of universality and as the process of science goes on the degree of universality of the theories increase. Popper argues it is always advisable in science that we formulate a bold conjecture. By bold conjecture he refers a conjecture or a hypothesis and in a sense a theory with high degree of universality.

3.1.iii.a Causal Explanations

Conjectures or theories have to be put into a language. Unlike the inductivist belief that there exist a phenomenal language, free of theories; Popper argues that any
language is theoretical. According to Popper, a causal explanation in a language consists of three elements; universal statements, singular statements (initial condition) and singular predictions. Universal statements are “hypothesis of the character of a natural law.”\(^\text{17}\) Singular statements “apply to the specific event in a question.”\(^\text{18}\) He calls these singular statements as ‘initial conditions’. A singular prediction is made from a conjunction of the universal statement with the initial conditions. According to Popper the principle of causality is “…the simple rule that we are not to abandon the search for universal laws and for a coherent theoretical system, nor give up our attempts to explain causally any kind of event we can describe.”\(^\text{19}\)

3.1.iii.b Universality of Statements

Popper classifies synthetic universal statements as ‘strictly universal’ and ‘numerically universal’. The first one “claims to be true for any place and any time”\(^\text{20}\), but the second one “refers only to a finite class of specific elements within a finite individual (or particular) spatio-temporal region.”\(^\text{21}\) According to Popper the second kind of universal statements can be replaced by a conjunction of singular statements; whereas the first kind of universal statement cannot be replaced like that. Popper holds that ‘strictly universal statements’ stand against the concept that all synthetic universal statements can be translated into a conjunction of finite number of statements and on this stand point the ‘strictly universal statements’ cannot be verified. Popper considers the natural laws as synthetic and ‘strictly universal statements’. Popper argues,
I consider it both useful and fruitful to regard natural laws as synthetic and strictly universal statements (‘all-statements’). This is to regard them as non-verifiable statements which can be put in the form: ‘Of all points in space and time (or in all regions of space and time) it is true that…’ By contrast, statements which relate only to certain finite regions of space and time I call ‘specific’ or ‘singular’ statements.22

3.1.iii.c Relation between Strictly Universal and Strictly Existential Statements

Popper explains the concept of ‘strictly existential statements’ with an example - A ‘strictly universal statement’ like ‘there are black ravens’ can be formulated in a different structure of the language to mean the same; it can be of the form, ‘there exists at least one black raven’. According to Popper the statement, ‘there exists at least one black raven’ is called a ‘strictly existential statement’. Popper analyses that, “The negation of a ‘strictly universal statement’ is always equivalent to a ‘strictly existential statement and vice versa.”23 Popper has argued the natural laws are expressed in ‘strictly universal statements’ and now from the above reached conclusion that natural laws can be expressed as negation of ‘strictly existential statements’. Popper further argues that both the above mentioned statements are empirically decidable but only in one way. He says, “…they are unilaterally decidable. Whenever it is found that something exists here or there, a strictly existential statement thereby be verified, or a universal one falsified.”24
3.1.iii.d Theoretical Systems and Axioms

A theoretical system contains many conjectures or hypotheses which all survey as a whole, with all its important consequences. Axioms are defined as all the assumptions needed to build the apex of the system. According to Popper, “The axioms are chosen in such a way that all the other statements belonging to the theoretical system can be derived from the axioms by purely logical or mathematical transformations.”

According to Popper an axiomatized system should satisfy four fundamental requirements.

(a) The system of axioms must be free from contradiction…(b) The system must be independent, i.e. it must not contain any axiom deducible from the remaining axioms…(c) the axioms should be sufficient for the deduction of all statements belonging to the theory which is to be axiomatized, and (d) necessary, for the same purpose; which means that they should contain no superfluous assumptions.

3.1.iii.e Statements and Levels of Universality

Popper differentiates the statements in the science with their levels of universality. According to him axioms are the statements having high level of universality. Hypotheses are high level empirical statements. The statements deduced either from an axiom or a hypothesis contains lower levels of universality. But Popper says that even some singular statements could possess high level of universality if it serves as a hypothesis; if conclusions may be derived from it.
3.1.iv Refutations

A hypothesis or a conjecture or a theory with high level of universality is proposed as a solution to a problem. Now according to Popper the scientists are left with the method of eliminating the errors contained in the theory and this is done by trying to refute the theory by all means. The conjecture is put under harsh tests to refute it. If a theory stands the tests, it is accepted tentatively till it is refuted. According to Popper,

What may be called the method of science consists in learning from our mistakes systematically: first, by taking risks, by daring to make mistakes – that is, by boldly proposing new theories; and secondly, by searching systematically for the mistakes we have made – that is, by the critical discussion and the critical examination of our theories…Among the most important arguments that are used in this critical discussion are arguments from experimental tests.27

Popper further makes his concept very clear by explaining the method of refutation as part of the theory of trial and error and he names them as conjectures and refutations. He argues, “…scientific theories were not the digest of observations, but that they were inventions-conjectures boldly put forward for trial, to be eliminated if they clash with observations.”28 The observations are rarely accidental they are undertaken with a definite aim of testing a theory by trying to refute it.
According to Popper the inductivist principle of verification fails to account for science because they do not give importance to the logical nature of refutation. Refutation is thus against the positivists idea of verification. Popper further argues that the objectivity of science consists in the critical approach that one shows to the theories. This critical attitude is expressed by Popper as,

It is we who always formulate the questions to be put to nature; it is we who try again and again to put these questions so as to elicit a clear-cut ‘yes’ or ‘no’ (for nature does not give an answer unless pressed for it). And in the end, it is again we who give the answer; it is we ourselves who, after sever scrutiny, decide upon the answer to the question which we put to nature-after protracted and earnest attempts to elicit form her an unequivocal ‘no’.  

The verification principle which rests up on the concept of pure observation is criticized and rejected with the discussions on the criticisms against the pure observation. No observation is pure, observations are theory dependent. Popper links the authoritarianism in science with that of the verification principle and argues that the critical approach provide by refutations outruns such forms of authoritarianism in science. He argues,

“Authoritarianism in science was linked with the idea of establishing, that is to say, of proving or verifying, its theories. The critical approach is linked with the ideas of testing, that is to say, of trying to refute, or to falsify, its conjectures.”
3.1.v The Demarcation Problem and Falsifiability

A theory which stands up to harsh tests are of high importance to science, but Popper analyses that the theories presented in the world, not all of them are refutable. This means some theories in the world are immune to refutation. There exist no observation criteria with which one can refute such kind of theories. Popper does not consider such theories as scientific to make the demarcation specific. Popper introduces the ‘falsifiability’ as the criterion to distinguish between scientific theories from other sort of theories.

For Popper a theory is scientific if it is refutable by a plausible event. Thus all scientific tests of a theory are logically speaking attempts to refute or to falsify the theory. A test which is an attempt to refute it may falsify the whole theory in question. The logical asymmetry between verification and falsification is the base on which Popper’s method of demarcation rests up on. In the criticisms against induction it is observed that logically it is impossible to convincingly verify a universal proposition by reference to experience. Opposite to this a single counter instance convincingly falsifies the universal theory. This asymmetry between verification and falsification is taken into account by Popper and logically argues that it is impossible to verify a universal theory but it is logically possible to falsify it. Thus a scientific theory can be tested and falsified but cannot be logically verified. Popper says, “A theory which is not refutable by any conceivable event is non-scientific. Irrefutability is not a virtue of a theory (as people often think) but vice.”31 Popper argues with this background that a theory which stood against harsh tests for a very long time cannot be taken as verified.
The theory in question is provisionally taken as the best available theory until its falsified or overthrown by a better theory.

Thus according to Popper a scientific theory is a prohibition, in the sense that it refuses to allow occurrences of some events. In Popper’s own words, “Every ‘good’ theory is a prohibition: it forbids certain things to happen. The more a theory forbids, the better it is.” So if such prohibitions are tested to occur, then that refutes the theory. Popper calls this criterion as refutability or falsifiability. Popper in ‘Conjectures and Refutations’ analyses Einstein’s general theory of relativity, astrology, the Marxist theory of history and psycho-analytic theories of Freud and Adler. He analyses with his criterion of falsifiability; whether these theories can be treated as scientific. He claims all the three theories other than Einstein’s theory as non-science. Popper argues that in astrology, Astrologers were unimpressed by any unfavorable evidence so they made their predictions so vague that it made it impossible to refute the theory in the presence of an event which goes against the theory. He says,

…the by making their interpretations and prophecies sufficiently vague they were able to explain away anything that might have been a refutation of the theory had the theory and prophecies been more precise. In order to escape falsification they destroyed the testability of their theory.
Popper analyses Marxist theory of history and points out that the theory’s predictions were testable and in fact falsified (In his ‘Open Society and its Enemies’ Popper analyses this in detail.), but the followers of this theory re-interpreted the theory and the evidences to make them agree with the events which falsified the theory. Popper argues,

…instead of accepting the refutations the followers of Marx re-interpreted both the theory and the evidence in order to make them agree. In this way they rescued the theory from refutation; but they did so at the price of adopting a device which made it irrefutable. They thus give us a ‘conventionalist twist’ to the theory; and by this stratagem they destroyed its much advertised claim to scientific status.\textsuperscript{34}

Popper keeps the two psycho-analytic theories as a separate group. These theories are made in such ways that they are non-testable and thus irrefutable. They explain anything and everything about human behavior. Popper argues,

There was no conceivable human behaviour which could contradict them…for Freud’s epic of the Ego, the Super-ego, and the Id, no substantially stronger claim to scientific status can be made for it than for Homer’s collected stories from Olympus. These stories describe some facts, but in the manner of myths. They contain most interesting psychological suggestions, but not in a testable form.\textsuperscript{35}
Popper argues that opposite to the nature of above mentioned three theories, Einstein’s general theory of gravitation possess the scientific nature as it has the character of falsifiability. Einstein’s theory makes bold predictions which if goes wrong will refute the theory. Einstein’s theory predicted that light must be attracted by heavy bodies such as sun. This prediction let to the testable observation that light from a distant star when reaches earth, the apparent position of the star may seem to be different from the its original position due to the bending of light with the attraction of the sun. In other words, the star close to the sun would look as if it is moved a little away from the sun. Popper states,

…This is a thing which cannot normally be observed since such star are rendered invisible in daytime by the sun’s overwhelming brightness; but during an eclipse it is possible to take photography of them. If the same constellation is photographed at night one can measure the distance on the two photographs, and check the predicted effect.\textsuperscript{36}

Here Popper finds the risk involved in the prediction of the Einstein’s theory. The theory is incompatible with certain possible results of observation. That is the theory has the criterion of falsifiability thus Popper gives it the status of scientific.

Popper’s concept of falsification has a very deep relationship with his concept of theory dependent observation. If the concept of pure observation put forwarded by the inductivist philosophers were taken then the criterion of science must have been the principle of induction; Poppers strong rejection of induction on the basis of theory
dependent observation led him to the concept of falsifiability as the criterion of science. He connects between the theory dependent observation and falsifiability in his elaborations of the observation statements. He calls the observation statements as basic statements. Stephen Thornton analyses Poppers demarcation on the stand point of Popper’s concept of basic statements (the concept of basic statement is explained in the second chapter) as,

Formally, then, Popper's theory of demarcation may be articulated as follows: where a ‘basic statement’ is to be understood as a particular observation-report, then we may say that a theory is scientific if and only if it divides the class of basic statements into the following two non-empty sub-classes: (a) the class of all those basic statements with which it is inconsistent, or which it prohibits—this is the class of its potential falsifiers (i.e., those statements which, if true, falsify the whole theory), and (b) the class of those basic statements with which it is consistent, or which it permits (i.e., those statements which, if true, corroborate it, or bear it out).\(^{37}\)

In the demarcation process Popper analyses three different kinds of demarcation problems. He has not elaborately discussed the three at a place. Nicholas Maxwell lists them as follows,

(a) Empirical theories from other sorts of theories (metaphysical, a priori, etc.)
(b) Scientific modes of enquiry from unscientific or pseudoscientific modes of enquiry.

(c) The highest form of scientific enquiry from other less worthwhile forms of scientific enquiry grading into the pseudoscientific.\textsuperscript{38}

Nicholas Maxwell analyses that Popper is more interested to solve the third kind of demarcation. But we can see that Popper with this falsifiability criterion provides satisfactory demarcation between the three different kinds of demarcation problems. In the examples discussed above may be considered as examples of these three different kinds of problems. Astrology is in a way metaphysical or a priori and Marxist theory of history is pseudo scientific in the second sense of the demarcation problem. Psycho analytic theories are pseudo scientific in the third sense of the demarcation problem.

3.1.vi Analysis of Popper’s foundational Problems

Popper’s foundational problems face criticisms from different philosophers. His analysis of the falsifiability criterion and its relation with basic statements are one of the main problems which face serious criticism. The criticism against the basic statement and falsifiability criterion becomes so crucial because for Popper’s philosophy this relation is the base. The demarcation problem and other foundational problems which Popper tries to solve comes into danger with the criticisms against the falsifiability criterion and its relation with basic statements
Popper following the essence of correspondence theory claims himself to be an anti-conventionalist. He proposes basic statements in place of the protocol statements used by the positivist philosophers to denote observation statements. He argues against the positivists and empiricist claim that the basic statements, observational statements, are infallible. He argues that the basic statements are not reports of passively registered sensations. For him basic statements are descriptions of the interpretation of an observer with a theoretical framework of what is observed. Here the theory dependent nature of the basic statements is stressed by saying that they are the interpretations of an observer’s perception with respect to a theoretical framework. He asserts about the basic statements that they are open-ended hypotheses. They have a causal connection with the experience but they cannot be determined or confirmed or verified by experience. If the basic statements are not justifiable by experience then how can one know the truth about the basic statements. Popper writes, “…basic statements are not justifiable by our immediate experiences, but are … accepted by an act, a free decision”\textsuperscript{39}. This makes problems with the consistency of Poppers’ theory. If we want to know whether a theory has falsifiability criterion; we should find at least a basic statement which would, if true, falsify it.

With this back ground Stephen Thornton argues that,

However, and notwithstanding Popper's claims to the contrary, this itself seems to be a refined form of conventionalism—it implies that it is almost entirely an arbitrary matter whether it is accepted that a potential falsifier is an actual one, and consequently that the falsification of a theory is itself the function of a ‘free’ and
arbitrary act. It also seems very difficult to reconcile this with
Popper's view that science progressively moves closer to the truth,
conceived of in terms of the correspondence theory, for this kind of
conventionalism is inimical to this (classical) conception of truth.40

Popper argues that bridging the gap between a universal theory and a
prediction is undertaken by singular existential statements. Popper’s this assumption
is proved to be wrong by many philosophers. Hilary Putnam argues that, in many
cases the gap is bridged by statements which are general rather than singular. He calls
these general statements as ‘auxiliary hypotheses’. With this view when we see the
refutation of a theory; this may not be due to the falsity of the scientific theory but
may be due to the auxiliary hypothesis.

3.2 Analysis of Methodological Problems

This section involves questions concerning the method of generalization,
theory appraisal and justification. Deductive testing of a theory, Experimental tests,
Degree of falsifiability and the problem of confirmation are analyzed.

3.2.i Deductively testing a Hypothesis or a Theory

Popper starts from a problem rather than the concept of inductivist
philosophers that the starting point of science is from bare facts. We have seen the
formation of a hypothesis or a conjecture or a theory from a problem. In order to stand
as scientific they possess the criterion of falsifiability. Now to test a theory logically,
only a deductive method can be adopted and this deductive method is an integral part of scientific method. From the tentative hypothesis conclusions are inferred and these conclusions are then compared with one another and with relevant statements. This is to test whether they falsify the hypothesis or not. To Popper the conclusions are not directly compared with the facts just because there are no ‘pure’ facts available. All observation statements are theory dependent. Popper points out four steps in the process of deductive testing of a theory.

(a) To see any contradictions are involved with a theory the internal consistency of the system is tested. This test is formal in nature. Popper states, “This is done by logical comparison of the conclusions among themselves.”

(b) The second step is a semi-formal process. The theory is distinguished between its empirical and logical elements. This can be seen as axiomatising of the theory. Here the logical form of the theory is revealed by the scientist. Failure to do this may lead to category-mistakes. The scientists may end up asking wrong questions and for the wrong questions the scientists may search for empirical data where none is available. The analytic and synthetic statements in a theory are thus distinguished in this stage.

(c) The new theory is compared with the existing and old theories to determine whether it constitutes an advance. Popper writes, “…the comparison with other theories, chiefly with the aim of determining whether the theory would constitute a scientific advance should it survive our various tests.” If the new hypothesis does not show any advancement up on the existing theories, the hypothesis is not adopted.
On the other hand if the new theory explains the problems solved by the existing ones and it further goes one step ahead to solve some problems which was not answered by the old theories, then the new theory is considered to be an advancement up on the existing and old theories and such theories are adopted. Popper emphasis on the point clearly that the selection of one theory over the other is not done in any case with the concept of induction but it is purely logical deduction. He argues that a theory is considered to be better than another one if and only if while standing unfalsified, it contains more empirical data and greater predictive power than the competing one.

(d) The final step in the deductive testing is the empirical applications of the conclusions of theory which is derived from it. If the conclusions are shown to be true the theory is tentatively accepted in science or the theory is ‘corroborated’ (this concept will be discussed in the following section). If the conclusions are shown to be false, then it is understood that the theory is not correct and the scientist begins his search for a better theory.

However according to Popper the present theory is not abandoned until there is a better one to replace it.

### 3.2.ii Experimental tests of hypothesis

Popper gives importance to the experimental parts of science in his philosophy of falsifiability but he argues that, “Theory dominates the experimental work from its initial planning up to the finishing touches in the laboratory.” He gives importance to the theoretical frame work over the experiments. This is because he wants the experimenter to be free from the inductive notions that a theory is nothing but
statements of regular coincidences. So Popper gives importance to the epistemological theory of experiment. He states, “The theoretician puts certain definite questions to the experimenter, and the latter, by his experiments, tries to elicit a decisive answer to these questions, and to no others.” Here it should not be assumed that the work of the experimenter is to put light on the theory presented by the theoretician. The theoreticians work needs to be completed ahead of the experimenter by formulating sharp questions. He is the one who gives the direction to the experimenter.

3.2.iii Degree of falsifiability, clarity and precision to give theory appraisal

According to Popper a good scientific theory is falsifiable because it makes explicit claims about the world. If a theory is more falsifiable then it is better to the greater degree. When one considers a theory as highly falsifiable, it accounts that there are more potential opportunities to show that the world does not behave the way the theory suggests. A good theory is the one which makes wide range of predictions such that it is highly falsifiable and it resists the tests to refute it. Alan Chalmers explains this Popperian concept with an example as,

…example involves the relation between Kepler's theory of the solar system and Newton's. Kepler's theory I take to be his three laws of planetary motion. Potential falsifiers of that theory consist of sets of statements referring to planetary positions relative to the sun at specified times. Newton's theory, a better theory that superseded Kepler's, is more
comprehensive. It consists of Newton's laws of motion plus his law of gravitation, the latter asserting that all pairs of bodies in the universe attract each other with a force that varies inversely as the square of their separation. Some of the potential falsifiers of Newton's theory are sets of statements of planetary positions at specified times. But there are many others, including those referring to the behaviour of falling bodies and pendulums, the correlation between the tides and the locations of the sun and moon, and so on. There are many more opportunities for falsifying Newton's theory than for falsifying Kepler's theory. And yet, so the falsificationist story goes, Newton's theory was able to resist attempted falsifications, thereby establishing its superiority over Kepler's.45

3.2.iii.a Bold conjecture, Clarity and Precision

In the growth of scientific knowledge, a bold conjecture is preferred than a less bold conjecture because the bold conjecture contains more empirical data than the other one. More empirical data means that the theory in question has a high degree of falsifiability or the number of potential falsifiers is large.

Clarity and Precision too make the degree of falsifiability high. When a theory is formulated with clarity and precision, it becomes more falsifiable. The clarity and precision have connection with Popper’s concept of basic statements. The statement
‘Planets move in ellipses around sun’ is more precise than ‘Planets move in closed loops around sun’. The first statement is precise and it has more empirical content thus it contains more potential falsifiers. When a theory has large number of potential falsifiers the degree of falsifiability of the theory goes up and thus it becomes a better theory compared to another whose degree of falsifiability is less than the first one.

3.2.iii.b  Measures to Test the Degree of Falsifiability

Popper considers three different methods to test the degree of falsifiability of rival theories.

(1) The concept of the cardinality (power) of a class. Popper analyses, that power of the class of potential falsifiers for all theories can be shown the same and so this concept cannot be used for the purpose of comparing the degree of falsifiability.

(2) The second concept he proposes is that of the concept of dimension. This idea rests in the base of set-theoretical concepts of dimension. According to Popper, “The vague intuitive idea that a cube in some way contains more points than, say, a straight line can be clearly formulated in logically unexceptionable terms by the set-theoretical concept of dimension.”46

The concept of dimension allows us to compare classes of higher and lower dimension. Basic statements when conjoined we get basic statements which are more composite than its components. This degree of composition of basic statements are linked with the concept of dimension and now as the concept of dimension allow us to compare higher and lower dimensions; we get a comparison of the basic statements and thus comparison of the degree of falsifiability is done.
(3) The third method he proposes is the use of ‘sub class relation’. Here, Popper states,

(i) A statement \( x \) is said to be ‘falsifiable’ in a higher degree’ or ‘better testable’ than a statement \( y \), or in symbols: \( \text{Fsb}(x) > \text{Fsb}(y) \), if and only if the class of potential falsifiers of \( x \) includes the class of the potential falsifiers of \( y \) as a proper subclass.

(ii) If the classes of potential falsifiers of the two statements \( x \) and \( y \) are identical, then they have the same degree of falsifiability, i.e. \( \text{Fsb}(x) = \text{Fsb}(y) \)

(iii) If neither of the classes of potential falsifiers of the two statements include the other as a proper subclass, then the two statements have non-comparable degree of falsifiability \( \text{Fsb}(x) \not\parallel \text{Fsb}(y) \)

3.2.iv Confirmation, corroboration and falsification

In the process of science we try to refute the newly proposed conjecture and if the conjecture is a bold one then we apply severe tests upon it. If the bold conjecture is not standing against the test, it has to be refuted, but the process of science needs some advancement in the scientific knowledge. When we look in this angle it makes sense that the refutation of a bold conjecture has done any advancement in the knowledge. In science we expect the confirmation of a bold conjecture than its refutation when it is newly introduced. Popper argues,
I can therefore gladly admit that falsificationist like myself much prefer an attempt to solve an interesting problem by a bold conjecture, even (and especially) if it soon turns out to be false, to any recital of a sequence of irrelevant truisms. We prefer this because we believe that this is the way in which we can learn from our mistakes; and that in finding that our conjecture was false we shall have learnt much about the truth, and shall have got nearer to the truth.48

Alan chalmers takes it further and writes, “Significant advances will be marked by the confirmation of bold conjectures or the falsification of cautious conjectures.”49 Thus the confirmation of the bold conjectures becomes important of the progress of science. A bold theory which stands up to severest of tests are said to be ‘corroborated’. Popper writes, “The rider that the hypothesis should be corroborated refers to tests which it ought to have passed-tests which confront it with accepted basic statements”50

However Popper makes a clear differentiation between ‘confirmation’ and ‘corroboration’. Popper says that his concept of ‘degree of corroboration’ was translated by Carnap as ‘degree of confirmation’ and soon that was accepted by the philosophy of science community and when Carnap started to use the ‘degree of confirmation’ synonymous to ‘probability’. Popper argues that this made his concept to be misunderstood. The term confirmation is linked with the verificationist idea of the immutability of natural process, or the ‘principle of the uniformity of nature’.
Popper argues, “Thus if we try to turn our metaphysical faith in the uniformity of nature and in the verifiability of theories into a theory of knowledge based on inductive logic, we are left with the choice between an infinite regress and apriorim”\textsuperscript{51}\textsuperscript{51} Popper holds the position that the theories of science are non-verifiable. With this background Popper wanted to make his point of ‘corroboration’ clearly differentiated from the concept of ‘confirmation’. In the concept of confirmation believes that the theory is verified and it is an end in itself, but in the concept of corroboration, the tentative survival of a bold theory against harsh refutation is reflected. For the concept of corroboration the theory is not an end.

Popper argues against the common notion that degree of corroboration and probability is one and the same. Supporting this argument he states,

If we compare these views of mine with what is implicit in (inductive) probability logic, we get a truly remarkable result. According to my view, the corroborability of a theory-and also the degree of corroboration of a theory which has in fact passed severe tests, stand both, as it were, in inverse ratio to its logical probability; for they both increase with its degree of testability and simplicity. But the view implied by probability logic is the precise opposite of this. Its upholders let the probability of a hypothesis increase in direct proportion to its logical probability-although there is no doubt that they intend their ‘probability of a hypothesis’ to stand for much the same thing that I try to indicate by ‘degree of corroboration’.\textsuperscript{52}
He argues that a hypothesis which is falsifiable in a higher degree will be a simpler hypothesis. This simpler hypothesis will have a high degree of corroboration. The corroboration attained not only depends on the degree of falsifiability. A statement may have a high degree of falsifiability but may have a less degree of corroboration or even it may be in fact falsified. Popper argues that thus the degree of falsifiability and the simplicity of the theories decide the appraisal of corroboration. He analyses that this appraisal can be regarded as the logical relationship between the theory and the accepted basic statements. He further states, “…this appraisal may be regarded as one of the logical relationships between the theory and the accepted basic statements: as an appraisal that takes into consideration the severity of the tests to which the theory has been subjected.”

3.2.v Critically analyzing the Methodology of falsification

One of the main criticisms against Popper’s methodology is that it is not a proper method itself. It has been criticized for having only the status of a psychological advice to a scientist on how to behave in the field of science or it just gives a description about the attitude of a scientist. Popper is well aware of these criticisms and to defend his method he provides logical and methodological arguments. For the progress of science he points out three requirements. The first two are formal requirements and the third one is a material requirement (These requirements are discussed in the next section.). Popper argues that the analysis of the third requirement, ‘the new theory should pass some new and severe tests’, provides
the necessary logical and methodological arguments for the validity of his methodology and he points out three reasons for considering this as important.

The first reason he gives is, “…if we had an independently testable theory which was, moreover, true, then it would provide us with successful predictions (and only with successful ones).” Popper analyses that if we consider truth as a regulative idea then, the successful predictions of a theory become necessary condition for an independently testable theory. The second reason he gives is, “If it is our aim to strengthen the verisimilitude of our theories, or to get nearer to the truth, then we should be anxious not only to reduce the falsity content of our theories but also to strengthen their truth content.” Popper argues that increasing the verisimilitude (this concept has been explained in the next section) can be simply done by proposing a new theory, in such a way that the refutations of the old theory are explained. But as a methodological tool the scientific theories are to be proposed which have more truth content not just be increasing verisimilitude. He explains this concept with an example.

The cases I have in mind are cases in which there was no refutation. Neither Galileo’s nor Kepler’s theories were refuted before Newton: what Newton tried to do was to explain them from more general assumptions, and thus to unify two hitherto unrelated fields of inquiry. Here Popper brings in the concept of ‘crucial experiments’. When a new theory is proposed as a better one than an old one then it should explain all the refutations of
the old one and along with it, the new theory should offer some new predictions which are unobtainable from the old one. The experiments to falsify these predictions are ‘crucial experiments’. If the theory fails to stand up to the ‘crucial experiments’, then it has no reason to refute the old one. Popper argues that, “Had the new theory been refuted in any of these crucial experiments then we should have no reason to abandon the old one in its favour - even if the old theory was not wholly satisfactory.”

The third reason he gives is, “…the importance of crucial tests-can be made without appealing to the aim of increasing the verisimilitude of a theory…the need to make the tests of our explanations independent.” Popper argues that this need is a result of the growth of knowledge. This is done by incorporating the new and problematic knowledge into background knowledge.

There are other fundamental criticisms against Popper’s problem of demarcation which paves the basis for methodology. Lakatos criticizes Popper on his concept of crucial experiment and its role in the corroboration of a theory. Popper often cites an example to explain his idea of crucial experiment. With Newtonian mechanics as the framework, scientists Adams and Leverrier, independently of each other, predicted a new unobserved planet from the observed divergence in the elliptical orbit of Uranus. The scientist Galle at the Berlin observatory observed such a planet (later it was name as Neptune) in the exact position, where Adams and Leverrier predicted it to exist, and confirmed its presence. Popper considers this as a crucial experiment faced by the Newtonian theory and it has passed the test. Lakatos analyzing the same prediction and experiment argues against the Popperian notion of
crucial experiment. Lakatos questions, if the new planet was not found what must have happened to the Newtonian framework in actual science. Lakatos argues that the Newtonian theory might not have falsified rather the failure of the prediction must have been attributed to some other causes or factors like, the interference of the earth's atmosphere with the telescope, the existence of an asteroid belt which hides the new planet from the earth, etc. This point makes it clear that the Popperian distinction between ‘falsification and corroboration’ is logically sound but it loses its ground in the practical application because non-corroboration is not necessarily ‘falsification’. This point makes the basis of Popper’s demarcation problem inconsistent.

3.3 Analysis of Axiological Problems

In this section the problem of objectivity, rationality, progressiveness and truthfulness of scientific knowledge are analyzed.

3.3.i Progress of science

Popper equates the progress of science as the progress towards the truth or getting near to the truth. For him the nature of scientific process is that of progress. One theory gets falsified and taken over by another one and the current one is tested harshly to get it refuted. This is an ongoing process and as it goes on the scientific knowledge progress with it. The growth of the scientific knowledge is linked with the refutation of a theory rather than the prolonged confirmation of a theory. According to Popper science will stagnate if the scientists are not attempting to refute theories.
Popper suggests, “…science would stagnate, and lose its empirical character, if we should fail to obtain refutations.”

Popper proposes a three –stage model of methodology of science,

1. The starting point is always a problem or a problem situation
2. Attempted solutions then follow. These always consist of theories, and these theories, being trials, are very often wrong: they are and always will be hypotheses or conjectures.
3. In science, too, we learn by eliminating our mistakes, by eliminating our false theories.

3.3.i.a Epistemological Approaches towards the growth of Knowledge

In the introduction of Logic of Scientific Discovery, Popper analyses the epistemological approaches in philosophy of science in connection with the growth of knowledge. He approaches the problem of epistemology from two sides. First one is the problem of ordinary or common-sense knowledge. The second one is the problem of scientific knowledge. He argues that the first approach is right in a sense that the philosophers who follow this approach follow that scientific knowledge is an extension of common-sense knowledge but they are wrong in assuming that the common-sense knowledge is easier to analyze. Popper analyses that those who follow the first approach remain invisible to the nature of growth in our knowledge. Popper states,

For the most important way in which common-sense knowledge grows is precisely, by turning into scientific knowledge. Moreover,
it seems clear that the growth of scientific knowledge is the most important and interesting case of the growth of knowledge.\textsuperscript{61}

As a criticism against the first group of philosophers who follow the commonsense approach in epistemology Popper analyses that these philosophers made philosophy look as if it is incapable of making any contribution to the knowledge. According to Popper, the second group of philosophers who approach the problem of epistemology as a problem of scientific knowledge are divided into two sub groups. The first sub group of philosophers aim at a language of science and the second sub group does not confine themselves to the study of the language of science or any other language. The first group of philosophers holds the claims that their methods are capable of solving the problems of the theory of scientific knowledge and that their methods are exact or precise.

Popper analyses that these claims of the first sub group of philosopher are not met with reality and they are not been able to tackle the problems of the growth of our knowledge. The second subgroup of philosophers according to Popper is the philosophers who contribute towards the growth of knowledge. They all take the approach that scientific knowledge is the result of growth of common-sense knowledge and unlike the first group of philosopher they consider scientific knowledge as easy to analyze rather than common-sense knowledge. An example of this growth is given by Popper, “…it replaces the Humean problem of ‘reasonable belief’ by the problem of the reasons for accepting or rejecting scientific theories.”\textsuperscript{62}
3.3.i.b Three Requirements for the Progress of Science

As we have seen, Popper formulates the process of science as a game of conjectures and refutations. The methodology proposed by him is that of constant criticism. A problem is pointed out and a tentative solution is provided which as a conjecture is put forward and it is harshly tested such that it is refuted. Finally it is refuted or replaced by another conjecture which has more empirical content. Then again the same process starts from the beginning. In this ever active process, to gain the progress Popper suggests three requirements. For Popper the first requirement is,

The new theory should proceed from some simple, new and powerful, unifying idea about some connection or relation (such as gravitational attraction) or facts (such as inertial and gravitational mass) or new ‘theoretical entities’ (such as field and particles).

Here when Popper writes simple, the analysis behind it is not so simple. In ‘The Logic of Scientific Discovery’ Popper elaborately discusses about the problem of simplicity and finally he argues, “Simple statements, if knowledge is our object, are to be prized more highly that less simple ones because they tell us more; because their empirical content is greater; and because they are better testable.”

The analysis of the simplicity of the theories leads to the second requirement, which is that the new theory should be independently testable. Popper with this requirement presses the new theory to explain all the explicanda which it was designed to explain and further to have new testable consequences. Popper prefers the
consequences to be a new kind and it should be able to predict phenomena which have not been seen yet. Popper analyses that this requirement satisfies the scientists’ quest for progress. The third and final requirement is that the new theory should pass some new and severe tests. Popper analyses the first two requirements as ‘formal requirements’ and the third requirement as ‘material requirement’. The first two are called as ‘formal requirements’ because to know whether these two requirements are fulfilled or not we can have a logical analysis of the old and new theory and can come to a conclusion, but the last requirement cannot be evaluated logically. It is empirical; it can only be tested by testing the new theory empirically. Popper argues that,

…I content that further progress in science would become impossible if we did not reasonably often manage to meet the third requirement; thus if the progress of science is to continue, and its rationality not to decline, we need not only successful refutations, but also positive successes.65

3.3.ii Ad hoc modifications, Auxiliary Hypothesis and growth

In the process of science as we try to refute a theory we may end up finding an event which goes against the theory thus falsifying the theory. According to Popper such a theory should be abandon. Any step taken to save the theory from the concerned falsification should not be entertained. Lakatos in his theory of ‘research programmes’ proposes some auxiliary hypothesis to save the theory from apparent falsification. For Popper such a modification in the theory or the way it has been interpreted is not admissible. For him such modifications may save the theory but will
reduce its scientific status. For him ‘auxiliary hypotheses’ are allowed in scientific practice if they do not diminish the degree of testability or falsifiability of the system rather it should increase the degree of falsifiability thus taking part in the progress of science. Popper writes,

As regards *auxiliary hypotheses* we propose to lay down the rule that only those are acceptable whose introduction does not diminish the degree of falsifiability or testability of the system in question, but, on the contrary, increases it…If the degree of falsifiability is increased, then introducing the hypothesis has actually strengthened the theory: the system now rules out more that it did previously: it prohibits more. We can also put like this. The introduction of an auxiliary hypothesis should always be regarded as an attempt to construct a new system; and this new system should then always be judged on the issue of whether it would, if adopted constitute a real advance in our knowledge if the world.\(^66\)

In the progress of science the theories of high degree of falsifiability are preferred over theories with less degree of falsifiability. During this course any modification in a theory just to stand against some falsifications are not allowed, it may not be in the form of an auxiliary hypothesis. The modifications of such kind which are not independently testable are called ‘ad hoc’ modifications. “A modification in a theory, such as the addition of an extra postulate or a change in
some existing postulate, that has not testable consequences that were not already

testable consequences of, the unmodified theory will be called ad hoc

modifications.67 ‘Ad hoc’ modifications which reduces the testability of a theory is

not allowed but if the modification has the capacity to increase the testability of the

theory then such ‘ad hoc’ modifications are allowed, but Popper argues that we should

be careful while accepting even an ‘ad hoc’ modification which is independently
testable so he states,

For if it is admitted that a theory may be ad hoc if it is not

independently testable by experiments of a new kind but

merely explains all the explicanda, including the experiments

which refuted its predecessors, then it is clear that the mere fact

that the theory is also independently testable cannot as such

come if we consider

that it is always possible, by a trivial stratagem, to make an ad

hoc theory independently testable, if we so not also require that

it should pass the independent tests in question: we merely

have to connect it (conjunctively) in some way or other with

any testable but not yet tested fantastic ad hoc prediction which

may occur to us (or to some science fiction writer).68

Hence Popper argues that these kind of ‘ad hoc’ modifications and auxiliary

hypothesis which are not going to increase the testability of the theories stand against

the growth of science. In science such things should be eliminated.
3.3.iii Concept of Verisimilitude

Popper in his early stages was uneasy with the concept of truth. He avoided asserting that a theory which is highly corroborated is near to truth. This was because he believed that each and every theory is open-ended hypothesis. It can only be considered as the best available but cannot be taken as an end. For him the best corroborated theory is also potentially false. So he considered a theory which replaces a falsified theory because of the large empirical content of the latter one is a better theory over the other. Popper in his ‘Conjectures and Refutations’, takes up the concept of ‘verisimilitude’. He equates with ‘truthlikeness’. For this he was influenced by Tarski’s concept of ‘correspondence theory of truth’. Popper argued that a good scientific theory has a higher level of verisimilitude than its competitor. He formulated his concept of verisimilitude by reference to the logical consequences of theories. The content of a theory is the totality of its logical consequences. This content of the theory can be classified into two sub classes. (1) Truth content of a theory, this class contains all the true propositions which may be derived from it. (2) ‘Falsity content’ of a theory, which contains the theories false consequences. This class may remain empty; quite sure for a corroborated theory.

Popper offers two methods of comparing the theories with respect to their degree of verisimilitude. They are the ‘qualitative’ and ‘quantitative’ methods. On the qualitative method Popper asserts,

Assuming that the truth-content and the falsity-content of two theories $t_1$ and $t_2$ are comparable, we can say that $t_2$ is more
closely similar to the truth, or corresponds better to the facts, than \( t_1 \), if and only if either:

(a) the truth-content but not the falsity-content of \( t_2 \) exceeds that of \( t_1 \), or

(b) the falsity-content of \( t_1 \), but not its truth-content, exceeds that of \( t_2 \). \(^{69}\)

Here in terms of subclass relationship the verisimilitude is defined. Here it is clear that the two theories verisimilitude can be compared only if their truth and falsity contents are compared through subclass relations. \( t_2 \) has a higher level of verisimilitude than \( t_1 \) if and only if either (a) \( t_2 \)'s truth-content includes \( t_1 \)'s and \( t_2 \)'s falsity-content, if it exists, is included in, or is the same as, \( t_1 \)'s, or (b) \( t_2 \)'s truth-content includes or is the same as \( t_1 \)'s and \( t_2 \)'s falsity-content, if it exists, is included in \( t_1 \)'s. On the quantitative account, Popper defines the verisimilitude by assigning quantities to contents. Popper writes,

If we now work with the assumption that the content and truth content of a theory \( a \) are in principle measurable, then we can go slightly beyond this definition and can define \( V_s(a) \), that is to say a measure of the verisimilitude or truthlikeness of \( a \). The simple definition will be

\[
V_s(s) = Ct_T(a) - Ct_F(a)
\]

Where \( Ct_T(a) \) is a measure of the truth-content of \( a \), and \( Ct_F(a) \) is a measure of its falsity-content of \( a \)...It is obvious that \( V_s(s) \)
satisfies our two demands, according to which $V_s(s)$ should increase

(a) if $C_T(a)$ increases while $C_F(a)$ does not, and

(b) if $C_F(a)$ decreases while $C_T(a)$ does not. $^{70}$

With the concept of Verisimilitude and the two methods of application of the same to compare two rival theories Popper holds that, when a theory $t_2$ with higher empirical content than a theory $t_1$, even if it is falsified in a later stage, is now regarded as a better theory than $t_2$ implies that $t_2$ is closer to the truth than $t_1$. Thus in the progress of science theories of higher verisimilitude abandons theories with less verisimilitude and reaches further close to the truth. With this concept Popper argues that the progress of science is not stagnant as was put by the inductivist philosophers with their concept of true theory which in turn was pessimistic in nature. He made the nature of science as optimistic by the concept that science progress towards the truth through the falsification and corroboration of theories. So with this concept science can be seen as a process of progress towards truth and experimental corroboration can be accounted as the sign of verisimilitude. Popper on the importance of verisimilitude states,

Ultimately, the idea of verisimilitude is most important in cases where we know that we have to work with theories which are at best approximations—that is to say, theories of which we know that they cannot be true. (This is often the case in the social sciences). In these cases we can still speak of better or worse
approximations to the truth (and we therefore do not need to interpret these cases in an instrumentalist sense).\textsuperscript{71}

3.3.iv Analysis of Popper’s axiological problems

The axiological problems of Popper have been criticized by many philosophers of science. Apart from the positivists philosophers Lakatos, Kuhn and Feyerabend are the main philosophers who have criticized Popper with respect to his axiological problems. His concept of growth in scientific knowledge and the concept of verisimilitude have been criticized in detail.

During 1970’s philosophers like Miller, Tichý, and Grünbaum had revealed serious problems of Popper’s concept of verisimilitude. In 1974, Miller Tichý independently of each other established the weakness of the conditions provided by Popper for verisimilitude. Both Philosophers argued that the conditions provided by Popper for qualitative and quantitative verisimilitude for comparing theories’ truth and falsity are satisfied only if the theories are true. Stephen Thornton puts it as, Popper's definitions are formally defective. For while Popper had believed that verisimilitude intersected positively with his account of corroboration, in the sense that he viewed an improbable theory which had withstood critical testing as one the truth-content of which is great relative to rival theories, while its falsity-content (if it exists) would be relatively low, Miller and Tichý proved, on the contrary, that in the case of a
false theory $t_2$ which has excess content over a rival theory false $t_1$ both the truth-content and the falsity-content of $t_2$ will exceed that of $t_1$. With respect to theories which are false, therefore, Popper's conditions for comparing levels of verisimilitude, whether in quantitative and qualitative terms, can never be met.\textsuperscript{72}

Acknowledging to the criticism, Popper in his book ‘Objective Knowledge’, states, …my main mistake was my failure to see at once that … if the content of a false statement $a$ exceeds that of a statement $b$, then the truth-content of $a$ exceeds the truth-content of $b$, and the same holds of their falsity-contents.\textsuperscript{73}

He was not negative about the failure of his problem of verisimilitude. He thought that the problem of verisimilitude can be solved but his latter attempt to solve the problem was not satisfactory.

3.4 Sum and Substance of Popper’s Methodology

Popper’s philosophy stems out of Hume’s problem of induction. Following Hume, Popper understands that ‘induction’ cannot be justified on the ground of logic or experience. This has caused a serious problem of demarcating science from nonscience. In order to solve this problem of demarcation Popper starts form Hume’s problem. He argues that pure observations are impossible. Induction based on many observations is a myth. It is easy to obtain confirmations or verifications for nearly every theory, if we look for confirmation. So the method of science is not that of
confirmation but that of refutation for that, science start from a problem rather than pure observations. As a solution to the problem conjectures are formulated and harshly tested to refute them. A conjecture is tentatively accepted till it gets refuted and when it gets refuted a new problem emerges and the process goes on. Here falsifiability is proposed as the criterion for choosing a theory to be scientific and thus making the problem of demarcation simple.

There are many criticisms against Popper. Here it is tried to sum up the limitations of falsification.

1. The observation statements are theory dependent according to falsifiability. So while refuting the theory it may be noted that the observation instance can be rejected as theory laden instead of the theory.

2. An observation statement depends on many theories behind the working of many instruments involved in the observation. So the observation instant which falsifies the theory in question may be confirmed through the instruments, in fact cannot falsify the theory because the confirmation of the instance may be produced by some error in the theories associated with the working of the instruments.

3. The problem of induction is not really solved by the criterion of falsifiability because, it is impossible to determine the truth of the basic statement which falsifies the theory according to the formulation of the basic statement in Popper’s philosophy.

4. Falsification is inadequate on historical grounds. The theories which are falsified are not refuted in science.
Reference


4. Ibid 47

5. Ibid

6. Ibid

7. Ibid 48

8. Ibid


12. Ibid


15. Ibid

16. Ibid 37

17. Ibid 38
18. Ibid
19. Ibid 39
20. Ibid
22. Ibid 42
23. Ibid 47
24. Ibid 49
25. Ibid 50
26. Ibid 51


28. Ibid
29. Ibid


32. Ibid
33. Ibid 37
34. Ibid
35. Ibid 37,38
36. Ibid 38


41. Ibid 9

42. Ibid

43. Ibid 90

44. Ibid 89


47. Ibid 99


51. Ibid 252

121
52. Ibid 269
53. Ibid 267
55. Ibid
56. Ibid
57. Ibid
58. Ibid 247
59. Ibid 244
61. Ibid xxii
62. Ibid xxvi
63. Ibid 241
66. Ibid 62
70. Ibid 243

71. Ibid 235
