

**THE PROBLEM OF INDUCTION RECONSIDERED: IN DEFENSE OF
REICHENBACH'S PRAGMATIC RESPONSE.**

BY

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Declaration

This project report is my original work and has not been presented for award of degree in any University.

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Dedication

I dedicate this work to the University of Nairobi's Department of Philosophy and Religious Studies.

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Abstract

Are we justified in believing that the future will be like the past? This is the problem of induction that challenges the process of inferring future unobserved claims from past observed claims as is the nature of scientific inquiry. This study sets out to revisit the problem of induction by re-evaluating the main solutions offered since its inception by David Hume in the 18th century. Several attempts have been made to give an epistemic solution to the problem or in other terms to validate induction. Epistemic solutions seek to show that the conclusions of inductive arguments will be true in the future. However, the fact that induction, unlike deduction, is not necessarily truth preserving has proved that validation of induction is not possible for this would amount to equating induction with deduction. In this regard, epistemic solutions to the problem of induction have failed to meet the sought objective. However, Hans Reichenbach has offered an alternative to epistemic justification of induction: pragmatic justification or vindication of induction. Pragmatic justification or vindication of induction seeks to show that induction is justified by virtue of being directed towards achieving a desired aim. Reichenbach's solution namely, that induction is justified by the fact that it will eventually lead scientists to the true value of the limit of relative frequency of repeatable events thus leading to predictive success, has been criticized of not being an epistemic justification and hence is not in line with Hume's demand namely, that the justification of induction should seek to show that the conclusions of inductive arguments will be true in the future. However, given the apparent impossibility of validating induction, there is need to revisit the problem of induction with an aim of defending the pragmatic solution. This study establishes that the three main epistemic solutions to the problem of induction namely, probabilistic, reliabilistic and inductive responses, are guilty of circular reasoning. As such, they fail to meet the standards of an acceptable justification of induction. Moreover the study shows that the linguistic and falsificationism attempts to show that the problem of induction is a pseudo problem do not succeed in dissolving the problem. On the one hand, the linguist's claim namely, that induction is rational by definition and thus justified, does not entail an impossibility of further justification of induction since vindication is a viable alternative. On the other hand, falsificationism, the alternative to induction as the methodology of science, fails owing to the indisputable fact that science makes use of induction. The study even shows that falsificationism appeal to corroboration of theories, where the most corroborated theories are preferred to the less corroborated ones, is a disguised concept of induction. In addition, the study establishes that Nelson Goodman's attempt to introduce a new problem of induction namely that of distinguishing valid from invalid inductive projections together with his attempted epistemic solution to it is nothing but Hume's problem in disguise. Hence, the study shows that Goodman does not advance the debate beyond Hume's assumptions. It is on these grounds that the study seeks to establish that Reichenbach's solution is more viable than any of the

aforementioned solutions and from which philosophers can seek to advance the debate. Further, Reichenbach's solution is criticized on the grounds that this aim may never be achieved either in the long or the short run. That even if the limit of relative frequency is achievable, there is no way that scientists could know they have arrived at it. To remedy this, the study has appealed to the immediate practical consequences of induction without seeking an aim that is to be achieved in the future as Reichenbach does. That is, induction sustains scientific predictions in their application to current policy formulation and technological advancement.

Operational Definitions

Falsificationism- to falsify is to refute something or to show that it is false. This concept is derived from Popper's theory of deductive methodology of science to imply that scientists seek to refute their theories rather than to confirm them.

Induction- drawing an inference claiming about the future from premises claiming about the past or reasoning from the observed to the unobserved.

Inference- is the process of drawing a conclusion from premises or assumptions. In this study inference will also be used to mean the drawn conclusion.

Justification- to justify is to make or imply a rational judgment on how a belief has been arrived at. Justification can either be epistemic or pragmatic.

Epistemic justification- in this study, epistemic justification implies making rational judgment that the conclusions of inductive arguments are true (or are likely to be true) in the future. In this form of justification, 'truth' is used to denote that the contents of inductive conclusions will match objective facts in the physical world.

Pragmatic justification- in this study, pragmatic justification implies making rational judgment that induction serves a useful purpose in attaining a desired end; without invoking the truth of inductive conclusions in the epistemic justification sense. Hence, 'truth' in pragmatic justification is invoked to denote that a belief is true if and only if it yields useful practical results.

Probabilism- is any theory that seeks to justify or to validate induction by appealing to probability. In this study, probability will be used to refer to the degree of confidence attached to a hypothesis or an inductive inference, and which goes beyond the evidence that sustains that confidence. This operational definition is derived from various theories of interpreting probability including; subjective (Ramsey 1931), objective or frequency (Reichenbach 1938 pp.307), and logical relation (Keynes 1973 pp.4 and 8) interpretations.

Projection- to project is to cast past observations into the future or to predict the future based on the past. This concept is derived from Goodman and will be used to refer to inferences drawn from inductive evidence.

Reliabilism- is any theory that seeks to validate induction by appealing to induction's consistency or reliability in deriving true predictions in the past.

Rule circularity- is a process in justification where a rule is justified by appealing to the same rule as the basis of the justification. In this study, rule circularity involves appealing to inductive arguments, based on the principle of induction, in the justification of inductive inferences. Rule circularity is considered as a fallacy in reasoning.

The new riddle of induction- this is the problem of induction as it is reformulated by Nelson Goodman. It is the problem of distinguishing between valid inductive projections from invalid inductive projections: "what is the criterion of distinguishing valid from invalid inductive projections?"

The old problem of induction-this is the problem of induction as it was formulated by Hume: “are we justified in drawing inferences of instances which we have not experienced from premises of instances which we have experienced?”

The principle of induction- is a principle which assumes that if a sufficiently large number of objects of a certain kind are observed to have certain characteristics, then all objects of that kind, including the unobserved, have those characteristics.

The Problem of induction-this is the problem of justifying induction. Inductive inferences do not logically follow from the contents of the premises from which they are inferred. This raises a problem since what has been observed does not logically guarantee the truth of what has not been observed.

Validation- to validate a rule or a principle is to give an epistemic justification for the rule or principle. In this study, validation of induction implies offering an epistemic justification of induction.

Vindication- to vindicate a rule or a principle is to offer a pragmatic justification for the rule or the principle. In this study, vindication of induction implies showing that the rule or the principle of induction is best suited as a means to a specified purpose.

CHAPTER ONE
GENERAL INTRODUCTION

1.1. Background to the Study

In the 18th century, the empiricist David Hume observed that it is impossible to rationally justify inductive conclusions either by a priori arguments or by arguments based on experience (such as inductive or probable arguments). For Hume, and as it is widely accepted, inductive conclusions, which consist of claims about the unobserved future events, are derived from the knowledge of the observed instances. Given that knowledge derives from sensory experience, Hume observed that this process of inference raises difficulties because it is inconceivable how knowledge of any number of past observed instances of an event can rationally justify the knowledge of future unobserved instances.

In the first place, it was Hume's observation that a priori arguments cannot suffice as a justification of induction because it implies no contradiction to conceive or to claim a contrary of any experienced instance or what he terms as matter of fact. For Hume, the course of nature may change in the future so that past observed instances may turn out to the contrary. In this regard, the principle of uniformity of nature on which inductive inferences are based is not an a priori truth. Hence, Hume contends, the claim that the future will be like the past is not based on a priori reasoning.

In the second place, all inductive inferences are based on the assumption that the future will be like the past. Moreover, Hume argues, the assumption that the future will be like the past is itself based on experience. Hence, Hume concludes that all arguments drawn from experience cannot be appealed to in justifying induction. From the two objections, Hume concludes that induction is not rationally justified.

The objections above set the ground for the formulation of the problem of induction as follows: “Are we justified in believing that the future will be like the past?” Scientific inquiry is based on induction. Hence, on observing a large number of instances of phenomena having happened in a certain regular manner in the past, scientists draw general statements regarding the phenomena. This is the origin of scientific theories and laws of nature. If Hume is right, then it follows that the most sophisticated results of science- the pride of scientists are without rational basis. Therefore, the problem of induction is important to the philosophical study of the logic of science in as far as it continues to undermine the scientific inductive methodology.

In response to this problem, some philosophers have sought to rebut Hume’s aforementioned objections thus seeking an epistemic solution to the problem. For instance, Max Black (1962) and Richard Braithwaite (1955) have appealed to an inductive argument as follows: induction has been successful in the past; therefore induction will be successful in the future. Closely related to this is the reliabilism

response by David Papineau (1992) and Michael Levin (1993). Both argue that all that is required for justification of induction is showing that induction is a reliable process of forming beliefs about the future. Particularly, Papineau argues that since induction has been reliable in yielding true beliefs in the past, it will continue to do so in the future.

Donald Williams (1947) and David Stove (1986) have appealed to probability for a defense of induction. For Stove and Williams, it is enough for the justification of induction to show that scientific statements are probable in nature and that scientists do not seek absolute certainty in their inquiry. As such, instead of claiming that inductive conclusions will certainly be true in future, scientists should claim that inductive conclusions will probably be true in the future.

As it is apparent with the three related responses above, they are guilty of circular reasoning and therefore do not succeed in rebutting one of Hume's main objection. With this difficulty in mind, some philosophers such as Karl Popper (1972), Peter Strawson (1963) and Paul Edwards (1949) have sought to show that the problem of induction is a pseudo problem. For Strawson and Edwards, on the one hand, induction is rational by what the term rational means in ordinary language. Strawson and Edwards argue that induction does not need a justification for the problem of induction arises from confusion in how the concept "rational" is used. For the two authors, the confusion arises in an attempt to equate induction with deduction, and thus applying deductive standards in evaluating induction.

Popper, on the other hand, claims that induction is not a rational method but nonetheless is not the method of science. Hence, he concludes that the problem of induction need not bother scientists. Instead, he introduces falsificationism as the alternative to induction. Falsificationism applies deductive logic whose rationality is not disputable. Both of the linguistic and the falsification attempts to resolve the problem of induction, as it will be shown, are unsuccessful.

Nelson Goodman (1954) reformulates Hume's problem into the problem of distinguishing between valid and invalid inductive projections. This amounts to Goodman's new riddle of induction. For him, not all past regularity in nature leads to the expectation that the future will be like the past. Hence, Goodman suggests a criterion for distinguishing between predicates that lead to valid projections and those that lead to invalid projections when used in scientific hypotheses.

Last and the most important to this study is the interesting aspect that Hans Reichenbach (1938) introduces into the debate. Unlike some of the aforementioned authors, Reichenbach does not seek to show that the conclusions of inductive arguments will be true in the future. Rather, for his defense of induction, he appeals to the aim of induction: leading scientists to predictive success upon realization of the true value of relative frequency of repeatable events in the long run. Reichenbach's account is, therefore, a pragmatic as opposed to an epistemic solution to the problem of induction. He has been

accused of giving an insufficient solution to the problem owing to it not being an epistemic solution.

Given the apparent dispute arising from the various attempts to offer an epistemic solution to the problem of induction, and especially between Hume and his successors, a pragmatic justification paves the way for a solution that is unchallenged by Hume's objections. While validation of induction or giving an epistemic solution for induction entails demonstrating that the conclusions of inductive conclusions will be true in the future, vindication of induction or giving a pragmatic justification of induction entails showing that induction is the best rational means suited for achieving a desired end. Based on this distinction, Reichenbach attempts a solution to the problem of induction. He shows that induction is scientists' best bet in confronting an unknown future.

However, it is important to revisit the problem of induction with a focus on Reichenbach's solution because it seems to be the most promising solution as compared to the epistemic solutions and the attempts to dissolve the problem of induction. This approach takes us a step forward in identifying Reichenbach's solution strengths and weaknesses, and thus paves a way for its improvement.

1.2. Statement of the Problem

Reichenbach attempted a pragmatic rather than an epistemic solution to the problem of induction. He argued that even though induction cannot be logically justified, it is nonetheless justified by virtue of being a means to a desired end: leading scientists to a limit of frequency thus achieving predictive success about the unobserved future. For him, it is the limit of frequency rather than the truth of any propositions, i.e., claiming about the future, that scientists are interested with.

If we accept Reichenbach's suggested solution above, we are left with an epistemological dilemma: we are forced to deny the most essential task of epistemology, namely, digging up an epistemic justification for our beliefs. However, in rejecting his solution, we are left with an equally perturbing option: agreeing with Hume that there is no justification for induction. This leads to the question; what does the justification of beliefs about the future entail?

1.3. Research questions

- (i). Does justification for induction entail an epistemic justification?
- (ii). In what respects is Reichenbach's defense of induction better than the epistemic solutions to the problem of induction?

1.4. Objectives of the study

The general objective of this study is to re-examine the major solutions to the problem of induct

The specific objectives are:

- (i) To re-evaluate Reichenbach's defense of induction in relation to other solutions to the problem of induction;
- (ii) To demonstrate that Reichenbach's defense of induction is more viable than the epistemic solutions to the problem of induction.

1.5 Justification and significance of the study

The Problem of Induction has engaged philosophers for more than two hundred years. This engagement has, however, not yielded satisfactory results. Even though some philosophers such as Popper (1972) have argued that science does not make use of induction, it is beyond reasonable doubt that induction is the method of science. As Strawson observes, scientists may make many deductive moves in their inquiry but were these the only steps, experimental science would be impossible (Strawson, *Op.cit.*: 234). Perhaps, this is why Charlie Dunbar Broad contends that induction is the growly of science, but the scandal of philosophy (Broad, 1926). By use of inductive process, scientists arrive at conclusions that are not entailed by the empirical premises. In fact, the laws of nature, which are a great achievement of science, are arrived at inductively. It is for the fact that what has been observed does not impose any logical guarantee on what has not been observed that induction is in need of a justification.

However, an epistemic justification of induction proves to be an unachievable task, at least, as far as the debate has reached to date. Validation of induction or epistemically justifying induction would imply committing a category mistake: applying the properties of deductive logic in evaluating induction. For this reason, it deemed important to revisit Reichenbach's pragmatic justification of induction if any hope of justifying induction is to be fulfilled. This study gives an epistemic insight as to why there is need to reconsider going pragmatic in the justification of induction. Any substantial contribution made in demonstrating the need for philosophers to turn from validation to vindication of induction is essentially important.

1.6. Scope and limitations of the research

This study falls broadly in the field of epistemology and specifically in philosophy of science. In terms of scope, it covers induction as a method of attaining scientific knowledge of future claims as inferred from past claims. As concerns common sense inferences, this study gives little reference only where need arises. This is because common sense inferences often turn out to fall short of scientific generalizations.

There exists in the history of the problem of induction a great deal of responses to it. This implied a massive literature at the disposal of the researcher for critical examination. This tended to limit the researcher in that much time and funds were

needed for the access of these materials. With an informed selection of the materials that were deemed extremely relevant to the problem, the researcher was able to overcome the challenge.

1.7. Literature Review

Several observations led to the desire to revisit the problem of induction and particularly narrowing down on Reichenbach's pragmatic defense. Firstly, there is an apparent dispute between Hume and his successors regarding the justification of induction. The latter include authors who seek an epistemic solution to the problem of induction by rebutting one of the main Hume's objections to such a possibility namely, that arguments deriving from experience cannot suffice as a justification for induction in pain of circular reasoning. These are the proponents of inductivism, reliabilism and probabilism.

Hume made it clear that when we infer propositions claiming of the future behavior of objects from the knowledge of their past behavior, that inference is founded on experience. There seems to be no doubts about Hume's notion since scientists derive generalizations in form of theories and laws upon accumulation of evidence of past behavior of objects. For instance, when a sufficiently large number of metals is observed to be good thermo-conductors in the past, scientists draw a generalization that all metals are good thermo-conductors. This

generalization includes those metals that have not yet been observed. According to Hume, a question emerges as to why we should put trust on past experience of behavior of objects as a rule for the behavior of unobserved objects.

It was Hume's observation that any argument that seeks to justify the claim that the future will be like the past must either derive from a priori claims or from experience. However, Hume reiterated that such arguments cannot suffice as grounds for inductive conclusions the reason being that all conclusions regarding the future behavior of objects are founded on experience and on the assumption that the future will be like the past. Hence, for Hume and as it is obvious, to seek to justify the assumption that the future will be like the past by appealing to arguments drawn from experience would be arguing in a circle. It is for this reason that the justification of the presumption that the future will be like the past must not derive from arguments based on experience (Hume, *Op.Cit*: 31-35).

The proponents of inductivism, reliabilism and probabilism underestimate the strength of the above objection. Disregarding the circular reasoning charge, they all appeal to the past record of success of induction in the justification of induction. Inductivists such as Black (*Op.Cit*) and Braithwaite (*Op.Cit*) argue that induction has been successful in the past and, therefore, induction will be successful in the future. Particularly, Braithwaite argues that the inductive rule, when applied to arguments with true premises in the past has yielded true conclusions. Hence, he concludes that if the inductive rule will be applied to

arguments with true premises in the future, then it will lead to true conclusions (Black, *Op.Cit*: 218).

The proponents of reliabilism such as Papineau (*Op.Cit*) contend that induction has been reliable in the past for it has yielded true conclusions and concludes that induction will be reliable in the future. On the other hand, Probabilism appeals to relative frequency of past observed samples of events to infer that the future samples will match the past samples in terms of characteristics (see Stove, *Op.Cit* and Williams, *Op.Cit*).

As it is obvious, no one can deny that the three attempts to offer an epistemic solution to the problem of induction namely, probabilism, inductivism and reliabilism are guilty of circular reasoning. Though seeking to refute Hume's aforementioned objection, none of them has been able to achieve this objective. This observation gives us an insight that an epistemic solution to the problem of induction is not possible if the justification of the claim that the future will be like the past is to derive from arguments based on experience against Hume's objection. Besides, to seek to show that induction will always yield true conclusions is to seek to validate induction and by so doing to commit a category mistake. Inductive reasoning is not necessarily truth preserving. To reason inductively is to risk error. As it is generally agreed, validity is not a feature of inductive reasoning but of deductive reasoning. Given this fact, our role in justifying induction, and here we agree with Hume, cannot be that of

demonstrating that the conclusions of inductive arguments will be true in the future.

Secondly and closely related to the observation above is the fact that Hume's objections to the justification of induction namely, that there are neither a priori demonstrative arguments nor probable demonstrative arguments for justification of the claim that the future will be like the past are irrefutable. As a matter of fact, if Hume's objections were refutable, then there would be no Hume's problem today. Since Hume, the debate on the problem of induction has been centered on the two objections.

As it has been observed in the foregoing, the attempts to offer an epistemic solution to Hume's problem mentioned above sought to refute the second of Hume's objections albeit unsuccessfully. In the same token, there seems to be no doubts regarding lack of a priori arguments in defense of the claim that the future will be like the past. This impossibility derives from the fact that a conception of a contrary of any inductive conclusion does not imply a contradiction. It seems Reichenbach was right in claiming that, as he wrote, "...these two pillars of Hume's criticism of the principle of induction have stood unshaken for two centuries, and...they will stand as long as there is a scientific philosophy" (Reichenbach, *Op.Cit:* 342).

The third observation that influences this study is the fact that there seems to be a genuine problem with induction. Despite the fact that some philosophers such as

Strawson and Popper have sought to refute this claim, they have not been successful. The failure to dissolve the problem of induction in conjunction with the failed attempts to offer an epistemic solution to it directs us to reassess the need for a non-epistemic justification. For instance, Strawson, in an attempt to show that the problem of induction is a pseudo problem, claims that a demand for demonstrative justification of induction is unnecessary and senseless. Instead, Strawson seeks to show that induction is rational by ordinary language definition of the concept rationality and thus does not need justification. For him, to have inductive evidence for a claim is what it means to be rational by standards of ordinary language (Strawson, *Op.Cit:* 257).

However, as Wesley Salmon has shown, Strawson may have succeeded in showing that a demand for the justification of induction takes us beyond the limits of possible validation or epistemic justification of induction. Nonetheless, Salmon shows that this fact does not imply impossibility of the justification of induction. He argues that even though induction cannot be validated, there remains a viable form of justification that does not seek to demonstrate the truth of inductive conclusions, but which seeks to show that induction is suited as a means to a desired end: the vindication option. This is the option that Reichenbach considers as the only hope of offering a solution unchallenged by Hume's objections (Salmon, 1978: 7).

Besides Salmon's observation, it seems plausible to question the rationality behind our ordinary understanding of inductive procedures. This has been pointed out by philosophers such as Bonjour (2009) and Papineau (*Op.Cit*). This implies that induction presents us a genuine difficulty that demands a solution. If we accept that vindication of induction is a viable alternative and given that validation of induction seems to be a lost course, then there remains a need to reconsider the call for a pragmatic justification such as that developed by Reichenbach.

Another attempt to dissolve the problem of induction as long as it is considered a threat to the logic of science is presented by Popper. Popper views the problem of induction as that of establishing the truth of universal scientific theories and hypotheses. He agrees with Hume that induction is an irrational method of arriving at beliefs. However, Popper reiterates that the role of the scientists is not to establish the truth of theories but to falsify them. By shifting the role of scientific inquiry from truth to falsity, Popper offers an alternative to induction: falsificationism. According to him, falsificationism does not make use of induction. Instead, scientists put forward tentative guesses in form of theories. Deductively, they derive predictions from them and by observation, look for instances that refute the derived predictions. Upon encountering such instances, they apply deduction to conclude that the theory behind the predictions is also false (Popper, *Op.Cit*: 50-51). Popper's views imply that the problem of induction

is a pseudo problem in as far as induction is mistakenly considered to be the logic of scientific discovery.

However, it seems indisputable, and this has been pointed out by Hillary Putnam (1979) and Salmon (*Op.Cit*), that science makes use of induction. As a matter of fact, scientific laws are arrived at inductively. This implies that Popper's account does not succeed in dissolving the problem of induction. Hence, the two attempts, by Strawson and Popper, to dissolve the problem of induction have not been able to meet their objective. Induction remains problematic and as such continues to undermine the rationality of scientific methodology.

Fourthly, the attempt by Goodman to reformulate Hume's problem is of influence to this study. Goodman claims that the old problem of induction has been resolved and that a new problem of induction faces us today. However, he agrees with Hume that inductive inferences do not logically follow from what has been observed since what has been observed imposes no logical guarantee on what will happen (Goodman, *Op.Cit*: 59). Hence, Goodman contends that it is impossible to demonstrate that scientific predictions will turn out to be true. In this regard, Goodman, via his Grue paradox (which we shall discuss later), shows that not all predicates when used in hypotheses lead to valid projections. The new problem according to Goodman is that of distinguishing between valid and invalid inductive projections. Consequently, Goodman proposes a criterion for making this distinction. According to him, only the deeply entrenched predicates in our

traditions of using them in hypotheses lead to valid projections. By implication, entrenchment of predicates derives from the habit of making projections using the predicates in question.

However, critics of Goodman such as John Norton (2006) and Frank Jackson (1975) have argued that Goodman's riddle depicts nothing new. For Norton and Jackson, there is nothing that Goodman introduces that was not handled in Hume's problem. As it is evident from the brief summary of Goodman's views, it seems he endorses Hume's position that induction cannot be epistemically justified. By asserting that the genuine problem of induction cannot be that of demonstrating the truth of inductive conclusion, and by appealing to habit albeit disguised in the concept "entrenchment", Goodman's entire idea is reminiscent of Hume's position. It is worth noting that on observing that induction is not justifiable via a priori and probable arguments, Hume appealed to habit as the basis of inductive inferences. It seems, therefore, that Goodman does not advance the debate beyond Hume's assumptions.

Finally and most important to this study is the observation that Reichenbach developed a pragmatic solution to the problem of induction; but despite the fact that an epistemic solution seems fruitless, his account has been dismissed as not a solution to Hume's problem. As it has been pointed out earlier, Reichenbach appreciates the fact that it is not possible to refute Hume's objections to the justification of induction. If this is true, it deems impossible to demonstrate that

inductive conclusions will be true in the future as demanded by an epistemic justification of induction. However, for Reichenbach, this does not imply that induction is not justifiable (Reichenbach, *Op.Cit*).

According to Reichenbach, induction is an indispensable tool for the preparation for action. Since any future action presupposes several means that may lead to the attainment of the desired aim, the choice of the means must be in accord with the principle of induction. Hence, Reichenbach contends that induction serves as the best assumption in confronting the unknown future. If the principle of induction is the best assumption regarding the future, then it is justified by virtue of the purpose it serves. For Reichenbach, the purpose of induction is, as he notes, "...to find a series of events whose frequency of occurrence converges toward a limit" (*Ibid*: 350).

Reichenbach contends that scientific statements are probability statements, in which case the most probable event is posited into the future. As a frequency interpreter of probability, Reichenbach contends that the aim of frequency interpretation of probability is to seek a point of convergence of the relative frequencies of repeatable events. Since evidence, and by implication induction, sustains and gives meaning to probability statements, the problem of induction arises from frequency interpretation as long as an event which has had a given relative frequency is projected into the future. For Reichenbach, frequency interpretation assumes that as the frequency of an event is extended, the relative

frequency of the event approaches the true value of the limit, that is, one (1). Hence, Reichenbach concludes, induction which is the basis of probability statements will in the long run lead to the true value of the limit of relative frequency of repeatable events. In this regard, induction is justified as long as it leads to the achievement of this aim in the long run.

However, Bonjour introduces an interesting element into the debate. According to him, the original problem of induction demands a justification that shows that the conclusions of inductive arguments will be true in the future. The problem of induction has to do with what reasons or justification there are for accepting general conclusions on the basis of observations of particular instances falling under them (Bonjour, 2009: 58). For him, Reichenbach's justification of induction gives no reason whatsoever for thinking that the conclusions of inductive process will (or that they are likely to) be true in the future. By disregarding the truth of inductive inferences, Bonjour reiterates, Reichenbach does not offer an epistemic justification of induction. Hence, as for Bonjour, to sideline truth is tantamount to not offering a solution to the skeptical question of induction. For him, the pragmatic vindication cannot thus be regarded as a solution to the classical problem of induction.

Besides, Bonjour views the aim that Reichenbach assigns for induction as achievable neither in the long run nor in the short run. For Bonjour, Reichenbach does not give the scientists any reason to think that any calculated value of the

relative frequency at any point during the process of calculating and revising the calculation is the true value of the limit. Hence, Bonjour concludes that the role of scientists in Reichenbach's account is not better than random guessing. Moreover, Bonjour agrees with Hume that no number of observed instances of an event assures us that the event will occur in the future. According to Bonjour, this implies that no duration, however long, can guarantee that the limit will be achievable in the long run. If Bonjour is right in this assumption, then it implies that Reichenbach's aim of induction is faced with an unshakeable objection.

From the foregoing, it is evident that there is an apparent dispute regarding the kind of justification possible for induction. The attempts to offer an epistemic solution to the problem of induction fail to meet the objective given the weight of Hume's skepticism. Surprisingly, even in the light of this impossibility, an alternative pragmatic justification of induction offered by Reichenbach is still dismissed as not being a solution to this perennial problem. For this reason, it seems important to reassess and to compare Reichenbach's solution to other solutions offered for the problem. By assessing its strengths and weaknesses it is possible to recommend on how it can be improved.

1.8. Theoretical framework

This study employs pragmatism to revisit the problem of induction with an aim of demonstrating the need to reconsider and improve on Reichenbach's pragmatic defense of induction. As a theory in philosophy, pragmatism generally holds that a proposition is true if it works satisfactorily. The truth of a claim therefore lies in the practical consequences of accepting it.

Pragmatism originated in America in the late nineteenth century. Charles Sanders Peirce formulated it in his article, *How to Make Our Ideas Clear*. In this article, Peirce argued that "...a belief is something that we are aware of which appeases the irritation of doubts and involves the establishment in our nature of a rule of action or habit" (Peirce, 1878: 397). In the same work Peirce emphasizes that beliefs are distinguished from each other according to the modes of action to which they lead.

In *What Pragmatism Is*, Peirce expounds pragmatism further by noting that "...pragmatism has the most striking feature in that it recognizes an inseparable connection between rational cognition and rational purpose" (Peirce, 1905: 412). He urges that pragmatism is a procedure of seeking meanings in concepts and formulas for action.

Pragmatism was also formulated in William James' *Pragmatism*. James argues that pragmatism is a method that seeks to interpret notions by tracing their

practical consequences. He states that the main question to ask when resolving philosophical disputes is “...what difference would it practically make if this rather than that notion were true?” (James, 1907: 46). However, unlike Peirce who was concerned with the meaning of concepts as the basis for action, James sought the meaning of immediate experienced facts as plans for action. For James, it is essential to examine the practical results of ideas in order to establish their truth and meaning. The usefulness or workability of ideas, arising from experience, comprises their truth and meaning. James views pragmatism as a method of enabling man to cope with his environment for purposes of successful action.

Pragmatism was reformulated to instrumentalism by John Dewey in his article of 1938, *Logic: The Theory of Inquiry*. Dewey takes instrumentalism as an attempt to make a logical theory of concepts, judgments, and inferences. This is done by examining how human understanding works in determining, experimentally, future consequences. Truth for Dewey becomes “warranted assertion”. This means that all problematic situations, for Dewey, are resolved through inquiry which leads the mind to warranted assertion. Dewey further urges that the purpose of all inquiry is to bring about satisfactions and solutions to problematic situations (Dewey, 1938: 42). This implies that the process of inquiry arrives at conclusions which are projected towards action. For him, thought is instrumental and bears a

practical function. Through thought, man seeks to handle problematic situations via changing his environment.

In spite of the apparent differences in approach between the three major pragmatists outlined above, they all agree that beliefs serve as the basis for action. That is, the meaning and truth of beliefs are to be evaluated solely on their practical consequences; both immediate and anticipated. Truth is not a comparison between statements and external states of affairs but it lies in the practical difference that the idea makes in our lives. It is on the basis of this point of agreement that I have demonstrated the need to reconsider and to improve Reichenbach's justification of induction. Reichenbach offered a pragmatic solution to the problem of induction by appealing to the anticipated purpose of induction as a method of science. However, his solution has been criticized on the grounds that it does not offer the epistemic justification required for induction but rather a pragmatic justification. Besides, the aim he assigns for induction may be hard, if not impossible, to achieve.

By applying pragmatism, I have shown that Reichenbach's solution is best suited as a justification for inductive inferences: a point from which philosophers should proceed in offering the justification of induction. I have demonstrated that an epistemic justification of induction, which amounts to showing that the conclusions of inductive arguments will be true in the future, is not possible for this would be equating induction with deduction; yet induction is not necessarily

truth preserving. This implies that inductive conclusions from true premises may turn out to be false in the future unlike the conclusions of deductive arguments which if the premises are true, then they are necessarily true even in the future. A pragmatic approach does not seek to show that inductive inferences will turn out to be true by matching facts in the external world. Rather, the immediate practical consequences of inductive inferences justify induction. Hence, the way to justify induction is by demonstrating the practical consequences of inductive inferences.

1.9. Methodology

The study applied the qualitative method of research. It relies both on primary and secondary data, critical examination of views and ideas of the relevant authors as well as conceptual analysis. Conceptual analysis was conducted in relation to concepts such as probability, induction, justification, validation, and vindication among others. Due to the evident controversy regarding the justification of induction, it deemed necessary to make a critical evaluation of the views of various contributors of the debate thus unearthing the root source of these disagreements. It is for the same reason that the aforementioned concepts were analyzed.

CHAPTER TWO

THE CHALLENGES OF INDUCTIVISM, RELIABILISM, AND PROBABILISM

2.1: Introduction

This chapter focuses on three related attempts to resolve the problem of induction, namely, inductivism, reliabilism, and probabilism. These three attempts seek to justify the principle of induction by appealing to inductive self-supporting arguments; and are therefore guilty of begging the question. Granted the plausible assumption that an epistemic justification cannot arise from circular reasoning, it will be concluded that the three attempts fail to successively rebut Hume's objection namely, that arguments based on experience cannot suffice as a justification of induction. Therefore, the three attempts do not take the debate beyond Hume's assumptions. It will be established that Reichenbach does not deny the impact of Hume's objection and that is precisely why he seeks a justification unchallenged by it: a pragmatic justification. Reichenbach's account of induction thus moves beyond Hume's assumption that induction is not justifiable.

2.2: Inductivism

Inductivism attempts to justify induction by appealing to past instances of success of induction and proceeds to infer its success in the future. Inductivism is the account which views science as guided by a methodology of making simple and unbiased observations. The descriptions of observed phenomena are then used as the basis of making generalizations in form of theories and laws. Scientists further deduce predictions from the generalizations with an aim of confirming them through further observation. Here, inductivism denotes the process of formulating inductive arguments to justify the principle of induction relying on observation of the past success of induction and proceeding from that knowledge to infer induction's future success.

Alan Chalmers summarizes the principle of induction as; "...if a large number of A's have been observed under a wide variety of conditions, and if all these A's without exception possess the property B, then all A's have the property B. He observes that all inductivists appeal to the argument: "...the principle of induction worked on a large number of occasions in the past, therefore, the principle of induction always works" (Chalmers, 1949: 47).

Black (*Op.Cit*) is among the authors who inductively justify induction. Black argues that when the inductive rule has been applied in arguments with true premises in the past, evidence has shown that the rule has been successful in drawing true conclusions. He then concludes that it is also true that the application

of the inductive rule in arguments with true premises in future will yield true conclusions (*Ibid*: 218). It is evident from the outset that Black's argument applies the same rule that it seeks to justify. Unless the inductive rule is accepted as legitimate, it is not possible to accept Black's conclusion as legitimate. This is precisely why the inductive procedure is in question in the first place.

Black further assumes that the ratio of success of the inductive rule in the past determines the degree of belief that the rule will work in the future. For him, if the principle of induction has worked sufficiently well in the past, then one is rationally justified in inferring that it will work in future. It is for this reason that he believes that induction is justified by the assumption that this self-supporting inductive argument raises the degree of reliability of induction. He explains this notion, "...at any time in the history of employment of the inductive rule it has what may be called a degree of reliability depending upon its ratio of success in previous applications" (*Ibid*: 212)

Besides invoking induction once again in the quote above, it seems questionable how Black's self-supporting inductive argument serves to raise the degree of reliability of the inductive principle by mere record of its past success. This notion is viewed by Johnsen Bredo (1972) as absurd. Bredo argues that at any given time the degree of reliability of a rule depends on the ratio of its success, say, m/n in the past where m denotes the number of times it has been successful and n the total number of times it has been applied. According to Bredo, Black argues so as

to imply that his second order argument raises the degree of reliability of the inductive rule to a new level, say, m'/n . According to Bredo, this assumption is absurd since Black's argument at best states the past ratio of success of the inductive rule. Moreover, Bredo argues, this very past ratio originally determines the degree of reliability of the inductive rule and thus cannot be claimed to further raise the degree of reliability of the same rule it derives from (Bredo, 1972: 111).

What Bredo implies is that Black's inductive argument does not provide any reason as to why we should have a higher degree of trust that the inductive rule will succeed in the future if we are basing this on the past success of the inductive rule. Bredo expounds this by saying, "...if the possibility of inductive justification depends on the possibility of increasing the strength of inductive arguments by means of second level arguments making use of the same inductive rule, then the former possibility does not exist" (*Ibid*)

Let us expound Bredo's view by supposing that scientists have been testing the effectiveness of a HIV vaccine by dosing subjects in Kisumu County and then exposing them to the virus. Supposing record has shown that there is remarkable decrease in chances of contracting the virus in the dosed subjects as compared to the other subjects. They may infer from that record that the vaccine in question lowers the chances of contracting HIV. The inductive argument arising from this record already gives a degree of reliability in trusting that the vaccine is effective. Scientists may further argue that every time they have administered the vaccine to

subjects, they have recorded a remarkable decrease in the chances of contracting the virus, and further conclude that this further raises the degree of trusting the effectiveness of the vaccine. This second argument is similar to Black's contention. It seems he would argue that this argument further raises the degree of reliability of the effectiveness of the vaccine. This notion seems absurd since the second argument at best states exactly what is contained in the first argument.

Another view similar to Black's is propounded by Braithwaite (*Op.Cit*).

Braithwaite formulates the criterion of reliability of the inductive policy as:

“On every time t later than a fixed time t_0 , and of every interval of time of a fixed length of years d lying within the interval (t_0, t) , it is true that many of the hypotheses established by the use of policy II (inductive policy) during the interval of d years (unless there are no such hypotheses) have joint property (1) of not having been empirically refuted at any time between the time of establishment and t , (2) of having been empirically confirmed at least once between the time of establishment and t ” (*Ibid*: 267).

For Braithwaite, any policy that satisfies the above criterion is an effective policy.

Simply put, his criterion purports that the inductive policy was effective in the past and therefore is always effective. However, Braithwaite argues that the circularity involved in this argument is not vicious since the contents of the conclusion are not implied in the premise. This argument is rule circular but for him there is nothing wrong with this; for as long as the premise is reasonably believed, the argument will not only be valid but free from vicious circularity in compliance with either of three conditions. Firstly, that the conclusion is merely

believed as opposed to being reasonably believed or; secondly, that the conclusion is true or; thirdly, that the conclusion is both true and merely believed.

According to Braithwaite, all that is needed for validity of the inductive process of inference besides reasonable belief in the premises is the truth of the proposition claiming the effectiveness of the inductive policy. A person making inductive inferences is to be regarded as a reasoning machine. He writes, "...there is nothing objectionable in machine arriving at new position which corresponds to having a reasonable belief in a proposition asserting some general property of the working of the machine" (*Ibid*: 281). For Braithwaite, the fundamental point that should concern us is the inductive behavior of humans rather than their inductive beliefs. Taken in this sense the logician does not need to give reasons for making inductive inferences. Rather, it is upon the critic to give grounds for abandoning inductive behavior.

It is hard to see how Braithwaite's machine analogy fits in the justification of induction. While a machine can be programmed to draw valid inferences, the case is different when it comes to inductions made by human beings. Robert Coburn (1961) criticizes Braithwaite's machine analogy: A programmed machine, Coburn argues, once fed with certain propositions can draw a general conclusion that its working principle is effective. However, he reiterates, there is little connection between the operations of a machine and the operations of human beings. Coburn contends that human beings cannot be viewed as inductive machines. Unlike

machines, humans have the ability to question conclusions arrived at from reasonably believed propositions by applying principles of inference whose effectiveness is not similarly reasonably believed (Coburn 1961: 67).

Coburn, to the contrary, claims that Braithwaite's analogy does not substantiate the claim that his argument is both valid and free from vicious circularity. Moreover, the conditions that Braithwaite suggests for validity of his argument would lead to a paradox on consideration of a counter-inductive argument that "...policy C is not effective in the past. Therefore policy C is effective." Hence, Coburn argues, if the counter-inductive argument is to be valid in line with Braithwaite's condition, all is needed for a logician is to start merely believing the conclusion of the argument. However, Coburn argues, empirical support cannot be gained for such a counter-inductive procedure by merely adopting some psychological change in belief of the conclusion in question (*Ibid*: 71). Simply put, the conditions that Braithwaite offers are not sufficient for substantiating his claim that his argument is valid. Besides, it is hard to conceive how validity can be applied to inductive inferences. Validity is a concept that only applies to deductive logic.

From the brief discussion it is easy to see that inductivists defend induction by claiming that the conclusions of inductive arguments were true in the past and therefore will be true in future. The objective is to offer an epistemic solution to the problem of induction. Reichenbach, however, views this notion as absurd. He

reiterates that requiring a justification of induction that seeks to establish that inductive inferences are true is tantamount to demanding the impossible. For him, Hume demanded too much of induction by insisting on this condition for inductive conclusions. Instead, Reichenbach contends that induction is not invoked with any pretension of arriving at true statements. For him induction leads to conclusions which are to be considered not as true but as posits or wagers carrying a certain weight. This implies that the truth or falsity of inductive conclusions cannot be established as inductivists claim.

Hence, for Reichenbach, scientists do not consider their predictions to be true statements. They consider them as wagers carrying a degree of weight or probability and choose to deal with them not as truths but as bets for the future events. He elaborates this by noting that, "...to fulfill the conditions sufficient for the attainment of true predictions does not lie in our power..." (*Op.Cit:* 357). Given the objection that the conclusions of inductive arguments cannot be claimed to be true and that induction does not even pretend to arrive at true conclusions, Reichenbach favors a justification of induction that proves the pragmatic rather than epistemic value of induction. For him induction can be justified by appealing to its aim namely, leading to a limit of frequency of repeatable events. Hume's objections to justification of induction, through demonstrating that inductive conclusions are true, according to Reichenbach at best show that it is not possible to justify induction in such a manner. It is this

plausible assumption by Reichenbach in line with Hume's assumption that defeats the inductivism response to the problem of induction.

So far it can be concluded that inductivism does not offer acceptable solution to the problem of induction given its inability to rebut Hume's skepticism. Seeking to justify the principle of induction by appealing to arguments that derive support from the principle of induction itself does not take the debate on the problem of induction beyond Hume's objections that probable or inductive arguments cannot be invoked while justifying the rationality of induction.

2.3: Reliabilism

Closely related to inductivism is the reliabilism response to the problem of induction. Reliabilism's initial formulation appears in Alvin Goldman who proposes a definition of justification as: a knowing subject is justified in believing a proposition at a given time if and only if (i) the subject's belief in the proposition results from a belief-independent cognitive belief forming process that is unconditionally reliable, or (ii) the subject's belief results from a belief-dependent cognitive belief forming process that is conditionally reliable and all the input beliefs are justified (Goldman, 1979). E. Sosa's (1991) evil demon problem is relevant here; if there exists a powerful demon that misleads subjects into acquiring false beliefs, then this challenges Goldman's formulation of

reliabilism outlined above. In an evil demon- world subjects acquire justified but unreliably arrived at beliefs. Sosa views the victims of the evil demon as living in a world in which there are unreliable belief forming processes but nevertheless these beliefs are justified.

With such a weighty challenge namely, the possibility of justification without reliability, Goldman suggests another condition for reliability. In addition to the aforementioned conditions, the subjects must not have reason to believe that their beliefs are unreliably caused. According to Goldman, this gives reliabilism a stronger formulation. That is, a knowing subject's belief in a proposition is epistemically justified if and only if (i) the subject's belief in the proposition is a result of a cognitive process that is (highly) reliable, and (ii) the subject does not have reason to think that his/her belief is unreliably caused.

Let us now evaluate the above claim in greater details. Induction as a belief forming process yields beliefs that are not logically entailed and therefore in need of justification. Reliabilists seem to agree that a belief that is inferred from other reliable beliefs is also reliable. By the same token, Jochen Breisen (2013) observes a major difficulty that faces reliabilism. An illustration similar to one given by Braisen will serve to outline this difficulty. Consider Aysha who has a reliable perception. Her kitchen is equipped with a fire detecting alarm. However she has no reason to believe that the alarm is or is not reliable for she has never checked its internal working status. On one occasion o_1 while resting in the

backyard she hears the alarm ring and proceeds to reason as follows. (i) On occasion o_1 the alarm is ringing. (ii) On occasion o_1 there is a fire in the kitchen. (iii) Therefore on occasion o_1 the ringing alarm denotes a fire in the kitchen.

According to reliabilism, Aysha is justified in all the three beliefs because each involves a reliable belief forming process and she has no defeaters in respect to the beliefs. Therefore, she is justified in believing the reliability of (i) owing to her perception. In reference to (i) she believes (ii) which is justified as well because the process that led to (ii) is 'believe what the alarm says' and this is justified as long as the alarm is working properly. She is also justified in believing (iii) since according to reliabilism drawing an inference from a justified premise is reliable. Following the accumulation of many such instances, Aysha gathers large evidence concerning the behavior of the alarm and proceeds to reason; (iv) on occasion $o_1 - o_n$ the ring of the alarm denoted a fire in the kitchen. From this evidence she inductively infers (v) the alarm is reliable.

However according to Jonathan Vogel (2008) and Braisen (*Op.cit*), it seems that Aysha cannot be justified in believing (v) unless she goes to the kitchen to confirm that the alarm is working correctly: by making internal checkup. But then, this need to carry out an internal checkup involves reliabilists in epistemic circularity in that the justification of (ii) above already presupposes the truth of the conclusion (v). This plainly jeopardizes all attempts by reliabilists to infer the reliability of all particular inductive inferences.

Papineau concedes that the conclusions of inductive arguments are not logically entailed by the premises from which they are drawn. For this reason induction is logically invalid. However, Papineau argues, this does not imply that inductive inferences do not yield knowledge (Papineau, *Op.Cit*: 12). By demonstrating that validity is not a necessary condition for knowledge but rather that the reliability of the process of acquiring knowledge is, he hoped to rebut Hume's skeptical conclusion namely, that induction is not epistemically justifiable.

A process of reasoning, according to Papineau, is "rational" as long as it is in accordance with the condition of 'reliably deriving truth'. Hence, Papineau argues that induction is rational and yields knowledge because it is a reliable method of arriving at new truths out of old ones. With this assumption, Papineau seeks a supporting argument: He contends that induction is justified because it has been a reliable tool for arriving at true conclusions in the past. He writes,

"When people make inductions, do their conclusions turn out to be true? There are plenty of past examples of people making inductions. And when they have made inductions, their conclusions have indeed turned out true" (*Ibid*: 14).

Responding to the possibility of circular reasoning charge, Papineau argues that to solve disputes regarding whether induction is reliable or not, it is rational to appeal to what he calls 'normal procedures of investigation' which include inductive procedures. Moreover, he claims, the circularity involved in his argument is not vicious. Even though his argument is rule circular, Papineau argues, this defect is not exclusively a difficulty in validating induction. For

Papineau, to show that any process of inference is reliable, be it induction or deduction, one is bound to involve in rule circularity. For him it is possible to demonstrate the reliability of deductive inferences by appealing to rules of soundness. However, the process of demonstrating this validity makes use of deduction thus making it as circular as that of justifying induction (*Ibid*: 16). For this reason, he concludes, it is unfair to deny an argument's legitimacy on grounds that it offers a circular justification.

However, as Alan Robert Rhoda (2003) put it, self-authentication is no authentication and as such needs not be taken lightly. What Rhoda implies is that one cannot claim to have offered an epistemic justification for a rule by simply employing the same rule in need of justification in his/her justification. Moreover, Rhoda argues, the parallel that reliabilists draw between induction and deduction does not exist. This is because while it is possible to prove the validity of deductive rules without making reference to the same rule in question (such as in proving the validity of a mathematical theorem without invoking the theorem in question) the same is not possible while proving the reliability of inductive rules. Rhoda concludes that for the reliabilists' parallel to hold they need to offer an inductive inference that does not use the rule in need of justification (*Ibid*: 36-38)

Rhoda insists that the reliabilists' use the parallel so as to equate inductive inferences to deductive inferences. Reliabilists according to Rhoda assume that just as validation of induction terminates at deductive rules of inference, (taken as

premises in need of no justification) so in the same way ought inductive rules of inference to be considered. Of course this does not only help to avoid an infinite regress in justification but also makes it possible to validate both deduction and induction. However, Rhoda argues, deductive logic unlike inductive logic contains truths of reason and does not infer anything beyond the contents of the premises. Inductive rules, in so far as they are contingent, imply that even if they were analyzed for ever, there can never be any hint of truth that they logically follow from the conclusions. As such, they cannot be taken as premises, in need of no justification.

The important point to note is that the problem of justifying the reliability of deductive rules is unlike that of justifying the reliability of inductive rules. As Rhoda writes:

“The attempt by...Papineau to legitimize rule circular inferences by appealing to parallel between deductive and inductive inference rules is misguided. The necessary parallel doesn't exist, and without that we are left with no good reason to suspend the highly intuitive principle that self-authentication is no authentication in favor of permitting rule-circularity” (*Ibid*: 44).

In furtherance of Rhoda's plausible view, it can argued that even if rule circularity cannot be avoided in demonstrating the reliability of any form of inference- be it deductive or inductive- this fact alone does not imply that justification terminates at this point. Rule circularity can be avoided by avoiding taking the process of validation to the level that Papineau takes it. That is, for further justification of the rules of inference, be they deductive or inductive, there is always a plausible

alternative: invoking the purpose or the aims of adopting the rules in question. We shall address this point later.

A further challenge arises for reliabilism being an externalist justification theory. It holds that the knowing subject needs not know that a process is reliable to be justified in claiming the information that results from the procedure. Connected to this, reliabilists suggests that as long as induction is reliable, the beliefs that arise from it are justified regardless of anyone's awareness that induction is reliable.

This view is supported by Michael Levin who urges, "...all that matters for knowledge is that the process causing his belief be reliable whether he realizes it or not" (Levin, 1993: 227). According to Levin, memory and perception are reliable apparatus. As such, the inductive beliefs that arise from these apparatus are reliable and thus justified. For him, the main challenge that inductive skeptics pose is that even though induction has been reliable in the past, it may cease to be reliable in the future. However, to this Levin reiterates that a reliable process does not depend on time (*Ibid*: 298). This implies that a belief forming process is reliable if and only if it is objectively reliable. Consequently, if induction has been reliable in the past, then it must continue to be reliable in the future.

Vogel (*Op.cit*) criticized this aspect of reliabilism. According to him, reliabilism is defeated by internalism since internalism requires that knowledge be justified and justification requires evidence. This is as expressed in the fire detector alarm illustration: Aysha has no evidence regarding the reliability of the detector. By

virtue of lacking evidence to support that the alarm is reliable, internalists would argue that she does not know that the alarm is reliable. We intuitively feel that there is need to conduct internal checks even on other machines that we believe are reliable in order to be justified that they are, really, reliable. This internal check reduces the knower to an internalist (*Ibid*: 520).

In response to Levin's claim, we may argue that it seems that reliability is not necessarily an objective reality. Just because a tool has been reliable in the past does not logically imply that it will be reliable in the future. This suggests to us that reliability is a contingent matter and therefore in itself raises the problem of induction. There exists no contradiction involved in the conception that a tool that was reliable in the past may give contrary results in the future. For instance, people have had reliable sensory apparatus in the past which have ceased to be reliable now due to unanticipated defects. It seems plausible to evaluate the reliability of the apparatus on the grounds of their practical usefulness at a given time without claiming its usefulness in the future for nothing about its future working abilities is known.

The reliabilism response discussed above applies inductive arguments in showing that induction will be reliable in the future. This does not, however, imply that the conclusion "induction will be reliable in the future" is necessarily true. As it is with all inductive arguments, the conclusion is not logically entailed by the premises from which it is inferred. Reichenbach (*Op.cit*) moves to a greater

extent. Although he does not explicitly invoke the reliability of the inductive rule, he does not only show that the inductive rule is a necessary condition for finding a limit of frequency of repeatable events, but also that it is a necessary condition for the existence of the limit (*Ibid*: 356). Unlike the reliabilists, he does not seek to show that induction has been reliably yielding true predictions and therefore will continue doing so in future. To the contrary, he denies, as it was already observed, that predictions can be shown to be true. His argument, however, avoids circularity for he does not use inductive arguments to support his claim but rather appeals to the purpose of the inductive rule.

In sum, reliabilism as a justification of induction is notoriously circular. It does not provide any plausible grounds as to why we should continue trusting induction as a guide to the future. Reichenbach's suggested solution thus seems more plausible as far as induction is not justified by appealing to its past reliability but by being a necessary tool for arriving at the specified aim.

2.4: Probabilism

Probabilism provides another attempt to offer an epistemic solution to the problem of induction albeit guilty of circular reasoning. This response to the problem of induction views scientists as incapable of being a hundred percent certain that their generalizations will continue to be true in the future. The core

assumption of this notion is that, guided by a large number of past observations, scientists can approach absolute certainty, and this is all that is needed for justification of scientific inferences.

As such, scientific generalizations are not universal deterministic statements but, probabilistic statements. The implication is that probabilistic theories, as pointed out by Anthony O'Hear, do not offer predictions to single future events. For example, on observing that Kinyua (and many other cases similar to Kinyua's), a chain smoker, dies of lung cancer at a tender age and on investigating his lungs to find evidence of traces of smoke, a scientist may formulate a theory that smoking increases the chances of contracting lung cancer. However, the fact that Njoroge, also a life-long chain smoker, dies at an old age in good health does not counter the theory that smoking increases the chances of contracting lung cancer. This is because the theory speaks of smoking as increasing the probability of contracting lung cancer (O'Hear, 1989:144-145).

The implication is that probabilism theories do not deductively entail all cases of events which they seek to explain. For this reason, the single case of Njoroge is not entailed by the theory. The conclusion to draw from the theory and the premise that Njoroge has been smoking the longest part of his life is that he will probably get lung cancer. This procedure involves weakening the conclusion of the argument by introducing the term 'probably'. Unlike inductivists who, upon observation of large number of instances of a phenomenon, draw a universal

inference that all cases of the phenomenon are such-and-such as observed, probabilists claim the occurrence of a single isolated event only in relation to the probability of a class in which that phenomenon belongs. However, they do not just assert vaguely about the probabilities of events. They may assign a numerical value to the probability of the isolated event based on the relative frequency of that class of events.

For instance, the action of drawing cards from a well shuffled pack would assign a 48 in 52 chance of drawing a non-ace. Suppose the event of drawing a non-ace is 'a' and the action drawing a card is 'b'. A probabilistic theory would be $P(a,b)=48/52$. This high probability does not, however, rule out the possibility of drawing an ace in the next single event of drawing a card. However, the theory does not claim anything about the particular drawing of a card more than that the event belongs to the class of all possible events.

Probabilism does not treat the cases that deviate from the theory as refutations of the theory unless such cases are sufficiently large enough to falsify the theory and also given that there is no reason to think that the deviating cases are atypical of the sample characterized. As pointed out earlier, probabilistic theories are based on observation of large number of instances of a phenomenon. This is the Law of Large Numbers with its origin in Jacob Bernoulli's theorem (1713) and gets its application in justification of induction in Donald Williams (*Op.Cit*) and Stove (*Op.Cit*). The law states that if a sufficiently large sample is drawn from a large

population, then it is most likely to be like the mother population regarding the distribution of characteristics (see O’Hear 1989: 147). The rationale is that as the sample size is increased, the likelihood of matching the mother population in terms of distribution of characteristics approaches the probability value one (1). According to probabilism this is the sense that inductive inferences are justified.

An example of a probabilistic justification of induction was presented by Williams (*Op.Cit*). Williams offers a justification of induction hoping to rebut Hume’s objections and the circularity that arise from attempts to justify induction via probabilistic arguments. However, as Campbell and Franklin (2004) observe and as it will be concluded by the end of this section, Williams’ argument at best claims that there are reasons for believing that good inductive arguments give a degree of support to their conclusions but this does not imply that the conclusions are entailed by the premises. For Williams entailment is one condition for support of a conclusion in which a hundred percent certainty for the conclusion is guaranteed. However, in most cases, certainty in a conclusion is below 100% but nevertheless strong in which category inductive conclusions fall.

Williams contends that proportional syllogism, in which a conclusion of a subset of a sample is non-demonstratively inferred from knowledge of the components of a larger sample or the whole population, is a justified form of inference. For instance, if a room has 50 persons and given that we know that 90% of the persons are males, then we are justified in inferring that the next person to be

selected by a blind-fold individual will be male has a 90% support from the background knowledge. That is, given this evidence, the conclusion has a probability 0.9 of being true. Even if the next person selected may turn out to be female, it is rational to believe the proposition ‘the next person to be selected has 0.9 probability of being male’.

The above argument is an example of proportional syllogism in which it is rational to have a calculated degree of confidence in the conclusion. Williams argues that the same reasoning (proportional syllogism) applies to inductive inferences but involves, rather, inferring from a large sample to the whole population. He contends that the premises of inductive arguments give high degree of support for inductive conclusions just like it is to infer from a population to the sample. This implies, for Williams, reversing the structure of the syllogism so that the process of inference shifts from “population to sample” to “sample to population”. From the outset this seems to be an illegitimate transference. This point will, however, be elaborated later.

A perturbing situation arises, as Campbell and Franklin (*Op.Cit*) observe, in establishing the truth of the transference above. They argue that as for the proportional syllogism it is quite clear that the reasons for accepting the conclusion are purely a priori (*Ibid*: 280). For instance in the illustration above given that there are 50 persons and that 90% of them are male, it follows, a priori, that the chances of picking a male are 90 in 100. The conclusion does not

presuppose any contingent claim. This is unlike in inductive arguments whose conclusions move beyond the available information.

However, Williams argues that it is possible to offer such an a priori justification for induction. To demonstrate this, he illustrates; suppose a scientist wants to investigate a sample of 1000 fold ravens (fold in that the scientist has no information concerning the ravens a part from that they of such-and-such color). The scientist can come up with several groups of 1000 fold ravens. The assumption is that however large the number of 1000 raven groups there may be to cover the whole population of ravens, it is a fact that the majority of them will have similar characteristics in terms of color. That is, the majority of the ravens in the groups will match the raven population. In such a case, according to Williams, it is rational to believe that a majority in the sample of 1000 fold ravens will most probably characteristically match the total population. However, this does not imply that there will be no deviant cases. Williams concludes that induction (inferring from sample to population) is justified since this reasoning is as direct as that involved in proportional syllogism (inferring from population to sample).

Supposing 95% of the ravens in the 1000 fold ravens sample are black. Williams' argument can be summarized, as Stove does, as;

The probability of the inference,
 { F. 95% of ravens are black
 G. Abe is raven
 H. Therefore Abe is black } is 0.95 and this is enough to justify inductive

inferences. In a generalized form the argument runs as:

m/n^{th} s of large sample S of the F 's are G
 Therefore, about m/n^{th} s of the population of F 's are G (see Huemer, 2002: 357).

The transference from "population to sample" to "sample to population" as advocated by Williams seems not to make a good analogy. While it is possible to have a degree of confidence in proportional syllogisms' conclusion owing to unbiased, representative, and finite population, the same is not true of inductive samples which cover an extensive and ill determined population. Therefore, the analogy between proportional syllogism and inductive arguments lacks the 'alikeeness' in terms of the structure apparent in each side. It is for this reason that Williams' justification has been criticized on grounds that inductive samples lack the precise randomness like that of statistical or proportional syllogisms.

For example, Alice Ambrose urges that there needs to be a method of selecting the inductive sample in question which allows one to infer in the same way as one does with proportional syllogism. Unless one is certain that the sample in question is unbiased and selected objectively, then one cannot be justified in asserting that the sample probably matches the whole population in terms of its characteristics (Ambrose, 1948: 516). The implication is that induction would be justified, in the way Williams suggests, if and only if the analogy is a perfect one. This seems to

be a condition that may never be achieved in inductive sampling as long as induction claims an infinitely large population. Inductive inferences do not just claim of enormously large present samples of cases but also infinitely large past and future cases of the population to which the sample examined is generalized.

Ambrose's criticism has practical application. Take, for instance, the long period before Kenyans had made any contacts with the white Europeans or the colored Indians. Assuming that communication and movement was confined within the small tribal territories and within a confined geographical context, it is appropriate to imagine that Kenyans thought that probably all human beings are black. This, however, may have lasted for a short while until the first nonblack human being came into contact with the black Kenyans. It seems that the data used to generalize that the sample observed probably matches the total human population in blackness was significantly biased and unrepresentative. It was not known whether, in the future, conditions will change such that the black human population changes to some other color. Neither was the distribution of other humans in both place and characteristics known. It is, therefore, seemingly hard to talk of an inductive sample that is unbiased and representative of the whole population regarding its present and future characteristics.

M.B. Brown also notes the difficulty arising from lack of random inductive samples. According to him, there are no reasons at all to think that inductive observations are arrived at through a good sampling process. Brown argues that

the only support that can be given for the sample would be inductive itself (Brown, 1987: 117-118).

Suppose we pose a question; what reasons are there to make us believe that the samples that were observed in the past will match the future population whose samples are yet unobserved? The immediate answer that Williams would offer is that large samples of a population are known to be representative and therefore the observed samples will probably be representative. This may seem an attractive answer but it does not settle the skeptical disputes. In answering the question; ‘how do you know it is representative?’, an appeal is made to probable arguments and this circularity leads back to Humean skepticism. In the illustration above, it perhaps was a great disappointment for Kenyans on learning that the population of non-blacks was, as a matter of fact, larger than that of the blacks.

Another version of the probabilism defense of induction was given by Stove (*Op.Cit*). Stove advances Williams argument by seeking to remedy a main difficulty arising from it namely, Williams interpretation of factual probabilities can lead to conclusions that make no sense or that are necessarily false (see Huemer, *Op.cit*: 359). Stove observes that the conclusion drawn from Williams’ argument that “Any F has a probability such-and-such of being G (for example probability 0.9) could lead to either of the following statements as expressed in Stove’s schema 77.

(77) Any F { has a probability of 0.9 of being
 has a high probability of being
 is very probably a
 is almost certainly a
 is almost certain to be } G

The statements above, Stove argues, are deceptive. To expound on the claimed deception Stove gives the following illustration commonly made by biologists (Stove's schema 78-82)

(78) Any mutation is almost certain to be harmful
 (79) M is a mutation
 Entails
 (80) M is almost certain to be harmful.

Stove argues that the 'Any' in (78) above is a universal quantifier and thus has syllogistic force. If this is conjoined with

(81) M is a beneficial mutation
 Entails
 (82) M is beneficial and almost certain to be harmful

It is clear that (82) is either nonsensical or necessarily false. According to Stove, Williams argument is characterized by schema (77); 'Any sizable sample very probably matches its population in any specific respect' and as such leads to the kind of absurdity outlined in the illustration above.

Stove's argument, like Williams', adopts the Law of Large Numbers which, however, contains less general statements than Williams'. His argument is based on the sampling principle: when a sample is drawn randomly from a population,

the probability that the sample is representative of the population is very high provided the sample is reasonably large (see Indrkhya, 1990: 101).

For instance, Stove demonstrates that if a population of a million ravens that contains 50% black ravens was to be investigated by taking samples of 3000-fold ravens, then more than 99% of 3000-fold ravens will match the blackness frequency of the population within 3%. That is, within 47% and 53%. As the size of the population grows larger and the fold-sample remains constant, the probability that the random sample nearly matching the population will not record significant decrease. From the sampling principle Stove draws an inductive argument;

A: S is a 3020-fold sample of PoP

B: just 95 percent of the ravens in S are black

E: the proportion of black ravens in PoP is near 95 percent

(Where PoP=the population of ravens in a given time interval)

The conclusion (E), in Stove's argument is, undoubtedly, less general than

Williams' H. However, does this argument counter the inductive skepticism?

Stove argues that his inductive argument is justified in that the conclusion follows

from the premises. It seems consistent to conclude that, as Stove does, owing to

the sampling principle a majority of the 3000-fold samples of PoP have nearly the

same proportion of black ravens as the whole population. It logically follows that

the probability that the sample S has similar proportion of black ravens as the

whole population is quite high. The process of inferring from A to E is inductive.

But, accordingly, E follows logically from A and B. For Stove this is enough to rebut Hume's skepticism.

However, as Indurkha observes, Stove's argument rests on an assumption that the sample in question is actually representative of the whole population of ravens. Dealing with a sample similar to that of Stove, Indurkha argues that in the absence any other information (apart from that the sample contains some black and some other color ravens) and on repeated investigation of the sample, it would be irrational to conclude that 95 or such-and-such percentage of the ravens are black. This is because there is nothing more known about the population of ravens regarding, for instance, their distribution in time and place. Suppose, as Indurkha does, a bucket contains 3020-fold balls and on repeated investigation one finds, in absence of further information, that 95 percent of the balls are black. Suppose also we are dealing with a sample of 3020-fold ravens and we observe that 95 percent of them are black. In the case of balls, we can infer with confidence that there is a high probability that 95 percent are black. However, in the case of ravens, the absence of further information restricts us from making such an inference. The much that can be said is that 95 percent of the ravens observed so far are black (*Ibid*: 103). This implies that Stove's conclusion E is not logically entailed by A and B.

Moreover, Stove would need to prove that the sample of ravens is random in order to claim he has justified induction. Unless the sample is random, the

inference from A to E is unreliable. According to Indurkha, the sample needs to be random in both time and space. This implies that it has to be picked fairly on all areas that ravens exist. If this is not done, then the inference E must be restricted to the place in which the sample is collected. Indurkha insists that it implies no contradiction to imagine that ravens will differ in color depending on geographical and environmental differences. Consequently, it would be a hasty generalization to claim that such-and-such percentage of all ravens on earth is black having drawn a sample from, say, Australia alone. According to Indurkha, place randomness is not a possible condition to meet.

In addition, Indurkha continues, a sample of ravens would be random in time if it is picked within reasonable time frame which includes the long past and infinite future. This is because, it involves no contradiction to imagine that ravens may change and may have changed their color as a result of adaptation. In two thousand years to come, for instance, all black ravens may turn out to be white or some other color. Indurkha concludes that unless time travel is possible, there can never be a random sample that guarantees a generalization to all ravens that disregards time and space randomness. While it is possible to include some past ravens in the sample, it is impossible to include future ravens (*Ibid*: 105)

Marcus Giaquinto (1987) traces an explicit fallacy in Stoves argument. He explains:

“The fallacy is explicit. Consider the question ‘why should I believe that the sample with which nature happens to have furnished me in a representative sample? The...answer, Stove says is in the essence; “...it probably is because most large are representative...” [But] A lot depends on how the sample is obtained. If we know that our sampling procedure is truly random so that we are just likely to end up with one (large) sample as any other sample of the same size we may reasonably infer that the sample obtained is probably representative. Suppose now that a high proportion of ravens are not black but all of these live in very remote regions, are difficult to spot, and are easily mistaken for birds of other species when they are spotted. In this circumstance we are likely to obtain a sample which is biased in favor of black: our sample is probably unrepresentative, even though most large samples are representative (Giaquinto, 1987: 614)

In spite of Campbell and Franklin (*Op.Cit*) efforts to save Stoves and Williams sampling argument from the randomness charge, these objections seem rationally grounded. Campbell and Franklin argue that the sampling argument by Williams and its advancement by Stove serve adequately to justify induction. They argue that unless one has a reason to think that the sample in question is unrepresentative, then probably the sample is representative because most possible samples are. This is clearly an inductive support thus implying circular reasoning. But, besides this defect, Campbell and Franklin continue to argue that it would be irrational to believe that a sample is unrepresentative if there is no evidence to make one believe that it is not. The same way that one believes that a sample of balls is representative of a finite population of balls, so should one believe inductive samples as representative. The same random procedure applied in statistical syllogism is applicable to inductive inferences from sample to population. Campbell and Franklin expound this by saying: “...you do not need to know that your sample is not biased- all you need to know is that the sample is

not known to be biased (or have no reason to think that it is likely that it is biased)” (*Ibid*: 85)

However it seems that Campbell and Franklin are wrong. Clearly, the objections to Stove and Williams, analyzed, cite reasons that can make one think that the sample in question is biased. For example, there could be an unanticipated change in the color of ravens due to adaptation and geographical differences and lack of representation of the sample in time and place. Statistical syllogisms, unlike Williams’ and Stove’s arguments, do not have their conclusions going beyond the evidence contained in the premises. Moreover, the fact that the sample is not known to be biased does not imply that the sample is not biased. For conclusive evidence in such generalizations, it seems reasonable not to just think that the sample is not biased but also to know that it is not biased. Being ignorant of the status of the sample does not justify the inferences drawn from the little that is known of the sample. Any such generalizations should therefore leave a room for further rigorous investigation which probabilism does not seem to grant.

Besides the above difficulties facing probabilism, Hume had strongly objected to any attempt to justify induction by appealing to probable arguments. Weakening the conclusion of an inductive argument by inserting the term probably does not make things simpler for a Humean skeptic. Hume acknowledges that as the frequency of instances of an event increase, the probability of the event is proportionately increased. This implies an increase in the degree of belief in the

event. Hume contends that matters of fact that portray exclusive uniformity render the mind to attach a higher degree of probability than those that record some irregularity. However, for Hume, this is the effect of custom. Given that all conclusions regarding matter of fact are drawn from the supposition that nature is uniform, to weaken the conclusion of an inductive argument by introducing the term probable, would also imply weakening the premises by inserting another premise that nature is probably uniform. The probabilistic response does not serve to validate induction any worse than any other inductive attempt.

The foregoing discussion has some similarities to Reichenbach's (*Op.cit*) account of induction. Of significance is the fact that Reichenbach's solution is based on frequency interpretation of probability. As far as events are repeatable, the relative frequency of their occurrence can be calculated. Reichenbach believes that the calculated, and frequently corrected, value of relative frequency of a series of events with a limit of frequency approaches the true value of the limit. Induction is justified as long as it leads to the realization of this aim. According to Reichenbach, the relative frequency calculated at any given time carries an appraised weight. In the case of probabilism discussed above, the calculated weight is posited to represent a future event in a generalized manner such as, say, 0.9 of the sample ravens probably matches the characteristics of total population.

However, for Reichenbach, the weight of the single future event is not known and as such the event is projected as a "blind" posit for nothing about it is known

(Reichenbach, *Op.Cit.*: 353). The much that can be said of it is that it is the best posit but not that it is a good or a bad posit. However, a process of updating the relative frequency goes on as the series of events is continued. It is this process that Reichenbach believes will lead to the true value of the limit should such success be possible.

Even though Reichenbach's solution stems from probability, he does not justify induction by appealing to probable arguments. His response as well as the probabilism response point to it that scientific statements are probable arguments. However, unlike probabilism which claims that this is enough to justify induction, Reichenbach carries on the debate to invoke an aim of induction in line with probability or weight of inductive inferences. This therefore, does not only escape the circularity involved in the probabilism attempts to justify induction but it also takes the debate to a higher level by justifying probability statements.

Besides, probabilism at best tells us how the problem of induction arises. As it is with this response, scientists use the calculated relative frequency of an event to invoke an unobserved future event. It is this projected event that gives rise to the problem of induction. The question arises as to why we should rely on past relative frequency as the guide for inferring a future event. The problem of induction is already evident in the probabilism conclusion that the future samples will probably match the past samples in terms of characteristics. As such,

probabilism does not give a justification for their inference. By implication, probabilism does not advance the debate beyond Hume's assumptions.

From the foregoing, it is evident that the three attempts namely, inductivism, reliabilism and probabilism to justify induction do not escape the circular reasoning charge since all are inductive in nature. Consider the three arguments below:

(i) Inductivism

P₁ Induction worked on occasion 1
P₂ Induction worked on occasion 2
P₃ Induction on occasion 3...n
C₁ Therefore induction works

(ii) Reliabilism

P₄ Induction was reliable on occasion 1
P₅ Induction was reliable on occasion 2
P₆ Induction reliable on occasion 3...n
C₂ Therefore induction is reliable

(iii) Probabilism

P₇ Inductive sample_x was probably representative of a population 1
P₈ Inductive sample_y was probably representative of a population 2
P₉ Inductive sample_z was probably representative of population 3
C₃ Therefore inductive samples are probably representative of populations

These three arguments seek to justify induction by appealing to experience; against Hume's objection namely, probable arguments when used to justify induction amount to circular reasoning. The circular reasoning involved in each leads to the conclusion that neither of them serves the intended purpose nor advance the debate beyond Hume's aforementioned objections. As it is evident,

the conclusion of each argument is arrived at inductively. Any arguments of this nature already presuppose that induction works, or is reliable, or provides a degree of probability: the very assumption that is in desperate need for justification.

However, Reichenbach's appeal to probability does not lead to this circularity. By going beyond a justification of induction that appeals to inductive or probable arguments, his approach suggests that induction can be justified albeit pragmatically. Further, by showing that inductive arguments are not intended to lead to true conclusions, his justification of induction does not only endorse Hume's plausible assumption that induction cannot be justified by demonstrating that inductive conclusions are true, but also offers an alternative justification which probabilism fails to. His appeal to an aim of induction, therefore, furthers the debate of the Problem of Induction contrary to the probabilism views discussed above.

CHAPTER THREE

ATTEMPTS TO DISSOLVE THE PROBLEM OF INDUCTION

3.1: Introduction

Whereas the previous chapter deals with attempts to externally validate induction, albeit unsuccessfully, a contrary thought is presented in this chapter. I present two attempts that seek to dissolve the problem of induction. The theorists presented in this seek to show that either induction needs no justification because it is internally justified, or that it is an irrational method, but it is not the logic of science. The latter is an attempt to show that there is an alternative logic of science whose validity is indisputable, and therefore the problem of induction need not bother scientists.

The solutions to the problem of induction discussed in this chapter are the linguistic (or the ordinary language) dissolution and Popper's falsification. It will be concluded that while the linguistic respondents are right on one aspect (that induction is the logic of science), their claim that induction is self-evidently rational is wrong, and therefore their arguments do not imply an impossibility of justifying induction. Consequently, to justify induction, a logician is left with an alternative that takes him/her beyond the limits of validation expressed by the linguistic respondents. Moreover, it will be concluded that Popper's falsificationism is neither historically nor practically tenable. That is, science applies induction in discovery and formulation of theories and laws.

Consequently, the problem of induction continues to undermine the logic of science.

3.2: The Linguistic Dissolution

Linguistic dissolution of the problem of induction seeks to show that the problem is a pseudo problem because it arises from conceptual confusion. Hence, linguistic respondents to Hume's problem seek to clarify the meaning of concepts such as rationality, reason, and evidence. The core of this attempt is to show that induction is rational by standards of definition of the concepts aforementioned. According to this school of thought, the problem of induction vanishes upon the clarification of the meanings (previously misconceived) of the concepts from which it arises. This section will critically re-examine Strawson's and Paul Edwards' accounts of induction as the representative of the linguistic dissolution.

Strawson, basis his argument on the distinction between types of reasoning which include arguing, proving, deducing, and inferring. The problem of induction, he argues, results from an attempt to reduce all reasoning to deductive reasoning. It is in similar respect that critics of induction seem to equate rationality with deductive logic. He urges that to follow either of the aforementioned ways is to be rational. For Strawson, and as it is widely acceptable, validity and soundness apply to deductive reasoning in which the conclusion necessarily follows from the

premises. Hence, in a deductive argument, it is a contradiction to affirm the conclusion and deny the premise(s). Inductive reasoning on the other hand involves drawing conclusions from known facts in order to investigate the logical consequences of those truths (Strawson, *Op.Cit*: 12-13). This distinction between induction and deduction if accepted from the outset points to it that seeking to demonstrate the truth of inductive conclusions is trivial.

By the same token, Strawson agrees with Hume that the conclusions of inductive arguments are not entailed by the premises from which they are inferred. It is not a contradiction to accept the premises of an inductive argument and deny its conclusion. Inductive arguments are therefore invalid and unsound in deductive sense. However, this according to Strawson does not render inductive inferences worthless. He contends that deductive standards are not the only standards of evaluating rationality. For him inductive standards are to be used in evaluating inductive reasoning just as deductive standards are used to evaluate deductive reasoning (*Ibid*: 233-234).

Strawson insists that scientists apply deductive reasoning especially in formulating predictions. As a matter of fact the premises of many deductive arguments are arrived at inductively which means that even the so called deductive arguments are groundless without induction. For example, the argument that “all copper metal conducts electricity and therefore this copper metal conducts electricity” has its premise arrived at via past observations of copper

metal conducting electricity in many instances thus implying induction. However, Strawson urges, deductive steps are not the sole steps that characterize scientific enquiry. As a matter of fact, and here I agree with Strawson, if deductive steps were the sole steps in science, then experimental science would be impossible. It is, therefore, part of scientific enquiry to draw conclusions that are not entailed by the premises from which they are drawn. This does not, however, undermine the rationality of scientific knowledge. For Strawson, inductive reasoning provides conclusive evidence which gives scientists reasons to accept its conclusions (*Ibid*: 237).

The implication is that while deductive conclusions derive entailment from premises, inductive conclusions derive support. Entailment and support, according to Strawson, do not compete in the same arena. For this reason, the demand for validation of induction arises from a state of confusion namely, demanding that inductive arguments should be valid. He urges that validity and invalidity apply to particular deductive arguments but not to deduction as a general procedure of inference. Similarly, justification of induction does not apply to the inductive procedure but to particular inductive arguments. It is for this reason that Strawson warns that to question whether induction as a procedure is valid is as senseless as asking whether deduction as a procedure is valid. He writes, "...for to call a particular belief reasonable or unreasonable is to apply inductive standards just as to call a particular argument valid or invalid is to apply deductive standards" (*Ibid*: 249). Strawson's notion is what Laurence Bonjour

understands as implying that the view that there exists a genuine problem of induction lies in an intellectual illusion: in a mistake that demands implicitly that inductive reasoning should meet the standards of deductive reasoning if it is to be reasonable or justified (Bonjour, 2009: 63)

The views outlined above set the grounds for Strawson's dissolution of the problem of induction. For him, a demand for justification of induction as a general procedure of arriving at new beliefs is misdirected. Induction implies rationality by ordinary understanding of rationality. He argues,

“It is an analytic proposition that it is reasonable to have a degree of belief in a statement which is proportional to the strength of the evidence in its favor; and it is analytic proposition...that other things being equal the evidence of a generalization is strong in proportion as the number of favorable instances and the variety of circumstances in which they have been found is great. So to ask whether it is reasonable to place reliance on inductive procedures is like asking whether it is reasonable to proportion the degrees of one's conviction to the strength of evidence. Doing this is what reasonable means in such a context. *This is tantamount to asking whether it is reasonable to be reasonable* (Strawson *Op.Cit:257*) (*my italics*).

What Strawson implies is that when scientists gather large evidence regarding a phenomenon, they get compelled to have a degree of confidence in trusting that the event will continue to happen in the future. By doing this they are being reasonable for this is what reasonableness entails as considered in its ordinary understanding. The implication is that it would be absurd and contrary to the meaning of 'reasonableness' to place convictions in the persistence of a

phenomenon that has had unfavorable instances or simply put to argue counter-inductively.

Moreover, Strawson argues, it is analytical that any method of finding out about the future is inductively supported. For example, the foretelling of a clairvoyant has to be evaluated by inductive standards if anyone is to place reliance on clairvoyance as a method of finding out about the future. If the clairvoyant has recorded a large number of true predictions in the past, then he can be trusted as a source of information about the future. Hence, Strawson writes, to argue that “...successful method of finding things out which has no inductive support is self-contradictory” (*Ibid*:259). Therefore, rationality, as Strawson insists, “...is a matter of what we mean by the word rational in its application to any procedure for forming opinions of what lies outside our observation or that of available witness; for to have good reasons for such opinion is to have good inductive support” (*Ibid*: 262)

Strawson’s account seems plausible in respect to it making a clear and an acceptable distinction between inductive and deductive logic. The claim that inductive standards, rather than deductive, are to be applied in evaluating inductive reasoning makes sense for anyone willing to accept the indisputable distinction. By commonsense standards, as Bonjour (*Op.Cit*: 62) observes of Strawson, a person who infers, inductively, from accumulated evidence of favorable instances of a phenomenon is considered reasonable while a person who

draws a contrary inference is considered unreasonable. It is by these standards that a claim of unreasonableness of inductive arguments is senseless in Strawson's view.

However, Bonjour reiterates, the linguistic response does not handle Hume's central concern. According to Bonjour, the fundamental question in the problem of induction is not whether inductive reasoning is "reasonable" or "justified" judged by the standards of ordinary usage of language and commonsense. After all, Bonjour insists, there are no serious doubts concerning commonsense judgments. The main concern is whether the standards of ordinary language and commonsense are themselves correct, reasonable, or justified. The question is 'are these standards likely to lead to true conclusions?' According to Bonjour, this is not a question that can be answered by appealing to the standards that Strawson appeals to. However, Strawson does not imply that these standards are likely to lead to true conclusions. According to Bonjour, the fact that the problem of induction is a demand to show that inductive conclusions are likely to be true, a demand that Strawson does not accomplish, shows that he does not attend to the central question in Hume's problem. Bonjour concludes that the problem of induction is neither senseless nor dissolvable as Strawson claims (*Ibid*: 63-64).

Bonjour's contention namely, that the central issue in Hume's problem is to demonstrate that the conclusions of inductive arguments are true is weighty since it is true that this was Hume's demand. However, there seems to be no other way

apart from by verification that one can tell that the conclusions of any inductive argument are true. As it would not be a matter of dispute, verification of inductive claims at best only adds to the inventory of past instances of true conclusions of inductive arguments but tells nothing about their being true in the future. Seeking the truth of inductive inferences is by no other means possible. However, this does not imply that justification of induction cannot be sought in any other way for justification can be in the form of accounting for induction as a means to attaining a desired end. Rather than seek the impossible, it seems plausible to demonstrate that induction as a method of arriving at scientific predictions is best suited owing to its practical consequences.

Moreover, Strawson's account is wrong in its appeal to ordinary sense in which the concept rationality is used. As Papineau observes, it is widely agreed that inductive inferences cannot be legitimized by saying that most people include induction in the category of rationality. According to Papineau, facts of common usage leave it open that there may be underlying conditions for a form of inference to be rational which may not be satisfied by induction. This implies that most people may be mistaken in believing induction to be rational (Papineau, *Op.Cit.*: 12)

Strawson takes the inductive principle as an epistemic foundation and as such, he argues, needs no justification. This assumption has been challenged by Salmon who argues that Strawson's argument shows, correctly, that Hume's demand for

justification of induction takes us beyond the limits of possible validation. Validation of induction requires that more basic principles than the inductive principle be invoked. According to Strawson, this possibility is not existent in validation of induction. For him the inductive principle must be considered analytic as per ordinary standards of rationality. To the contrary, Salmon urges that justification of a rule of inference does not necessarily terminate at the limit reached at by Strawson. Vindication is a form of justification that moves beyond the limit of validation for it does not require an appeal to higher principles. Instead, it demands demonstrating the purpose for adopting the rule of induction as a means to achieving a specified aim or end (Salmon, 1978: 7).

A similar attempt to Strawson's to dissolve the problem of induction is supported by Paul Edwards (1949). It is similar to strawson's to the extent that it also alludes to ordinary usage of language. His account is, however, different from Strawson's to the extent that he does not consider the principle of induction as analytic. Rather, Edwards appeals to ordinary senses of understanding the term 'evidence' which he equates with 'good reasons' as applied to inductive reasoning.

Edwards's account of induction is a reaction to Bertrand Russell's doubts concerning induction as the basis of laws of nature. For Edwards, Russell expresses these doubts in the question; "have we any reason, assuming that the laws of nature have always held in the past, to suppose that these laws will hold in the future? Or "does any number of cases of law being fulfilled in the past afford

evidence that it will be fulfilled in future?” Like Hume, Russell argues that we have, absolutely, no reason or evidence because the course of nature may change so that the laws that have always held in the past may not hold anymore. For Russell, it is on the assumption of the intrinsic or self-evidence of the principle of induction that inductive inferences would make sense (see Egner and Denon, 1961: 151-154). Edwards seeks to defend the commonsense answer given to Russell’s questions. That is, there are reasons to suppose the future will be like the past based on past evidence even without invoking the principle of induction as an a priori truth as Russell does (Edwards, 1949: 141).

To advance this defense, Edwards seeks to clarify the meaning of concepts: ‘evidence’ and ‘reason’ in respect to their ordinary meanings as used in inductive inferences. According to Edwards, the problem of induction arises from a state of confusion between the sense in which the term reason or evidence is applied by scientists and the sense in which Hume and Russell apply them. Hume and Russell, Edwards argues, use the term ‘reason’ to mean ‘logically conclusive reason’ and ‘evidence’ to mean ‘deductively conclusive evidence’. According to Edwards, Hume’s and Russell’s sense of the terms is a higher definition of these concepts which by no means contradicts the ordinary usage of the same concepts. For Edwards, when reason and evidence are used in Hume’s and Russell’s sense, undoubtedly, there can be no reason or evidence to suppose that the laws of nature will hold in future based on their past behavior.

However, Edwards argues, this is not the sense in which science and ordinary life applies these concepts. Hence, Edwards contends, when one claims that he/she has reason for a conclusion he is invoking either of the following ordinary senses none of which implies logical conclusiveness: (1) that past observations of a phenomenon inferred are exclusively positive, fairly large, and derived from an extensive variety of circumstances. This is the main sense in which the concept reason is used in ordinary language. (2) That it is reasonable to infer the inductive conclusion even if one has no reason in the main sense. For instance, predicting that a soccer team A, which has won four in six matches against team B, will win a future match against team B even without any further knowledge regarding the team as would be required by the main sense. (3) That any number of positive instances, however small, of an event gives some reason for concluding that the event will be positive in the future. For instance, having some reason to conclude that team B will win against A even though it has won only twice in the past and having more reason to conclude that team A will win (Edwards, *Op.Cit*: 147)

Edwards appeals to the second ordinary usage. Consequently, he argues, we have reason for every inductive inference. Edwards contends that, for instance, the assertion that the sun will rise tomorrow is believed with excellent reason since observed instances of a phenomenon provide reasons for an inductive conclusion in this sense. The same would be true even if one appealed to the main sense or the third sense. For Edwards, to argue contrary is to be guilty of *ignoratio elenchi*. Edwards redefines *ignoratio elenchi* as,

“Any instance...in which (i) the same sentence expresses both the proposition which ought to be proved and the statement which is confused with it and where (ii)in the later employment of the sentence one or more of its part are used in a sense which is different from their ordinary sense or senses” (*Ibid*: 144)

Russell had argued that the premises of an inductive argument never, by themselves, offer logically conclusive reason for an inductive conclusion. To the contrary, Edwards claims that this assertion does not contradict the ordinary sense of the term reason. For him, Russell’s use of reason is not applicable to inductive arguments but to deductive arguments. Inductive inferences involve drawing a conclusion claiming about the unobserved future from premises claiming the observed past. However, by means of clause (ii) above, Russell draws the conclusion that the premises of an inductive argument do not give logically conclusive evidence for the conclusion. For Edwards, it is a contradiction to assert that an inference is inductive and at the same time talk of deductive conclusive evidence or reason for it. Hence, Edwards claims that the problem of induction, as long as it arises from this confusion, is a pseudo problem.

Edwards account appears plausible to the extent that it coincides with commonsense knowledge. Intuitively, we feel that we have reason for inferring a conclusion beyond present evidence in the senses that Edwards outlines. As Hume observes, this psychological tendency is so strong that we feel almost absolutely certain that past regularity will persist in future. However Edwards is wrong in claiming that we are justified in making such inferences by commonsense standards. There seems to be cases in which people have had strong convictions in

the past but evidence proved them wrong. The Geocentric theory is a typical example of strong convictions deriving from observations of the 'movement' of the sun from east to west. As a matter of fact, that conviction was so strong until it was falsified and replaced by the heliocentric theory. Moreover, as already pointed out we still need to question our ordinary understanding of procedures in order to judge their legitimacy. The central concern is whether we are justified in inferring in line with our ordinary understanding of procedures such as induction. If people have been mistaken in the past, is there any reason to think that they are not mistaken today or in the future?

Besides the challenges mentioned, Edwards' account of induction has been criticized on the grounds that it makes the legitimacy of inductive inferences a matter of mere societal conventions. For instance, Ahmed Jamal Anwer observes that Edwards view, namely that induction is rational as long as it matches the accepted definition of evidence, leads to relativism which, by implication, leads to absurdity. Anwer argues that it is possible that a given society may understand by rationality the use of counter-inductive arguments while our society understands by rationality the use of inductive arguments. By implication the members of the counter-induction society will apply the same reasoning as applied by Edwards to justify their counter-inductive procedures. The implication is that there will be no criterion for legitimizing that our inductive procedures are rational while those of the counter inductive society are irrational (Anwer, 1995: 254).

From the foregoing, it seems that neither Strawson nor Edwards succeed in dissolving the problem of induction or offering a satisfactory reason as to why we should continue to place reliance on inductive inferences. The kind of justification for inductive procedures demanded by Hume is, however, not achievable but this does not imply that justification of induction is not possible. Strawson and Edwards demonstrate correctly that induction cannot be justified by proving the truth of its conclusions. However, their claim that induction is justified by its matching our ordinary usage of the aforementioned concepts is wrong. At best, their views show that a limit of validation of induction terminates at the inductive principle from which further validation will involve a logician in circular reasoning as already demonstrated in the previous chapter.

To the contrary, their views do not limit us from moving beyond the basic rule of induction in search for its justification. As a matter of fact, it is from the limit expressed by such views as Strawson's and Edwards' that Reichenbach extends his justification of induction. Unlike linguistic respondents, Reichenbach (*Op.Cit*) agrees that there is a genuine problem of induction which emerges from frequency interpretation of probability. Reichenbach urges that as much as the observed frequency of events provides reasons for believing probability statements, and as much as it serves to verify probability statements, there remains unaccounted for the frequency of future events which must be asserted anyway. In this regard, therefore, probability statements proceed from known to unknown frequency and this leads to the problem of induction (Reichenbach, *Op.Cit*: 339).

Further than this, Reichenbach endorses Hume's criticism namely, that there exists neither logical demonstration for validity of inductive inferences nor a posteriori demonstration for inductive inferences. He appreciates the fact that the two criticisms have remained and will remain unchallengeable. It is for this reason that he advocates for a new theory of induction unexposed to Hume's objections. He warns that if a justification for induction is not offered, then, as he explains, "...the working procedure of science sinks to the level of a game and can no longer be justified by the applicability of its results for the purpose of actions" (*Ibid*: 346). For him, such a theory of induction must appreciate the aim that induction achieves in science and in preparation for action.

In sum, the linguistic response to the problem of induction does not give us any reasons as to why we should not seek a justification for inductive procedure. At best, it demonstrates correctly that deductive standards are not the sole standards of evaluating rationality. However, this does not imply that because induction is not deduction, it does not need a justification.

3.3: Popper and the Falsificationism

To the contrary of the views expressed by the linguistic respondents discussed above are the views of Popper regarding induction and the logic of science. Popper (*Op.Cit*) offers an alternative logic of science: falsificationism. Prior to

this turn, philosophers had been battling to save the conventional logic of science (induction) from Hume's skeptical attack. It is worth recalling that Hume despises reason as the source of expectation about the future truths regarding matter of fact. The fact that Hume advocates for custom as the source of these expectations renders the most carefully derived scientific inferences rationally worthless. While some philosophers (those analyzed earlier) sought to prove the rationality of induction as the logic of science, a contrary view develops in Popper's attempt to show that induction is an irrational procedure of inference but nonetheless it is not the logic of science. According to Popper, science progresses through trial and error and this process relies on valid deduction. Against the proponents of induction, Popper contends that scientists do not aim at establishing the truth of their theories but instead aim at testing conjectured theories in order to falsify them: thus the concept falsificationism.

According to Popper, Hume's logical problem of induction concerns the justification of inferences about unobserved phenomenon from knowledge of repeated instances of observed phenomenon. Hume's response to this was that the process of inference involved is not logically justified. Hence, Popper reformulates Hume's logical problem in three stages (Popper, *Op.Cit*: 7-8).

Logical problem 1

According to Popper, the first formulation centers on the question: "...Can a claim that an explanatory universal theory is true be justified by empirical reasons

or test statements?” On this, Popper agrees with Hume that no number of test statements (observed instances in Hume’s words) can establish that a universal explanatory theory (unobserved instances in Hume’s words) is true. However, given that scientists do not seek to establish their theories as true but aim to refute them, a more general formulation of the problem is important for Popper’s new logic. It should be noted that the first formulation captures, entirely, Hume’s logical problem and his solution to it.

Logical problem 2

The second formulation is a generalization from the first formulation and centers on the question: “...Can the claim that an explanatory universal theory is true or that it is false be justified by empirical reasons?” This second formulation does not only capture Hume’s problem but also captures Popper’s logic of falsification. To this problem, Popper answer is that at some instances test statements can lead to the conclusion that an explanatory universal theory is false. However, given that only falsity but not truth can be established, at any given time a scientist may prefer a theory to another for practical reasons. This leads to the third and last formulation of Hume’s logical problem of induction.

Logical problem 3

“Can a preference, with respect to truth or falsity for some competing theories over others be ever justified by empirical reasons?” According to Popper, such a

justification rests on luck. Sometimes scientists may be lucky in that test statements refute some theories while some may remain un-refuted yet. In such a case empirical reasons justify the preference of a theory that is not yet falsified to its falsified competitor, but this rests on practical application of the theory preferred.

The problem of induction as Formulated by Hume thus is presented in Hume's logical problem 1. It is the answers that Popper offers to this formulation and to his second formulation that are of interest to this section for it is in line with these answers conjoined with Hume's answer that Popper advances a new logic of science by shifting the role of science from truth finding to falsity finding.

Popper, contrary to inductivists, views all observation as theory laden. While inductivism hold the view that scientists start by making simple observations whose accumulated evidence serve as the basis of theory formulation and generalizations, Popper argues that scientists begin from pre-held theories which are put forward as conjectures to handle problems obtaining in the physical world. These tentative theories may also be proposed in order to explain some aspects of reality that prior theories failed to account for. Further, the speculative guesses are put to critical tests via observations and experimentation. It is Popper's view that the theories which fail to stand up for the critical tests are eliminated but, when this happens, more advanced conjectures are proposed to undergo the same testing procedure. Throughout this process, only the best fitted theories survive.

However, Popper warns, the survivors should not be considered as true theories but as undefeated conjectures: suspects of falsification in the future. The process that Popper advocates does not make use of induction and it is for this reason he thinks that the problem of induction ought not to bother scientists.

Popper's process of critically testing of theories (the logic of scientific discovery) is deductive in nature. He terms it as "deductive testing of theories" (Popper, 1959: 9). He explains that from a new idea (the tentative guess) conclusions are drawn by logical deduction. Further, the conclusions deduced are weighed against each other and together with some other relevant statements in order to establish their logical relations- such as their equivalence, compatibility or incompatibility with an aim of establishing their internal consistency. In addition, the logical structure of the new theory or conjecture is evaluated to establish its empirical nature in order to eliminate statements that have no empirical value such as analytical statements. Beyond this, Popper continues, the theory is compared with other theories to establish whether it contributes to growth of scientific knowledge. This implies that the new theory must have more empirical value than a previous theory. That is, it should explain more than its predecessor. Finally the theory is tested by applying its consequences to establish whether these consequences match the demand of practice. Popper schema of science progress, as he outlines it, is;

"Using 'P' for problem, 'TS' for tentative solutions, 'EE' for error-elimination, we can describe the fundamental evolutionary sequence of

events as follows: P \square TS \square EE \square P. But this sequence is not a cycle: the second problem is, in general, different from the first: it is the result of the new situation which has arisen, in part, because of the tentative solutions which have been tried out, and the error-elimination which controls them. In order to indicate this, the above schema should be rewritten: P1 \square TS \square EE \square P2.” (Popper, *Op.Cit*: 243)

Popper describes EE (error-elimination) as “a severe critical examination of our conjecture” (*Ibid*: 164). It is at this stage that the tentative theory is deductively tested by deducing easily testable predictions and weighing them against observation and through experimentation. If the predictions are confirmed by evidence, then the theory is retained as having withstood the tests, at least, that far. However, if the predictions are falsified by evidence, then the theory is considered false as well (*Ibid*: 10). The implication is that a single instance of false prediction deduced from the theory is enough to make a scientist abandon a theory as false while whatever number of true predictions is never enough to qualify the theory as true but enough to make a scientist retain the theory. For Popper, a theory that has withstood the severest of tests is the highly corroborated and should be taken as the best standing theory.

An illustration will help clarify Popper’s criterion of testing a theory. Suppose we have a background theory “all planets revolve around the sun in elliptical orbits”. The logical consequences that can be deduced from the theory will include all singular test statements regarding every known planet such as ‘Mercury revolves around the sun in an elliptical orbit’, ‘Mars revolves around the sun in an elliptical orbit’, and so on. The test statements are then weighed against observations. If a

planet, say, Mars that does not revolve around the sun in an elliptical orbit is observed at position, say y, at time, say t, then the theory that “all planets revolve around the sun in elliptical orbits” is by deductive standards false. The argument can be formalized as follows by replacing the theory with P and the test statement with Q:

$$\begin{array}{l} \text{If P then Q} \\ \text{Not P} \\ \hline \text{Therefore not Q} \end{array}$$

The above argument is a logically valid deductive argument. According to Popper, the role of scientists is to seek instances of not P.

Popper argues that inductivism does not offer a criterion for distinguishing scientific theories on the one hand and mathematical, metaphysical and logical systems on the other. It is for this reason that he rejects induction (*Ibid*: 11). According to him, scientific theories should meet the criterion of falsifiability. This implies that it should be possible to refute an empirical scientific system by evidence. This is unlike metaphysical statements which are not falsifiable. The falsifiability criterion leads Popper to the dissolution of Hume’s problem. According to Popper, Hume’s problem arises from a contradiction between fundamental theory of empiricism claim that the truth or falsity of scientific statements can only be decided via experience (*Ibid*: 18-20). It was Hume’s observation that inductive inferences, which are the source of scientific statements, contradict this empiricism thesis because present experience cannot

prove that a scientific statement is true in the future. According to Popper the contradiction arises from the assumption that verification and falsification of scientific statements should both, in principle, be logically possible. By denying the possibility of verification and advocating for one line process of falsification, Popper evades this contradiction and by implication the problem of induction.

Popper's account is plausible in various aspects. For instance, it offers a criterion for demarcating between science and pseudo-science. This is not to imply that Popper was purely original in solving the problem of demarcation. As he admits, the positivists had battled with this problem albeit from a different perspective. The positivists' criterion of verificationism made it clear that scientific statements are verifiable as opposed to metaphysical statements. However, given Hume's problem that experience cannot serve to verify empirical statements, the verificationism criterion is undermined. It is for this reason that Popper offers a better criterion of demarcation.

Moreover, Popper's appeal to hypothetical deduction helps, at least in principle, to restore scientists' rationality previously undermined by Hume's response to the logical problem of induction conjoined with his resort to habit. However, since science does not rely on induction according to Popper, scientists need not feel rationally undermined. After all, the rationality of deduction is not in dispute.

In addition, Popper's falsificationism explains the progress of science in a way that inductivism does not. By beginning with an initial problem and through the

process of tentative solutions (in form of theories) through to error elimination, as outlined earlier, scientists are able to identify a new problem, different from the initial problem, and the process is continued indefinitely. The new problem leads to other tentative theories. It is a requirement that the new tentative theory must explain more than the initial theory and this does not only mark progress in science but also adds scientific rigor. As Chalmer's (*Op.Cit:* 69-73) observes, falsificationism offers a better explanation of the progress of physics from Aristotle to Newton through to Einstein.

However, Popper's account faces severe difficulties. It does not seem to have historical and practical support. For instance, Putnam thinks that falsificationism does not characterize the practice of science. As he puts it "...Popper's doctrine gives a correct account of neither the nature of scientific theory nor of the practice of scientific community" (Putnam, 1979: 126). Putnam cites the Law of Universal Gravitation as a weakly falsifiable law. However, he argues, for more than two hundred years, scientists derived predictions from the law not seeking to falsify it but to explain numerous astronomical phenomena.

Putnam continues to argue against Poppers doctrine that 'singular predictions (test statements) are deducible from universal theories'. Given that in a valid deductive argument denying a conclusion implies the falsity of premise, Popper thinks that if the conclusion is false then the theory from which it is deduced is false. According to Putnam, however, theories do not imply predictions in isolation

(*Ibid*:125-126). Instead, theories are conjoined with auxiliary assumptions in order to derive predictions. The falsity of predictions is, therefore, not necessarily as a result of false theories but could be a result of false or *ad hoc* auxiliary assumptions.

A view similar to Putnam's is that proposed in the Duhem-Quine thesis which holds that it is impossible to test scientific theories in isolation. Instead, tests are carried out on assumptions of auxiliary hypotheses (see Grayling, 1998: 153). Just as theories are incapable of deriving predictions on their own, auxiliary hypotheses are also incapable of this task in isolation. Let us now illustrate this notion. Suppose we want to predict the behavior of Mercury's orbit by using Newtonian Laws of motion. Popper would formulate an argument as shown below;

Premise from universal theory: If Newton's $L_1+L_2+L_3$ then Mercury retrace her orbit after every revolution
Premise from observation: Mercury's orbit tilts after every revolution
Conclusion: Newton's $L_1+L_2+L_3$ is false.

Duhem-Quine thesis proposes that upon encountering a false prediction, the predictive content of the premise from observation should be reformulated by aiding the premise from universal theory with an auxiliary hypothesis as shown below:

If Newton's $L_1+L_2+L_3$ +existence of Vulcan (auxiliary hypothesis) then Mercury does not retrace her orbit.

On observing that that Vulcan does not exist, the theory behind the prediction, $L_1+L_2+L_3$, is not falsified. Rather, a better auxiliary hypothesis is sought: for instance, the presence of sun's gravitation force.

In furtherance of the above view, it seems historical that science progresses as proposed by Putnam and the Duhem-Quine thesis. Scientists do not seek to falsify but to save their theories even in the face of false predictions. Imre Lakatos scientific programs describe this progress in a greater detail (see Chalmers, 1999: 130-144). Lakatos argues that in the face of false predictions scientific programs maintain their core assumptions (the hardcore) and in addition, make adjustments to the auxiliary belt. For Putnam, it seems an oversimplification of scientific methodology to argue, as Popper does, that scientists immediately consider their theories false upon encountering false predictions without seeking assumptions as to why the predictions have not been confirmed.

Moreover, as Salmon (*Op.Cit*) observes, it is perfectly acceptable that the conclusions of a deductive argument do not provide any new information beyond what is contained in the premises. Salmon writes,

“Deduction, as Popper is fully aware, is non-ampliative - that is, the conclusion of a valid deduction has no content which was not already present in the premises. If we grant the plausible assumption that all our observations are confined in happenings in the past and present, then it follows immediately that observation plus deduction can yield no information whatever about the future. Indeed, the total information content of science cannot exceed the contents of our observations themselves” (*Ibid*: 11).

Salmon contends that science cannot be denied its predictive role. For Salmon, any method of predicting the future is necessarily ampliative since predictions go beyond observations. According to him, either science has predictive role or it does not. If it has predictive role then it must necessarily apply an ampliative method which in this case is induction.

This discussion so far takes us back to induction as the logic of science. As a matter of fact, if scientists sole aim is to refute theories, then some theories that are most cerebrated should have been abandoned at their very tender age. The Newtonian laws of motion are a perfect example as depicted in the behavior of Mercury's orbit illustration.

Besides lack of historical support, Popper's account has been interpreted as an inductivist's account. Anwer, for instance, claims that Popper's account is inductively self-defeating. Popper contention is that a theory that has withstood severest of tests is a corroborated theory. For Popper, the greater the degree of severity of tests the greater the degree of corroboration. Anwer argues that Popper's *Modus tollens* without corroboration is empty. But *Modus tollens* conjoined with corroboration is a good non-deductive scientific method. The legitimate question that Anwer raises is 'why should we accept from among all the unfalsified theories the one that is highly corroborated?' This, according to Anwer raises the issue of induction since corroboration implies confirmation in

disguise. For this reason, popper does not succeed in showing that scientific method operates without induction (Anwer, *Op.Cit*: 250).

Popper has reiterated to these accusations by claiming that his concept of corroboration does not imply that since a theory has been corroborated in the past that it will be corroborated in the future. He remarks, "...nobody expects that a species which has survived in the past will therefore survive in the future" (Popper, *Op.Cit*: 19). But, this does not render Anwer's objection worthless for survival of a species in future is what we expect in our actual world and that is why we induce in the first place not only in science but also in daily life. The point that Anwer purports is that corroboration is confirmation in a new guise and I think there is no doubt in this; for corroboration is accumulation of many positive instances of a theory being true. Besides, any hope of adopting the theory that is corroborated for practical reasons can only make sense if we expect the theory to be corroborated in the future.

Putnam (*Op.Cit*) also endorses Anwer's position namely, that Popper account implies induction. He demonstrates how Popper's schema coincides with the inductivists' schema. Putnam explains that inductivists on the one hand hold that a theory is false if the predictions it implies are false. However, on accumulation of many positive instances, the theory is said to be true. On the other hand, Putnam continues, Popper holds that a theory is false if predictions it implies are false. However, on accumulation of many true predictions, a theory is highly

corroborated. It is on these grounds that Putnam concludes that Popper's account is an account of the logic of accepting theories and this implies induction (*Ibid*: 123).

The foregoing portrays an inductivist quaver for Popper's account. In sum, there is no doubt that induction is part and parcel of scientific investigation. Poppers attempt to replace induction with deduction is a failed attempt to give hope to science whose rational base is undermined by Hume's problem. It is for this reason that Reichenbach insists that "...inductive inference cannot be dispensed with because we need it for purpose of action" (Reichenbach, *Op.Cit*: 346). Reichenbach claims that even when the proponents of an alternative logic (Popper in this case) divert from theoretical discussions to lead an ordinary life, they have to follow the dictates of induction. As he illustrates, a philosopher who neglects the prescriptions of the inductive principle and steers his motor car to the left when he actually intends to turn the wheels to the right is a bad philosopher. Equally, Reichenbach urges, science proceeds by induction not by tautological transformations of reports. For him, action presupposes diverse means for realizing the aim and this makes the choice of the appropriate means inevitable. Moreover, deciding on the means to apply is tantamount to applying the inductive principle (*Ibid*: 347).

The apparent disagreement, between Popper and Reichenbach, points to it that science makes use of induction contrary to Popper's view. However, given the

plausible view by Reichenbach namely, that Hume's objections to the justification of induction that seeks to establish that inductive conclusions are true are unshakable; we are left with an option of evaluating how matters stand in Reichenbach's point of view. By establishing the indispensability of induction both in scientifically and ordinary life based actions regarding the future events, Reichenbach's views stand on a better podium compared to Poppers opposing views.

In conclusion, it seems that neither the linguistic nor the falsification attempts to dissolve the problem of induction is successful. As a matter of fact, science makes use of induction. Popper's claim that scientists seek to falsify their theories is therefore self-defeating even in the sense that his concept of corroboration implies confirmation and therefore induction. In this regard, the problem of induction is not a pseudo problem in as long as science continues to apply induction as its main methodology.

However, this does not in any way imply that induction is rational by definition. Hence, the view that induction is in need of no justification expounded by Edwards and Strawson has proved untenable for we would still want to know whether we are justified in applying the ordinary standards of definition in evaluating the rationality of induction. We have seen that there is a genuine problem of induction which needs a solution. Moreover, even if validation of induction hits a limit at the principle of induction as linguistic proponents argue,

there remains a plausible alternative to justification namely, vindication, which neither requires an appeal to further principles nor a demonstration that inductive conclusions are true. Given that none of the two attempts offers a solution to the problem of induction, we can conclude that the justification of induction must remain a question without an answer as far as falsificationism and linguistic proponents are concerned.

CHAPTER FOUR

GOODMAN'S NEW RIDDLE: HUME'S PROBLEM IN DISGUISE?

4.1: Introduction

Another attempt to resolve the problem of induction was propounded by Nelson Goodman (1954). Goodman seeks to show that the old problem of induction, as formulated by Hume and which makes a general assumption that all past regularities are projectible into the future, has been resolved. However, he introduces a new riddle of induction: the problem of distinguishing legitimate from illegitimate inductive projections or in other words valid from invalid projections. It derives from Hume's observation that the mind forms a habit of projecting past regularities. However, Goodman brings to the reader's attention that not all past regularities lead to the habit of projecting. For Goodman, Hume did not handle the problem of distinguishing between law-like projections from unlaw-like projections. While law-like projections are valid, unlaw-like projections are not.

Goodman's new riddle alongside the solution he suggests for it, offers a criterion for this distinction. This chapter seeks to show that Goodman does not advance the problem- of -induction debate beyond Hume's assumptions. We shall see that Reichenbach's disregard of habit as a solution to Hume's problem does not only apply to Hume's old problem but also to Goodman's new riddle. For

Reichenbach, there is still a need to establish whether inducing is a good habit in relation to the practical results it leads to. Neither Hume nor Goodman gives us the reasons as to why we should continue relying on induction. For this reason, Reichenbach's proposed solution to the problem of induction, which seeks to establish the purpose of induction, takes us beyond Goodman and thus stands strong as compared to Goodman's proposed criterion for distinction between valid and invalid projections.

4.2: The New Riddle

Goodman presents his new riddle in form of a paradox now commonly known as the 'grue paradox' (Goodman, *Op.Cit:* 73-75). He aims at demonstrating that while some generalizations are confirmed by their positive instances, others are not. Of importance is the fact that even those generalizations that are not confirmable by positive instances derive from induction by enumeration. Below is a summary of the paradox.

Suppose all emeralds observed and examined before January 2015 AD are green. This implies that by induction via enumeration and as at January 2015AD we can infer a generalization, supported by evidence, 'all emeralds are green'. Suppose now we introduce a new predicate 'grue' and define it with familiar predicates, say, green and blue. Let grue mean all things examined before January 2015 AD

just in case they are green, and to other things not examined, just in case they are blue. Using induction and as at January 2015 AD we can infer a generalization, still supported by evidence, 'all emeralds are grue'. This implies that the two generalizations 'all emeralds are green' and 'all emeralds are grue' are equally supported by evidence statements.

However, any emerald examined after January 2015 AD is grue and therefore blue not green. Goodman argues that, intuitively, we know which of the two test statements will be confirmed by its positive instances. But given the definition of grue, both generalizations derive from induction by enumeration and thus both are supported by evidence statements. This is Goodman's paradox. He contends that even though we feel that the green generalization will be positively confirmed after 2015 AD, while the grue generalization will not; there exists no criterion of distinguishing projectible from non-projectible predicates. For Goodman, if that criterion is not put in place, then all predicates including the non-projectible ones such as grue, will find their way into induction by enumeration.

Hume's answer to his problem would, in my view be, descriptive. In section five of the *Enquiry* Hume appeals to custom as the foundation of all inductive inferences. Whenever the mind sees a constant conjunction between objects, this conjunction is projected not by means of reasoning or any process of understanding but as the effect of the habit of associating the constant conjunction to like objects. As such, past regularity is taken as a rule for the future regularity.

Goodman argues that Hume's solution is inadequate not because it is descriptive but because Hume fails to acknowledge that not all regularity is projectible. Goodman writes, "...projections based on some regularity are valid while predictions based on other regularities are not" (*Ibid*: 82). For instance, the regularity in greenness is projectible while regularity in grueness is not. Goodman assumes that while Hume was addressing the question of validity of inductive inferences in his solution to his problem, he needs to have come up with a criterion for distinguishing between valid and invalid projections. He urges that only projectible predicates lead to valid or legitimate projections. For Goodman, a hypothesis is projected when it has been adopted after it has been confirmed by its positive instances.

In this regard, it seems that when Goodman talks of adopting a predicate when its instances have been examined and found to be true, he is, actually, talking about Hume's constant conjunction in a new way. The implication is that past instances of projected predicates have to be examined in order to determine their projectibility. This, according to Goodman, helps to eliminate predicates that ought not to be projected. For instance, Goodman warns, a hypothesis projecting a predicate that has had negative instances is falsified and should never be projected further. Moreover, some hypotheses containing certain predicates are exhausted in that all their instances have been examined and thus should never be projected. However, some hypotheses have had positive instances yet not all their instances

have been examined. For Goodman, these are the hypotheses that can be projected
(*Ibid*: 90-92)

Even though these hypotheses can be projected, not all of them are law-like. According to Goodman, law-like hypotheses are selected from among them via the criterion of entrenchment. For him, the predicates which have had impressive projections when used in hypotheses are the better or the deeply entrenched. A predicate is projected if and only if it has, actually, been used in a hypothesis that is projected.

According to Goodman, valid projections contain the better entrenched predicates and the better entrenched predicates are those that we have, habitually, successfully projected (*Ibid*: 97). However, Goodman argues, it is irrelevant to claim that one has knowledge that the projected hypothesis will turn out to be true. Truth about the future, according to Goodman, is yet undetermined. For this reason, the criterion for distinguishing valid from invalid projections does not comprise the truth condition. All that should be known is that the predicates that are better entrenched in our traditions of making projections are the right ones to project. At this juncture, it seems that Goodman's response is an assertion of Hume's position, namely, that no number of observed instances is enough to infer a judgment concerning the truth of future matter of fact.

Goodman's new riddle captures a difficulty that Hume does not address. The question, as Horner observes is, "...why do we regard some projections as

expressing or resting on laws of nature but view others as projecting merely accidental generalizations?" (Horner, *Op.Cit*: 103). This is the question that leads Goodman to the 'grue paradox'. Hume's metaphysics of causation (constant conjunction) is the root of this difficulty that Goodman seeks to address. However, the extent to which Goodman succeeds in addressing it is the main problem of this chapter.

Some critics have argued that there is nothing new in Goodman's riddle that was not handled by Hume. It is contended that Goodman at best reaffirms Hume's position in a new guise. This view is supported by Horner (*Op.Cit*) who argues that Goodman's solution to his riddle is significantly reminiscent of Hume's own solution to the classical problem of induction. While Hume argues that custom is the foundation of all inductive inferences and makes it possible to project past regularities, Goodman insists that we prefer projecting some regularities to others based on how used we are to making such projections. This implies that Goodman appeals to Hume's principle of custom as the foundation of inductive projections. Consequently, Hume and Goodman at best describe how inductive inferences are arrived at but do not offer any rational grounds for these inferences.

Frank Jackson (1975) agrees with Horner's views namely, that the new riddle is Hume's problem dressed in a new 'suit'. According to Jackson, all predicates are projectible and thus Goodman's paradox is illusory. In the first place, Jackson argues, Goodman supposes 'grue' to be non projectible based on the sense in

which grue is defined. For Jackson, Goodman implies that an emerald is grue if and only if that emerald is green before time, say, T, and blue after that time. Jackson argues that when grue is defined in this way, the definition is not dependent on time. He insists that, "...an object is grue or not once and for all, it cannot be grue at one time and not grue at another-and in this respect differs from green" (Jackson, 1975: 115).

Jackson reiterates that if grue is defined in this way it cannot be said to be non-projectible since by definition an emerald is grue if it is green up to a certain time and blue thereafter, and if all emeralds examined by time T have this property, we would accept the assumption that all examined and unexamined emeralds have the feature of being green to a certain time and changing to be blue after that time. In such a case, Jackson writes, "...we would be regarding emeralds as like tomatoes and oranges, one of those things which change color dramatically during their life cycles" (*Ibid*: 115). If this is so, Jackson contends, there can be an explanation that shows why the emeralds change in color during their life cycle. "Grue-ifying" a predicate does not, therefore, raise difficulties for induction by enumeration.

Moreover, Jackson argues, if the definition of grue is understood as time dependent such that grue means an object is grue at t_1 if and only if that object is green at t and t is less than T or that object is blue at t_1 and t_1 is greater or equal to T, then this still does not raise problems for induction. This is so because if the

object endures through time, a temporal factor must be invoked in the predicates with which induction is concerned. What is to be projected must be understood as at a given time. Jackson writes, "...a tomato isn't both red and green; it is green early in its life history and red later" (*Ibid*: 117). In the case of Emeralds it would be proper to universalize that 'all emeralds are green at time t_1 (where t_1 is before T) and also 'all emeralds are grue at t_1 . According to Jackson, the two generalizations are not incompatible. However, at time t_2 greater than T, by definition of grue, induction by enumeration cannot lead to drawing the incompatible generalizations 'all emeralds are green at t_2 ' and 'all emeralds are grue at t_2 '. The paradox, according to Jackson, arises only after an illegitimate slide from t_1 to t_2 . If there is no illegitimate slide, then induction cannot offer support for incompatible predicates.

Another weakness in Goodman's account of induction as Jackson points out concerns violation of the logic of counterfactuals. The logic of counterfactuals holds that if something did not have such-such traits, then it would not have behaved in such-and- such manner. For instance, if we know that Iron rusts when exposed to oxygen and moisture because we know Iron combines with oxygen in the presence of moisture to form Iron (II) oxide (rust) and when we observe that an Iron wire rusted when it was exposed to oxygen and moisture, we can argue counterfactually that if the Iron wire had not been exposed to oxygen and moisture, then it would not have rusted. Applying this reasoning to Goodman's paradox, Jackson argues that in addition to examined emeralds, Goodman

introduces a new emerald which has not been examined with new information that it will be blue after time T. According to Jackson, this new information leads to violation of the logic of counterfactuals for we know that emeralds are not green because they have been examined but they would still have been green even if they had not been examined (*Ibid*: 121-124).

In the case of the Iron wire, it would be irrational to expect that it would rust after a specified time later than now if new information such as the wire will be oiled after the specified time is added. We know that the wire rusted because there were no barriers to deter the reaction from taking place. Hence, according to Jackson, the inductive rule cannot be used to draw incompatible generalizations as Goodman does, for it would be a violation of the logic of counterfactuals.

The logic of counterfactuals as expressed by Jackson is a big blow to Goodman's paradox. Scientists do not just project regularity. Besides, induction by enumeration oversimplifies scientific methodology by taking for granted the role of other factors that influence scientists such as imagination and guess work. Scientists, for instance, do not just merely project that copper metal conducts electricity better than lead metal. They also know that copper metal would not have been a better conductor than lead if it did not have such-and-such features that are not present in lead.

But Adina Roskies disagrees with Jackson's criticism of Goodman namely that Goodman's account violates the logic of counterfactuals. Roskies argues that

Jackson's appeal to counterfactual knowledge of the already examined emeralds leads to absurdity. Counterfactuals, according to her, cannot be evaluated purely on the basis of knowledge about emeralds (Roskies, 2008: 224). She reiterates that observing the emeralds alone cannot lead to deriving their counterfactual properties as Jackson claims. For her, what can be derived of the emeralds, by observation, is their color and, possibly, their microstructure. Hence, Roskies argues, this information alone is not enough to dissolve the paradox. As a matter of fact, she argues, if all things were known about the emeralds that makes them to be green, the grue paradox would not arise since it will not only be known that a future emerald is not examined but also that it has a certain structure and thus it is green. As such, the counterfactual condition would not be needed to solve the paradox.

According to Roskies in order to assess whether a counterfactual condition is violated, more information is needed such as how structure determines color and that objects with such a structure are green and not grue. This, according to Roskies, requires an avail of methods of investigating the microstructure of emeralds. The implication that Roskies draws from Jackson is that if the methods are not available then the inference that the next emerald is green not grue would not be justified. For Roskies, this implication is absurd for justification cannot be restricted to only the predicates whose microstructure account is known.

However, Roskies seems to underestimate Jackson's argument regarding the apparent Goodman's violation of the logic of counterfactuals. It seems acceptable that justification of inductive arguments cannot be restricted to predicates whose microstructure is known. However, my understanding is that Jackson's argument does not seem to be purely based on Roskie's point of view. Jackson's point is that predicates can be projected without invoking a demarcating criterion as Goodman assumes. Moreover, Jackson's counterfactual argument correctly demonstrates that Goodman's riddle can be dissolved for it is a logical consequence of accepting the definition of the logic of counterfactuals. To the extent that Goodman offers additional information for a future emerald, the compromising generalization "all emeralds are grue" when asserted at a time later than T is not supported by induction via enumeration.

Another author who views Goodman's account as a restatement of Hume's old problem is John D. Norton. Norton sees Goodman's invention of the compound grue as "colorful way of stating old news" (Norton, 2006: 186). He reiterates that Goodman's grue and bleen compounds at best express the old problem of induction that 'any pattern may be confirmed in many different ways'. Norton observes that as much as the grue and the bleen (bleen denotes all things examined before time t just in case they are blue but to other things just in case they are they are green) could be dismissed on grounds that they invoke a time factor which green and blue do not, Goodman takes his definition further by defining grue and bleen as the primitive predicates in terms of blue and green thus

creating a formal symmetry between 'grue/bleen' and 'green/blue'. While the initial symmetry took grue and bleen as the grue-ified predicates, the second definition takes green and blue as the grue-ified predicates.

Green applies to all things examined before time t just in case they are grue but to other things just in case they are bleen. Blue applies to all things examined before time t just in case they are bleen and to other things just in case they are grue (Goodman, *Op.Cit:* 79-80). From this definition, the qualitiveness present in the unfamiliar predicates grue and bleen is now present in green and blue. Goodman, therefore, concludes that qualitiveness is a relative matter thus does not establish a dichotomy of predicates. This implies that, as Norton observes, "...for any predicate...that can be defined in a system that takes green and blue as primitives, there will be a 'grue-ified' analog in a system that takes grue and bleen as primitives, as long as the symmetry of description obtains" (Norton, *Op.Cit:* 189). Hence, he argues that the conclusion drawn from Goodman is that any account of induction confirms the grueness and greenness descriptions equally.

According to Norton, Goodman's new riddle would be different from Hume's problem, if and only if the formal and perfect symmetry can be refuted in the physical context. That is, if facts can prove that the two components of the symmetry do not contain the same information. If it cannot be refuted, then there is nothing new in Goodman's paradox (*Ibid:* 198). For Norton, it is a fact that "for symmetrical descriptions, a failure of physical equivalence must be grounded in

external facts, that is, in facts not expressed within the descriptions themselves” (*Ibid*: 193).

For instance, Goodman’s symmetry depicts one side as consisting of statements “all emeralds are grue and “all emeralds are bleen” while the other side of the symmetry consists of statements “all emeralds are green” and “all emeralds are blue”. For Goodman, the two sides of the symmetry are supported by inductive evidence but are not physically equivalent in that they do not describe the same facts. While the statement “all emeralds are green” will obtain positive instances in the physical world, the statement “all emeralds are grue” will not. What Norton implies is that to show that the two descriptions in the symmetry do not describe similar facts; one has to appeal to facts that are not already implied in either description in the symmetry such as the time in which the emeralds are observed. Norton concludes that if there are no such facts to appeal to, then the symmetry is perfect and thus the descriptions on either side are physically equivalent.

This implication, Norton argues, follows from the definition of symmetrical descriptions. He argues that if symmetrical description means that for every sentence in one description there is a corresponding sentence in the other description, then to be sure that the sentences do not mean the same thing, one has to appeal to facts outside the symmetrical description. The result of this is that as the scope of symmetrical descriptions grows larger, the facts to be appealed to become lesser. Norton expounds this by saying:

“If symmetrical descriptions cover all of science, then facts that establish the failure of physical equivalence must lie outside science...if the symmetrical descriptions cover all of our formally expressed knowledge then facts that establish the failure of physical equivalence must lie outside our expressed knowledge, that is, in ineffable facts” (*Ibid*).

If the condition above, namely, that failure of equivalence has to obtain from facts outside the description does not obtain, then, Norton argues, the two descriptions, that is, grue/bleen and green/blue describe the same facts thus physically equivalent. The implication is that if it did obtain, then the new riddle would be entirely new as Goodman claims. According to Norton there are no relevant facts outside the symmetry to show that the descriptions are not physically equivalent (*Ibid*: 198). This notion is similar to Jackson’s view that all predicates are projectible such that there is no criterion for partitioning them that is needed.

Norton writes,

“So we have reasons to believe that the two descriptions are merely notional variants of one another. As a result, no account of induction should pick between them. A failure to pick between ordinary and grue-ified hypotheses is just what we should expect of any good account of induction” (*Ibid*: 198)

By ordinary hypotheses, Norton implies inductive inferences as expressed in the old problem of induction while by grue-ified hypotheses he implies inductive inferences as expressed in the use of nonprojectible predicates invented by Goodman. If the two hypotheses, that is, ‘all emeralds are green’ and ‘all emeralds are grue’, are physically equivalent as Norton seeks to show, then it follows that the new riddle is, actually, Hume’s problem in a new guise. Norton seeks to establish that the two descriptions are physically equivalent by showing

that facts do not lead to breakage of the symmetry and thus the aforementioned condition does not obtain.

According to Norton, the symmetrical description would be a perfect one, such that the components of the descriptions explain the same facts, if the whole science serves as one description of the symmetry (*Ibid*: 193). Norton argues that even if the whole science was taken as the scope of one description, it is still possible to provide an alternative to it by grue-ifying the whole of science. For him, if the whole of science is grue-ified, then there will be two accounts of the symmetrical description; the normal science and the grue-ified science. The implication is that there will be no more scientific facts to appeal to in order to show the lack of physical equivalence of the symmetry and, therefore, the two cases will not be distinguishable. As such, there will be no difference between the original science (Humean inductive science) and the grue-ified science (Goodman's science of nonprojectible predicates) (*Ibid*: 199)

It may be objected, as Norton observes, that the two descriptions; all emeralds are green and all emeralds are grue, cannot be both true and therefore are not physically equivalent. However, Norton notes, the two descriptions belong to 'different members of a pair of total description'. In the normal world "all emeralds are green" will be true and "all emeralds are grue" will be false. However, in the grue-ified world "all emeralds are grue" will be true but "all

emeralds are green” will be false. Therefore, the two descriptions can be true provided each set is referred to its appropriate total description.

Norton’s argument is quite appealing in that it follows from the definition of symmetrical descriptions. If the definition of symmetrical descriptions is accepted and conjoined with the fact that their lack of physical equivalence has to derive from facts outside the symmetry, then there is no reason to reject the logical consequences that follow from the definition. Hence, Goodman’s new riddle is a restatement of Hume’s old problem. However, Norton’s argument has not gone unchallenged but as we will see, it retains its plausibility.

Robert Schwartz disagrees with both Jackson and Norton. He argues that to collapse Goodman’s new riddle into Hume’s problem is to misunderstand both Hume and Goodman. Schwartz contends that as much as Goodman accepts Hume’s analysis of induction and causality, he also observes that Hume did not cover all that is expected of induction. While Hume admits that the principle of regularity of nature cannot be used to justify induction but nonetheless past regularity is the guide to future expectations, Goodman seeks to show that not all regularity can be projected. Projecting all regularity leads to conflicting projections such as depicted in grue and green all deriving support from the inductive rule. Schwartz, therefore, concludes that Goodman does not reaffirm Hume’s conclusion but offers a criterion for distinguishing projectible from nonprojectible predicates (Schwartz, 2009: 398).

However, Schwartz seems to overlook the fact that the entrenchment criterion that Goodman offers for his riddle is reminiscent of Hume's own solution. Both philosophers are inclined to habit as the guideline for projections. Moreover, Hume seems contented with the fact that induction can be validated neither a priori nor by probable arguments for no number of observed instances guarantees the truth of future projections. Hence, he adopts a psychological solution to his problem by appealing to habit. However, Goodman wrongly takes Hume's solution as if it were a validation of induction. Surprisingly, Goodman accepts Hume's negative answer to the logical problem of induction for he understands its roots. He explains,

“The problem of validity of judgments about the future or unknown cases arises, as Hume pointed out, because such judgments are neither reports of experience nor logical consequences of it. Predictions, of course, pertain to what has not yet been observed; for what has happened implies no logical restrictions on what will happen” (Goodman, *Op.Cit:* 59).

Later on Goodman argues that there is no guarantee that the projected predicates will turn out to be true. He writes,

“If our critic is asking, rather, why projection of predicates that have become entrenched happen to be those projections that will turn out to be true, the answer is that we do not by any means know that they will turn out to be true. When the time comes, the hypothesis that all emeralds are green may prove to be false, and the hypothesis that all are grue prove to be true. We have no guarantees. The criterion for legitimacy of projections cannot be truth that is as yet undetermined” (*Ibid:* 98-99)

The two passages show that Goodman agrees and restates Hume's position. Both Goodman and Hume are aware that induction cannot be validated in the sense of

showing that the conclusions of inductive arguments will turn out to be true. However, Goodman wrongly takes Hume's appeal to custom as the way to go about validating induction. He believes that Hume posed a problem and offered a solution to it and that the problem of induction when dissociated from the problem of describing how induction takes place cannot be termed as Hume's problem (Goodman, *Op.Cit*: 61)

However, Goodman seems to forget the fact that Hume posed two questions and gave each an answer. To the question "are we logically justified in inferring instances we have no experience from instances we have experience", Hume argues we are not. To the question "how does the inference from experienced instances to the unobserved instances take place?" Hume appeals to custom or habit. The first of these questions concerns validity of inductive inferences while the second concerns the description of the process of making inductive inferences. From our discussion, it is clear that both authors agree on both questions. However, unlike Hume Goodman treats the second question as addressing validity of induction. Nonetheless, it is clear that the new riddle is a restatement and a reaffirmation of Hume's problem and his solution to it. If we agree that Hume's problem is a question without a satisfactory answer yet, we are compelled to conclude that induction remains as unjustified in Goodman's analysis as it were in Hume's analysis.

It should be noted that the question of validity of inductive inferences involves a logician in a category mistake. That is, transferring the features of deductive logic to induction. Validity and soundness are features that apply to deductive not inductive inferences. If we agree that inductive arguments can never be valid or invalid but only strong or weak, we are compelled to conclude, like Hume does, that induction cannot be justified by invoking the truth of inductive conclusions. It is in this vein that Herbert Feigl discloses two forms of justification: validation and vindication (see Black, 1970).

Feigl contends that in validation, a process of inference is justified if it conforms to established rules of inference. Further, the rules of inference are justified by invoking more basic rules until the justification arrives at foundational rules which cannot be further validated. Chapter two of this study led to the conclusion that any attempt to validate or to justify induction by demonstrating that inductive conclusions are true and by appealing to principles of inductive inference is fallacious. The circularity involved in such attempts gave this study the first insight that a limit of validation, assuming validation was possible, has been reached. Moreover, the linguistic response to the problem of induction discussed in chapter three revealed that the principle of induction is the limit of justifying particular inductive arguments. However, while the linguistics argued that the principle is justified by ordinary standards of meanings of terms such as “rational” and “evidence”, we reiterated that that assumption is unsatisfactory and that it is still within our rights to demand the justification for the principle of induction.

The second form of justification, according to Feigl, is vindication or pragmatic justification. This process implies justifying a rule or a principle by appealing to the aim it is meant to achieve. The principle in need of justification is thus taken as a means to an end. Feigl urges that if the principle of induction is taken as the basis of all inductive inferences, then any further questions regarding the justification of the principle can only be answered by citing the purpose of adopting it as means to a desired end. This is the path that Reichenbach (*Op.Cit*) adopts in his justification of induction. Salmon (*Op.Cit*) backs up the need for vindication of the inductive rule in his critique of Strawson in which he views Strawson as having arrived at a limit of validation. Salmon, as it was observed, urges that this does not imply a limit of justification for vindication is the best alternative.

In this regard, Reichenbach urges that any attempt to show that induction is a habit does not suffice as a justification for induction. For him, even if it should be accepted that induction is a habit, it is still legitimate to question whether it is a good habit in the sense that it is or it is not useful in giving meaning to actions directed towards the future events. Reichenbach warns: "...if we are not able to demonstrate that it (induction) is a good habit, we should either cease using it or admit frankly that our philosophy is a failure" (Reichenbach, *Op.Cit*: 347). Given Reichenbach's plausible assumption, it is clear that Goodman's suggested criterion for distinguishing valid from invalid projections, namely, entrenchment

deriving from habit, does not suffice a solution to the notorious problem of induction.

The foregoing discussion has revealed that Goodman's 'new riddle' is a restatement and a reaffirmation of Hume's position. The solution that Goodman suggests for the new riddle is similar to Hume's own solution in that both authors appeal to custom for justification of induction albeit Goodman disguising it in the concept entrenchment. Moreover, Goodman's assertion that there is no guarantee that the projected hypotheses will turn out to be true is yet another way of endorsing Hume's position namely, that induction is not logically justified. In this regard, both authors agree on the two important aspects arising from the old problem of induction.

We have also seen that any attempt to appeal to habit as the justification of induction is unsatisfactory. Reichenbach takes note of this notion and urges that if we are to continue following induction as a habit, then we need to establish that it is a useful habit when directed to actions about the future events. Further, the distinction between validation and vindication conjoined with the fact that validation applies to deductive logic leads to the conclusion that a demand for justification of induction has to be pragmatic in nature if it is to be unexposed to Hume's skepticism. It is in this light that Reichenbach's pragmatic justification or vindication offers the best hope of arriving at the justification of induction by taking us beyond both Hume and Goodman.

CHAPTER FIVE

REICHENBACH'S PRAGMATIC DEFENSE OF INDUCTION

5.1: Introduction

As it has been established in the previous chapters, an epistemic justification or validation of induction is not possible, since it entails demonstrating that the conclusions of inductive arguments are true. By the very nature of inductive logic, validity cannot be invoked in reference to inductive arguments. It is a characteristic of inductive arguments to derive conclusions whose truth is not entailed. To seek to demonstrate that inductive inferences are true is tantamount to equating induction to deduction. But, as it has been established, rationality cannot be restricted to deductive logic. For the above reasons, the justification of induction takes us beyond establishing the truth of inductive conclusions (This is why Reichenbach's solution to the problem of induction has stood firm as compared to all the previous solutions discussed)

This chapter focuses on Reichenbach's pragmatic justification of induction. It will be shown that Reichenbach's forceful argument lies in the aim that induction serves both in science and in ordinary life: that of arriving at a limit of relative frequency. For Reichenbach, if induction is successful in achieving this aim, then it is justified on that basis. Reichenbach contends that induction is our best hope in facing a future characterized by uncertainty. However, as we will observe,

there is no guarantee that this aim is achievable either in the long run or in the short run. Hence, this chapter will recommend on ways to improve Reichenbach's pragmatic justification by alluding to the purpose induction serves in sustaining scientific predictions for application in technological advancement and policy formulation.

5.2 Reichenbach's Probability Theory and Pragmatic Defense of Induction.

Reichenbach's solution to the problem of induction is based on his theory of 'weight'. According to Reichenbach, propositions containing knowledge of the unobserved future have an unrevealed truth value. However, like any other proposition, they are capable of being true or false. Even though their truth is not yet determined, they are nevertheless uttered in ordinary speech with some determination of their truth or falsity. For Reichenbach, the 'utterer' holds an opinion regarding their truth. This opinion, according to Reichenbach, is called a weight which takes the place of an unknown truth value and measured in terms of probability. It is for this reason that Reichenbach views the concept probability as only applicable to propositions whose truth value is not yet determined. The weight of a proposition is determined through verification but is applied to propositions that are yet unverified (Reichenbach, *Op.Cit:* 23-24). For Reichenbach, weight is a bridge between the known and the unknown and is particularly important when propositions are used as basis for action.

Reichenbach insists that any action presupposes some knowledge of future events and therefore is based on the weight of the unverified propositions. Moreover, any action depends on volitional decision and the means of attaining the decision (*Ibid*:26). Thus, for instance, Reichenbach would argue, a student may have verified that philosophy lesson proceeds from 9 a.m. every Monday in the past. But for the student to take the lesson this Monday, he/she must have some knowledge that it will be the case today. He/she must have a weight towards the unverified proposition that the lesson will take place today.

For Reichenbach, scientific hypotheses are probability statements and, therefore, do not claim certainty. Like any other frequency interpretation of probability, Reichenbach contends that repetition of an event is crucial in determining the degree of probability of an event. For him, probability statements derive meaning from the fact that they can be utilized in preparation for action. Hence, scientists believe that the event with a higher probability, determined by its relative frequency, will happen in the future (*Ibid*: 309-310). This is the principle of the most probable event which if followed, according to Reichenbach, leads to the best ratio of success of the event happening even in the light of possible failure.

Consider an illustration similar to one given by Reichenbach: Suppose a train station time schedule shows that the train we intend to travel in arrives at the station at 1300 Hrs. As Reichenbach would argue, it is better to believe the time keeper not because it is impossible for the train to arrive two hours earlier or later

but because by using the principle underlying the time schedule, we shall avoid great disappointments. Any action presupposes weight and therefore probability. In everyday life, the principle of most probable event is applied. For instance, we take drugs prescribed by a doctor because there is a probability that our disease will go away. We eat bread because there is a probability that we will get nourished. The totality of actions must be submitted to the “principle of assuming the most probable event” if we are to avoid diminution of successes. Hence, for Reichenbach frequency interpretation of probability justifies our behavior.

However, Reichenbach urges, the term probable applies to a class of events and not to a single event which has not yet been verified (*Ibid*: 313). Given that truth and falsity also do not apply to future unverified events, it follows that the individual event cannot be said to be probable, true, or false. For Reichenbach, the single event is a posit. Hence, a posit is what is assigned to statements about the future in the sense that they are not to be taken as actually true but the scientists choose to deal with them as though they are true but without any proof of their truth value. The event with the highest probability is posited in a statement as that which will occur.

For Reichenbach, the rationale behind a posit is that should the event be repeated, the decision to deal with the statement posited as true will lead to “greatest ratio of success.” Reichenbach likens a posit to a gambler’s wager. A gambler attaches a weight to his wager possibly in terms of money he is willing to stake for the bet.

Moreover, the probability, in terms of relative frequency, of the event he bets on happening determines the weight of his wager. Reichenbach contends that “a weight is what a degree of probability becomes if it is applied to a single case” (*Ibid*: 314). According to Reichenbach, a single case refers to an event represented in a scientific hypothesis. Consequently, a weight is the “predictional value of a sentence.”

Reinchenbach further contends that for the sake of prediction, scientists face the future like a gambler uttering nothing about the truth-value of their hypothesis but rather adopt a weight or posit or wager which nonetheless may be assigned a numerical value. However, while a gambler’s wager has an appraised weight in that the gambler knows the odds in which he is willing to bet, a scientist’s posit is not appraised and thus is a ‘blind’ posit. But, desire for action makes scientific gambling necessary. For him, gambling is the only way that scientists can deal with the future for logic does not provide a way. This does not imply that predictions which arise from induction are not justified. For Reichenbach, induction is justified by the aim it seeks to achieve in scientific predictions. He contends that this aim is tied to frequency interpretation of probability statements.

According to Reichenbach, frequency interpretation of probability makes the assumption that a calculated relative frequency of a given event approaches a limit of the frequency of repeatable events. This implies that as long as an event is repeatable, the relative frequency calculated at any given time, which is less than

one, will approach the true value that is, one, upon repetition of the event (*Ibid*: 340). Assuming that the relative frequency of an event calculated at a given time, say t , is x , then upon repetition of the event it is expected that the revised relative frequency will be $x \pm \epsilon$ where ϵ is a small number. Reichenbach argues that since the calculation of relative frequency is only possible by use of the frequency of the observed events, then it follows that the principle of induction assumes that there is a limit of relative frequency which is close to the value calculated from observed events. For him, the principle is indispensable if there is any hope of finding the limit of frequency. For Reichenbach, therefore, the aim of induction is to arrive at a limit of relative frequency for repeatable events (*Ibid*: 350).

However, Reichenbach warns, there is no certainty that the aim will be achieved. But for the sake of preparation for action, we cannot help but follow the prescriptions of induction as means to an end. For Reichenbach, the demand for justification of induction requires nothing less than showing that induction is a useful means for the purpose of actions directed to future events. Reichenbach reiterates that it is not a necessary condition for a justification of induction to demonstrate that the conclusions of inductive inferences are true. For Reichenbach induction would be justified if it can be demonstrated that the conclusions of inductive arguments are true, but justification of induction does not imply that the conclusions of inductive arguments are true. However, inductive inferences serve as the best assumption regarding a future whose truth is not known.

Reichenbach gives an illustration, which may be put in the context of the recent case of the use of an experimental drug to treat Ebola, to show that induction serves us the best hope in dealing with an unknown future. Suppose a man is suffering from a grave disease such as Ebola. There exists an experimental drug whose therapeutic value has not been fully established. The doctor says that he does not know whether the experimental drug will cure the man. However, he adds, if there is any hope for the man surviving then the drug is the only remedy. According to Reichenbach, even though it would be better and a sufficient condition to know whether the experimental drug will cure the disease, the administration of the drug would be justified without that knowledge for it is the only hope available. The knowledge available to the doctor is sufficient for this justification. It is on these grounds that Reichenbach insists that even if there may be no sufficient conditions for success, it is nonetheless enough for a justification to realize the necessary conditions (*Ibid*: 349). Hence, Reichenbach seeks to show that induction is a necessary condition of success namely, arriving at a limit of relative frequency.

Further, Reichenbach argues that attaining the limit of frequency is not guaranteed owing to a possibility of a world that is not predictable. This is because it would be impossible to construct a series with a limit in a non-predictable world. However, if the world is predictable, induction is a sure way of attaining the limit. Given that the value of relative frequency calculated at any time is taken to approximate the limit and that events are bound to be repeated, scientists are not

tied to stick at the calculated frequency. Rather, the process of calculating relative frequency is continued as the number of instances of the event increase thus considering the last relative frequency calculated as the best value of the limit. Reichenbach insists that if there is a limit at all, the procedure will eventually lead to the true value of the limit. The principle of induction is, therefore, a necessary condition for attaining the limit of frequency.

Reichenbach does not imply that the principle of induction is the sole principle of arriving at the limit of frequency. For him, induction belongs to a set of other methods that can equally serve as necessary conditions for arriving at the limit. He considers clairvoyance as being among the methods in the set. Thus it follows that there must be rational grounds for choosing the principle of induction from among the members of the set. Take, for instance, the forecasts of a clairvoyant and the suspicion that he may give false forecasts of the value of the limit. This implies that nothing about him (his magic) is known to us. To verify that he is a true clairvoyant, Reichenbach contends that we would appeal to his past forecasts to see whether they match the facts. We would also wait to verify his current forecasts against evidence. According to Reichenbach, if the forecasts match the facts, we will pronounce him as a true and reliable clairvoyant. This procedure applies the principle of induction. The implication is that, at least, there is something known about the principle of induction. For Reichenbach, the inductive principle must therefore be chosen so as to control other methods, which nothing about them is known, of arriving at the limit (*Ibid*: 355).

Further, Reichenbach warns that if the world is not predictable such that there is no limit of frequency, the inductive principle will not be a necessary condition for finding it since there would be other methods of telling future frequencies. But, if there are a number of methods such that a choice of one or more must be made if a limit is to be found, then each of the members in the set is a necessary condition for arriving at the limit. If any of the members is applicable, then it follows that that particular member is a necessary condition for the existence of the limit. From the above assumption, Reichenbach concludes that the principle of induction is applicable as a special member of the set of methods that can be used to foretell the future. Hence, he remarks, the method of induction presupposes a limit of relative frequency of repeatable events.

This far then, Reichenbach's justification of induction is plausible and stands out strong compared to the other attempts to solve the problem of induction owing to its ability to escape Hume's skepticism namely, that induction is not justified due to lack of probable or a priori arguments in its support. Hume's objections have proved unshakable as it has been established in the previous chapters and therefore the skepticism remains. However, to evade this skepticism, Reichenbach reiterates that proving that the conclusions of inductive arguments are true is not the only way that induction can be justified. Instead, induction can be justified by appealing to the aim it seeks to accomplish in scientific inquiry.

However, this does not imply that Reichenbach's account has not been criticized. For instance, Bonjour (*Op.Cit*) observes that first, Reichenbach's notion of a 'blind' posit makes it impossible for the scientist to know whether there are any chances of success. (Bonjour, *Op.Cit*: 69-72). Bonjour argues, and here we agree with him, that even if a limit of frequency exists, as Reichenbach assumes, the inductive rule cannot guarantee success either in the short run or in the long run. Firstly, taking the assumption that induction will lead to success in the long run, the question of how long should the run be still remains. Hence, just like Hume would contend, Bonjour argues that no run will be long enough to guarantee success. In our view, this seems to make sense to the extent that no number of past frequencies imposes a logical guarantee as to what will happen in future.

Secondly, even if induction was to lead to success in the long run, if at all success is possible, such success cannot be recorded at any point in the short run during the observation process. Consequently, Bonjour argues, while applying the principle of induction, there is no number of repeated events from which we can have justified confidence that a calculated relative frequency reasonably approaches the true value of the limit even if the limit, actually, exists. Moreover, Bonjour adds, it may happen that the value of relative frequency arrived at some particular time was the correct approximation of the limit. According to Bonjour, Reichenbach gives us no reason to believe that the relative frequency is the true value of the limit. Therefore, success may be achieved at a certain point but there is no reason to think that it has been achieved. Hence, Bonjour concludes, the

success of induction in the short run would be no better than a matter of random guess.

A further disagreement between Reichenbach and Bonjour concerns their different understanding of justification. According to Bonjour, the original problem of induction demands a justification that seeks to show that the conclusions of inductive arguments are likely to be true. It has to do with what reasons there are for accepting the general inferences on the basis of particular observations (*Ibid*: pp.58). Bonjour reiterates that Reichenbach's justification gives no reason whatsoever for thinking that the general inferences are true or even likely to be true. For Bonjour, Reichenbach's account does not claim, at any point, to demonstrate the truth of inductive conclusions. It is for this reason that Bonjour dismisses Reichenbach's solution as non-epistemic. For Bonjour, by neglecting the demonstration of truth of inductive conclusions, Reichenbach does not offer a solution to the skeptical question of induction. He writes, "Reichenbach's vindication renders the most carefully derived results of science epistemically no better, indeed worse, than a gambler's bet" (Bonjour, 1998: 195).

As observed, this disagreement rests on the difference in approach as pertains to justification. While Reichenbach takes demonstration of truth of inductive conclusions not as a necessary condition for justification, Bonjour argues to the contrary. A chronological analysis of three crucial documents to support this notion is important. These are: Reichenbach's *Experience and Prediction* (1938),

Herbert Feigl's *De Principiis non Disputandum* (1950), and Laurence Bonjour's *In Defense of Pure Reason* (1998). We touched on Feigl's paper in the distinction between validation and vindication in an earlier section. In Feigl's paper Reichenbach's pragmatic justification of induction is acknowledged as an application of vindication. Bonjour's critique appears forty eight years after Herbert Feigl's distinction between validation and vindication. Hence, either Bonjour was unaware of Feigl's distinction or he dismisses this distinction as illegitimate. However, in our opinion, it seems that Bonjour is wrong since vindication seems to be a legitimate form of justification, especially in the light of the impossibility of validation of induction.

However, our chapter two pointed out to us the challenges involved in seeking an epistemic solution to the problem of induction. Besides, one of the main observations that led to the desire to revisit the problem of induction is that Hume's objections to the possibility of an epistemic justification of induction have withstood all attempts to refute them. Hence, we deemed a non-epistemic solution to be more viable in defense of induction.

Perhaps, this is why Salmon views Reichenbach's solution as the most fruitful and promising attempt to resolve the problem of induction when compared to other solutions. According to Salmon, the fact that Reichenbach does not seek, unlike other authors, to establish the truth of any synthetic proposition but to justify a rule, which cannot be said to be true or false, makes his solution

outstanding. However, he warns that Reichenbach's solution is not an adequate justification but it gives a sound ground from which philosophers can attempt an adequate justification of induction. He agrees with Reichenbach that induction is to a great extent the logic of science. Disregarding the attempts by Popper and Strawson to dissolve the problem of induction, Salmon writes, "...in contrast to both of these views I claim there is a crucial sense in which the logic of science is inescapably inductive, and that a justification of induction is essential to a full understanding of the logic of science" (Salmon, 1968: 24).

For Salmon, the problem of induction can be reduced to the problem of evidence as "...what rules ought we to adopt to determine the nature of inductive evidence?" (*Ibid*:32). What Salmon implies is that a justification of induction demands grounds for adopting the rules that we adopt as pertaining to inductive evidence. For him, Hume's objection to the possibility of logical or probable arguments demonstrating that inductive arguments with true premises will lead to true conclusions in future is correctly and definitively demonstrated. However, this does not imply an impossibility of justification; for justification does not have to take the form of proving that inductive conclusions will be true in future. Vindication is the way to go about justifying induction: to show that adoption of the inductive rule as, Salmon notes, "...is well suited as a means to some desired ends" (*Ibid*: 34).

According to Salmon, Reichenbach's justification consists in showing that inductive method will yield predictive success if at all any method is capable of the same. However, he notes a major difficulty in Reichenbach's argument. For Salmon, the same argument as provided by Reichenbach can be equally applied to justifying other asymptotic rules besides induction by enumeration being the special member. Other asymptotic rules are those in which the difference between the observed frequency and the inferred value of the limit converges to zero for increasing sample size. For Salmon each member of the set of asymptotic rules fulfills the convergence requirement of induction. For this reason, there is need to place restrictions on the rules such that induction stands out among the many asymptotic rules.

Salmon recommends two restrictions to narrow down the set of asymptotic rules. The first is the normalizing condition which restricts the limit of relative frequency at the interval of numerical value zero to one (0-1). Any rule that infers a relative frequency of negative value or a positive value above one (1) should be eliminated from the list. Secondly, the linguistic invariance condition requires that the limits of frequency inferred should not be a function of the language used in formulating the evidence statements. This implies that two logically equivalent descriptions of a sample should not allow the inference of two different values for the limit of the relative frequency as would be the case with 'grue' and green expressed in the Goodman's grue paradox (*Ibid:37*).

However, Salmon does not seem contented with the two conditions he suggests. As observed in Bonjour's critique, the choice of the inductive rule from among other rules with a limit of frequency remains problematic. Salmon acknowledges this problem and warns that:

"Taken together, the convergence condition, the normalizing condition, and the linguistic invariance condition are quite powerful. At one time I thought they provided a full vindication of induction by enumeration, but now I realize this view is incorrect. Additional conditions are needed, but, I have no idea what they might look like or whether there are any acceptable ones" (*Ibid*: 37).

Elsewhere salmon seems to endorse his failure in finding a satisfactory answer to Hume's problem as he admits:

"It seems to me, however, that the least we can do on the bicentennial is to acknowledge candidly that part of Hume's legacy is work still to be done. The problem he left us is a tough one, but we have no excuse for pretending that it does not exist. And, I think, we had better not stop trying to solve it" (Salmon, 1978: 18)

At this juncture, this study takes notice of a major problem facing Reichenbach's solution to the problem of induction. The aim of induction according to him centers on predictive success of scientific hypotheses. This success will be made possible by the role of induction in discovering a limit of frequency in the long run. However, given the persisting doubts concerning the ontological status of a limit of relative frequency, it is very uncertain whether such success, as suggested by Reichenbach, will ever be possible. Bonjour makes this point very clear in his analysis already given in this chapter. Salmon who sought to save Reichenbach's

theory seems to have shown desperation in identifying the relevant conditions that can enrich Reichenbach's vindication of induction.

The rationale behind Reichenbach's choice of the inductive rule as a means to achieving predictive success by discovering a point of convergence, therefore, seems blurred. Perhaps, the problem with Reichenbach's vindication is not frequency interpretation but the aim he assigns to induction. Reichenbach appeals to predictive success on arriving at a true value of the limit. This true value, undoubtedly, depicts arriving at the truth of inductive inferences however long it may take as long as that truth is attainable. But, as we observed in the preceding chapters, there is no way in which we can know that inductive inferences will turn out to be true in the future. This is, precisely, why it was concluded that validation of induction is not possible. By insisting on finding the true value of the limit, Reichenbach involves himself in an impossible endeavor.

Even if the limit of relative frequency is possible to achieve, there is no way in which scientists would know that they have achieved it. This is because scientific predictions can either be confirmed or refuted by evidence. If scientists are lucky to confirm some of the predictions, this would at best add to the inventory of the frequency of the confirmed hypotheses. Consequently and as Reichenbach contends, scientists will use the accumulated frequencies to revise the value of the relative frequency. This implies that the process of calculating and correcting the value of the relative frequency will continue infinitely as long as predictions are

confirmed or refuted by evidence. Moreover, the value calculated at any given time is assumed to approach the true value of the limit. Hence, the question arises: when will the true value of the limit of relative frequency be achieved? The possible answer that can be given to this question is “at an infinite time” which implies never unless an end of time is conceivable.

5.3: Vindicating Induction Beyond Reichenbach

As already observed Reichenbach holds that the ultimate aim of induction is to find a limit of relative frequency. However, along the vein of Bonjour and Salmon, we have shown that this aim may be impossible to arrive at either in the long or short run. Reichenbach seems to be more inclined to the theoretical results of induction. Hence, he seeks to show that induction will lead scientists to the specified aim in the long run. If scientists seek to arrive at the true value of the limit of relative frequency, then this seems to be more of a theoretical aim than a practical aim. Vindication entails justifying claims in relation to the aim that those claims seek to achieve. However, besides theoretical results, there are practical aims which are as well achievable.

Moreover, as Dewey contends, pragmatism entails the application of the thought process in the manipulation of the environment for human benefit. Hence, scientific theories are created by humans with an aim of pursuing particular

interests and aims (Dewey, 1938: 42-43). Reichenbach does not make this explicit in his account of induction. Even though his illustration about the man suffering from a grave disease (see page 116) points to some practical application of induction, that illustration is not meant to imply the applicability of induction for practical benefits but for theoretical benefits. As such, it is an analogy showing that just like a physician would recommend a drug as the only hope to save the man, so should we take induction as the only hope in finding the limit of relative frequency. Even though the aim that Reichenbach assigns for induction may be achievable in the long run, there are doubts concerning its realization. Besides, what would scientists do with the true value of the limit of relative frequency should they happen to find it?

Perhaps, the remedy to Reichenbach's pragmatic justification lies in abandoning the search for a limit of relative frequencies within an ill-defined future. Instead, the focus should be placed on the usefulness of induction in practical applications at the present. When we talk of scientific predictions, we talk of inductive inferences for it is these inferences that have the scientific predictive value. For instance, when scientists observe numerous cases of copper metal conducting electricity, they draw a general statement that all copper metal conduct electricity. The inference drawn has predictive value for it leads the mind to the expectation that the next copper metal to be observed will also conduct electricity. In other terms, laws of nature, formulated via induction, have predictive power for we do

not only believe that the laws have worked in the past but we also expect them to work in the future.

Suggestively, induction can be justified by appealing to the aim that scientific generalizations seek to accomplish not just in the future but by considering their practical consequences at present. This way, one does not need to seek after an aim that is to be achieved in a future: a future which none of us know about. To begin with, scientists make predictions with two main aims in mind namely, to apply the predictions in advancing technology and to use those predictions in policy formulation.

On the one hand, policy formulation is addressed to actions and measures related to an unknown future. Policies necessarily emanate from scientific predictions. The formulated policies guide human behavior in preparedness for the unknown future. In the face of global warming, for instance, scientists use computer models to predict future changes in climate. Policy makers take up the predictions as core ingredients of policy formulation. It should be noted that policy formulation as the basis for action takes place only in accordance with the dictates of induction. For instance, it would be irrational to formulate policies for curbing global warming that do not appreciate the inductive generalizations derived from past weather changes.

On the other hand, scientists make predictions so as to apply them in technological advancement. As a matter of fact, technology is a component of

applied sciences. Studies in Nuclear Physics have found diverse applications in medical and military technology. For instance, on observation of atomic nucleus and the forces governing it, scientists derive predictions in terms of general statements concerning its behavior. These generalizations have had a wide range of application in nuclear power and medical diagnostics technology. Nuclear medicine is of great importance in modern healthcare especially in treatment of illnesses such as cancer and also in medical imaging technology.

The application of scientific predictions in policy formulation and technological advancement is neither an aim that has to be sought within a future scope nor is it a theoretical aim whose realization is disputable. This application is evidence of how induction has enhanced human survival in the past and in the present. Whether these predictions will continue to hold or that they will turn out to be true in the future is beyond the comprehension of the mind for no human mind has control over the future nor has awareness of future events. However, their current practical consequences are evidence that induction is useful in enhancing human prosperity through technology and policy.

It may be demanded that we give grounds for preferring the method of induction among other methods that may be used to predict the future. Like Reichenbach would argue, induction is the only method that something is known about. It has been the method of science with successful practical results and as such must be applied in evaluating other rules of telling about the future such as clairvoyance.

This does not, however, imply that induction will continue to be successful in the future. The point to note is that induction currently yields plausible practical consequences when applied in advancement of technology and formulation of policies and thus is justified.

The foregoing analysis has investigated an alternative to validation of induction: vindication. The previous chapters set the grounds for vindication by showing that, on the one hand, there is a genuine problem of induction in spite of attempts by philosophers such as Popper, Strawson and Edwards to dissolve it. On the other hand, we have shown that an epistemic solution to the problem of induction also termed as validation of induction as attempted by inductivists, reliabilists and probabilists is not possible in pain of begging the question. Hence, this chapter sought to re-evaluate Reichenbach's vindication of induction. We have seen that in Reichenbach's account, the problem of induction arises from frequency interpretation of probability.

For Reichenbach, scientific conclusions are probability statements with a calculated relative frequency. The event that is more probable is projected as that which will happen in the future. According to Reichenbach, the projected event has an unknown probability and thus goes beyond the knowledge of the relative frequency of the events of the class in which it belongs. In this respect, the problem of induction arises as to what justification there is for relying on past relative frequency as the rule for positing an event which has not yet occurred.

Since Reichenbach concedes to the impossibility of demonstrating that the posited event will turn out to be true in the future, he favors a justification of induction that does not seek to meet this condition.

Reichenbach contends that frequency interpretation of probability assumes the existence of a limit of relative frequencies of repeatable events. Hence, Reichenbach contends that scientists, by applying induction, seek to arrive at the true value of the limit in the long run. For Reichenbach, induction is justified because it will, in the long run, lead to the achievement in this aim. However, we have observed, in line with Bonjour criticism, that this aim may not be achievable either in the long run or in the short run. For Bonjour, even though scientists may happen to have arrived at the true value of the limit during the process of calculating, Reichenbach gives us no reason as to why scientists should believe that the calculated value is the true value of the limit. Further, Bonjour argues that this aim is not achievable in the long run for there is no 'run' that will be long enough to guarantee that the true value of the limit will be achievable. This is precisely the root of the problem of induction for no number of observed instances of an event gives us logical guarantee that the event will happen in the future.

On the basis of this criticism, we have argued that Reichenbach seems more inclined to the theoretical aim of scientific inquiry. Even though pragmatism focuses on practical consequences of a process for the justification of the process,

Reichenbach does not make this fact explicit in his account. Theoretical aim such as arriving at the true value of the limit as Reichenbach alludes to is not the only aim that can be appealed to in a pragmatic justification. Hence, we observed that the difficulty in Reichenbach's defense can be remedied through abandoning the search for a limit for a relative frequency which might not be achievable. Instead, induction is justified because it sustains scientific predictions for application in current policy formulation and technological advancement. Therefore, Reichenbach's account of induction strength lies in its appeal to the aim of induction in scientific inquiry rather than seeking to demonstrate the impossible. That is, demonstrating that inductive conclusions will be true in the future. However, its weakness lies in its appeal to an aim that is hard if not impossible to achieve.

CHAPTER SIX

SUMMARY AND CONCLUSION

The study endeavored to show that an epistemic justification of induction by self-supporting inductive arguments is untenable. We have seen that the inductivists, reliabilists and probabilists responses to the problem of induction are guilty of circular reasoning. It is not a matter of dispute that inductive inferences, unlike deductive inferences, are not necessarily truth preserving. Hence, to seek to demonstrate that inductive conclusions are true is to seek to equate induction with deduction and consequently equating rationality to deductive logic.

It is on these grounds namely, that induction is not truth preserving that the linguists dissolve the problem of induction by making the distinction between induction and deduction. For Strawson and Edwards, validity applies to deductive reasoning where the truth of the deduced conclusions derives entailment from the premises. To the contrary, inductive conclusions do not derive entailment but evidential support from the premises. For the linguists, having evidence for believing in the conclusion of an inductive argument is what rationality entails as par ordinary usage of language. Induction is thus justified in this sense. Even though this study agrees with the linguists on the aspect of the distinction between induction and deduction, we saw that ordinary standards are insufficient for the justification of induction for we still need to question our ordinary understanding

of rationality. Hence, the demand for the justification of induction takes us beyond appealing to ordinary usage of language.

Further, the study has established that Popper's attempt to replace induction with falsificationism as the method of science is self-defeating. We remarked that, as a matter of fact, scientific predictions have predictive value and if so are necessarily ampliative. Therefore, science necessarily applies an ampliative methodology, that is, induction. To the contrary of Popper's assumption namely, that scientists seek to falsify their theories, we saw that scientists seek to save their theories by adjusting the auxiliary hypotheses in the face of false predictions. Therefore, falsificationism does not account for either the method or practice of science. Moreover, Popper's use of the concept corroboration, where a theory that has withstood the severest of tests is preferred to other theories, leads him to inductivism for corroboration presupposes induction. Besides this, the logic of falsificationism is also self-defeating in that it turns out to be the logic of accepting theories for preferring the most corroborated theory is tantamount to accepting that theory. From our evaluation of the linguists' as well as Popper's falsificationism, it appears that there exists a problem of induction that cannot be dissolved in either of the way proposed by both schools of thought.

In furtherance of the debate, it was observed that the attempt by Goodman to consider the old problem of induction resolved together with his attempt to introduce a new problem of induction is a disguised way of restating and

reaffirming Hume's position namely, that the justification of induction should not seek to demonstrate that the conclusions of inductive arguments are true. Contrary to Goodman's assumption, it was argued that there is nothing new in the "new" riddle of induction. Both Hume and Goodman agree that what has been observed places no logical guarantee on what will happen in the future. This notion is evident in Goodman's claim that there is no guarantee that the right projections to make will turn out to be true. In the second place, Hume had appealed to habit as the source and the basis of all inductive projections and so does Goodman disguised in the concept entrenchment. For this reason, Goodman does not advance the Problem of Induction debate beyond Hume's assumptions.

However, Reichenbach takes a different approach in the debate. He contends that induction would be justified if it can be demonstrated that the conclusions of inductive arguments will be true in the future. However, he shows that Hume's objections to such a justification of induction are strong evidence to make us give up in seeking an epistemic justification. It is for this reason that Reichenbach seeks a justification of induction that acknowledges the strength of Hume's objections but nonetheless gives us reasons as to why we should rely on induction as long as we confront an unknown future.

Hence, Reichenbach appeals to the aim of induction in scientific inquiry. For Reichenbach, scientists apply probability statements, arrived at inductively, to confront the future. Reichenbach contends that the aim of induction is to help

scientists achieve predictive success by discovering a limit of relative frequency of repeatable events. Moreover, Reichenbach shows that induction is a necessary condition for arriving at the limit of relative frequency if such success is possible at all. Hence, induction is indispensable if this aim is to be achieved in the long run. For this reason, induction is scientist's best bet.

This study has preferred the pragmatic solution to the problem of induction by particularly improving on Reichenbach's solution. This preference for a pragmatic solution was based on the major observations pointed out in chapter one and that have been discussed at greater depth in the other chapters. Firstly, it seems indisputable that Hume's objections to the possibility of the justification of induction are strong and sound. Hume's observation that induction cannot be justified by appealing to a priori arguments is beyond reasonable dispute. The principle of induction is not an a priori truth. It is conceivable that the course of nature may change such that what was observed and thought to be true about the behavior of objects may turn out to the contrary and therefore false in the future. It does not, for instance, imply a contradiction to claim that the sun, which has always risen from the east in the past, will not rise tomorrow.

The second of Hume's objections namely that induction cannot be justified by appealing to arguments from experience has been shown to be irrefutable. This was established in chapter two in which the attempts by probabilists, inductivists and reliabilists failed to meet their objective because they beg the question. It was

established that they appeal to inductive arguments, which are based on the principle of induction or the assumption that the future will be like the past, to justify induction. This implies that none of the aforementioned attempts to offer an epistemic solution to the problem of induction takes the debate beyond Hume's objections. But a pragmatic solution does not seek to show that the conclusions of inductive arguments will be true in the future. Instead, it seeks to show that induction is justified because it is meant to lead to a specified aim. Hence, given the impossibility of an epistemic solution to the problem of induction and the apparent strength and soundness of Hume's objections, the remaining option is to offer a non-epistemic solution; in this case a pragmatic solution.

Moreover, the attempts to dissolve the problem of induction by Popper, Edwards and Strawson also fail to meet the intended objective. Popper, for instance, is wrong in assuming that science does not make use of induction. Since it was established that falsificationism, which Popper offers as the alternative to induction, is not the methodology of science but induction is, it is beyond reasonable doubts that Popper does not offer a solution to Hume's problem but rather side steps the problem. Further, Strawson and Edwards claim that induction is rational by standards of ordinary language definition of the concept rationality is also wrong. Although induction is different from deduction as the two authors claim and, therefore, should not be evaluated by deductive standards, this does not imply that induction is justified. The conclusions of inductive arguments contain

information that goes beyond the available evidence. This is precisely why inductive inferences are problematic. Hence, just like Popper, the linguists circumvent the problem of induction. Moreover, by seeking to show that induction is rational by definition, the linguists do not only intend to dissolve the problem of induction but also to show that we have an apparent internal epistemic justification of induction and, therefore, we do not have to seek it by appealing to arguments beyond the meaning of the term rationality. Given that the linguists do not succeed in dissolving the problem, it follows that their implied internal epistemic justification of induction also fails. This led to the need for seeking a justification of induction albeit non-epistemic.

Goodman's attempt to reformulate Hume's problem into the new riddle of induction ends up being a restatement of Hume's problem. Goodman contends, albeit wrongly, that when Hume appealed to habit of observing past regularity as the basis of inductive conclusions, he was dealing with the question of validity of inductive arguments thus by implication the epistemic status of induction. Hence, Goodman attempts an epistemic solution to his new riddle of induction, a long Hume's principle of habit, by appealing to entrenchment as the basis of making projections. For Goodman, entrenchment derives from the habit of using certain predicates in making projections. As a matter of fact, habit is a psychological aspect and for this reason cannot be appealed to as the basis of an epistemic justification. In this regard, Goodman does not only fail to take us beyond Hume

but also fails in his attempt to offer an epistemic solution to his riddle of induction. Given Goodman's failure in advancing the debate beyond Hume and in offering an epistemic solution to the "new" problem of induction, a more pressing need to reconsider the call for a pragmatic justification of induction arose.

It was necessary to make a distinction between the two forms of justification competing in this study: validation and vindication. On the one hand, validation of induction involves giving an epistemic justification of induction. The inductivism, reliabilism and probabilism sought to achieve this aim by showing that the conclusions of an inductive argument will be true in the future. The linguists sought to show that induction is rational by definition while Goodman sought to show that validity of induction derives from the habit of using projectible predicates in hypotheses.

On the other hand, vindication of induction does not involve showing that the conclusions of inductive arguments will be true in the future but involves justifying induction by showing that it is the best means of achieving a desired end. This implies appealing to the aim that induction seeks to achieve in scientific inquiry. Reichenbach sought to achieve this by showing that the aim of induction is that of arriving at the limit of relative frequency of repeatable events. Hence, the goal of scientific inquiry, based on frequency interpretation of probability, is to achieve the true value of the limit.

Therefore, Reichenbach's vindication takes the debate beyond Hume's assumption that induction is not a justified procedure of arriving at beliefs about the future. The strength of vindication lies in the assumption that Hume's objections to the possibility of an epistemic justification are based on sound arguments. This assumption defeats the attempts to offer an epistemic solution presented in chapter two. Further, by acknowledging the strength of Hume's objections, Reichenbach implies that there is a real problem of induction that calls for a justification contrary to linguistic and falsificationism assumptions that induction does not need to be justified. Moreover, Reichenbach's vindication acknowledges that habit if used as the justification of induction must be in conjunction with the assumption that it is a useful habit in leading to a desired end. In this regard, Reichenbach's vindication takes us beyond both Hume and Goodman's assumptions, beyond any of the discussed attempts to offer an epistemic solution to the problem of induction and beyond any attempts to dissolve the problem of induction.

However, it was observed that Reichenbach's aim of induction is difficult, if not impossible to achieve either during the process of calculating its value or in the long run. Firstly, there is no way of telling that the limit has been achieved in the short run. Secondly, there is no number of past frequencies of a repeatable event, however large, can guarantee us that the limit will be achieved in the long run. Besides, this aim does not explicitly capture immediate practical consequences of

induction. It is more of an aim directed to theoretical results of scientific inquiry than at practical results.

Given the difficulties arising in Reichenbach's solution, this study offers a way of moving beyond the role of scientific inquiry expressed by Reichenbach. It abandons the search for an aim whose achievement in the short or long run is disputable. Instead, the study appeals to the aim of induction which is apparent in the use of scientific predictions in policy formulation and technological advancement. Scientific predictions are presupposed in scientific generalizations such as laws of nature and scientific theories. These generalizations are arrived at on accumulation of reasonably many instances of regular behavior of aspects of reality. Their predictive power derives from the fact that we do not only know that objects in the physical world have behaved in such-and-such a manner, but we also expect that they will continue to behave in the same way in the future.

This expectation namely that the future will be like the past is a result of induction. We expect the future to be like the past and that scientific generalizations will continue to hold in the future. However, since we cannot tell, for sure, that these predictions will turn out to be true, our role in justifying the expectation that the future will be like the past cannot be that of showing that the predictions will turn out to be true. Instead, pragmatism offers us the best hope in justifying this expectation. Scientific generalizations are applied in policy formulation as the guide to an unknown future. With the help of laws of nature

and with the expectation that the future will be like the past, we formulate policies that will guide us in confronting the future. Induction, which assumes that the future will be like the past, makes policy formulation sensible.

Secondly, scientific generalizations are applied in technological advancement. The behavior of theoretical entities such as atoms, quarks, gravity, force, viruses, electrons and so forth, when generalized in terms of laws and theories, makes it possible to design a technology that is compatible with the generalized behavior. This has led to sophisticated technology in various aspects of life such as medicine, transport, exploration of space, military power among other fields of life. Hence, the sophistication in policy formulation and technological advancement provides us with rational base that induction is justified.

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