Hume on Induction: A Critical Study

Suchai Komalittipong

A Dissertation Submitted in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy
In Philosophy

Graduate School of Philosophy and Religion
Assumption University of Thailand

2009

Hume on Induction:
A Critical Study

Suchai Komalittipong

A Dissertation Submitted in Partial Fulfillment of

The Requirements for the Degree of

Doctor of Philosophy

In Philosophy

Graduate School of Philosophy and Religion

Assumption University of Thailand

Running Head: HUME ON INDUCTION

Hume on Induction: A Critical Study

Suchai Komalittipong

Student ID: 4719427

Adviser: Assistant Professor Warayuth Sriwarakuel, PhD

Co-Adviser: Professor Gerhold K. Becker, PhD

Assumption University of Thailand

Bangkok

2009

DISSERTATION TITLE: Hume on Induction: A Critical Study

RESEARCHER NAME: Mr. Suchai Komalittipong

DISSERTATION ADVISOR: Asst. Prof. Dr. Warayuth Sriwarakuel

DISSERTATION CO – ADVISOR: Prof. Dr. Gerhold K. Becker

ACADEMIC YEAR: 2009

The Graduate School of Philosophy and Religion, Assumption University, has approved this dissertation as a partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Philosophy.

(Asst. Prof. Dr. Warayuth Sriwarakuel)
Dean of the Graduate School of Philosophy & Religion

Approval Committee:

..... Chairman
(Dr. Joseph I. Fernando)

..... Member
(Asst. Prof. Dr. Warayuth Sriwarakuel)

..... Member
(Dr. Veerachart Nimanong)

..... Member
(Dr. John T. Giordano)

..... Member
(Dr. Kajornpat Tangyin)

..... Member
(Dr. Siriphen Piriyachittakornkit)

Acknowledgements

First of all, I am grateful to the Graduate School of Philosophy and Religion (GSPR) for giving me the opportunity to join its prestigious PhD program. I highly appreciate having the opportunity to study under knowledgeable professors in a friendly, pleasant, and cordial atmosphere.

Secondly, I would like to express my sincere appreciation and gratitude to my dissertation advisers, Dr. Warayuth Sriwarakuel and Dr. Gerhold K. Becker, for their valuable advice, guidance, encouragement, and support. Without them, my writing would have taken much longer to complete, if at all possible.

Thirdly, my special thanks to Dr. Joseph Fernando for, among other things, keeping me abreast of the latest developments in Hume studies, and to Dr. Veerachart Nimanong for giving me confidence to continue my project. Also, my sincere thanks to Dr. Imtiyaz Yusuf, Dr. Subhavadee Numkanisorn, Dr. John Giordano, Dr. Kajornpat Tangyin, and Dr. Roman Meinhold for their valuable advice and support. Last but not least, my heartfelt gratitude to Dr. Sebastian Vadassery for teaching me how to do research properly.

Fourthly, my sincere thanks to all my friends at GSPR for their moral support and encouragement, especially to Mr. Anawat Bunnag, who guided me through my qualifying exam. I would also like to thank Ms Chonticha Bunarunraksa, our GSPR Office Manager, who helped me to deal with the formalities and who gave me moral support as well.

Finally, my sincere appreciation to all members of my family. I am grateful to my mother, who inspired me in my quest for knowledge. I thank my dear wife Orawan for her understanding and support. I should also mention my grandson, Ray, who helped to cheer me up whenever my battery ran low.

So many people have contributed to my work that it is not possible to mention all of them. I apologize to those contributors whose names are omitted.

Abstract

The problem of induction is a multi-faceted problem, involving several aspects of epistemology. Since David Hume sensationalized it in the eighteenth century by claiming that induction had no logical foundation, many philosophers have tried to meet the challenge, resulting in several creative ways to solve it. However, most people hold that Hume's argument is irrefutable, but at the same time they think that the success of natural science proves that induction is quite reliable, if used properly, although it does not guarantee absolute certainty. This is called 'the paradox of induction.'

In this writing, I shall critically examine the problem of induction in general and Hume's conception of the problem in particular. Then I shall discuss popular attempts to meet the challenge and explain why they fail to solve the problem decisively. Finally, I shall offer a way out, not in the form of a solution, but one of circumvention. I shall conclude that induction should be treated differently by people in different fields of study. This will avoid the conflicts that may be caused by different aims of particular fields of enquiry.

Table of Contents

Chapter 1

Introduction

The first chapter introduces the reader to the problem that gave rise to this writing by discussing a few preliminary concepts related to the problem, the problem of induction in general, and the research methodology employed in this work.

1.1 Preliminaries

In this section, I shall first discuss the background of this study, followed by a brief discussion of inferential logic. After that, I shall discuss the significance of the study, and end the section with a discussion of the implications and consequences of the problem of induction.

1.1.1 Background of Study

Induction may be thought of simply as the process of drawing inferences from what is known to what is unknown. As such, it is older than humanity itself. It had been practiced by animals long before human beings came into existence in this world of ours, assuming that the theory of biological evolution is reliable. We know, from our observations of their behavior, that animals practice induction. David Hume (1711-1776), for example, says that, 'Even brute beasts improve by experience, and learn the qualities of natural objects, by observing the effects which result from them' (Hume, 1975, p. 39). Bertrand Russell (1872-1970) agrees. He says that induction is very strong in animals. Domestic animals, for example, expect food when they see the person who feeds them, implying the expectation that what has happened in the past a number of times will happen again (Russell, 1912, pp. 34-35).

And so, induction had been practiced by both animals and human beings since time

immemorial, without any problem, or should we say, without any known and recorded problem, until the eighteenth century, when Hume pointed out that there seemed to be no foundation on which induction could be based.[1] Hume asks this question: 'What logic, what process of argument secures you against this supposition [that the future will resemble the past]?' (Hume, 1975, p. 38). Hume pointed out further that scientific inferences from observations to laws or predictions cannot be obtained by logical deduction because their conclusions do not follow logically from their premises (Gillies, 1993, pp. 7-8). Russell also says that animals have the same problem. The man who has fed the chicken every day throughout its life at last wrings its neck instead (Russell, 1912, p. 35). The fact that induction has worked well in the past does not guarantee that it will work in the future.

Many people consider the recent history of induction to have begun with Francis Bacon (1561-1626), who criticized Aristotelian logic. Bacon treated Aristotle's logic as ineffective for drawing inferences from observation. What Bacon found to be ineffective was the logic of the syllogism because its conclusion contains no more factual content than the premises. He thought that deductive inferences cannot discover new facts (Howson, 2000, p. 7). Aristotle's writing on logic was called *Organum* (which literally means 'tool'); Bacon's major work was called *Novum Organum*, or new Organum, which was meant to replace Aristotle's work as a tool of reasoning (Gillies, 1993, p. 4).

Bacon emphasized the use of inductive inference in science (Gillies, 1993, p. 4). His basic idea is that science starts from observations leading to theories. However, not everyone agreed with Bacon's view. For example, many writers in the seventeenth century considered induction as merely sophistical because it was based on incomplete evidence (Milton, 1987, p. 59). This disagreement still exists today.

After Aristotle, Hume is another philosopher who systematically draws a distinction between deduction and induction, or, in Hume's terminology, between demonstrative and

---

[1] This is the conventional view. Other views will be discussed later.

probable reasonings. According to Hume, demonstrative reasonings are certain but are limited to mathematics, while probable reasonings are uncertain but are applicable to matters of fact (Hume, 1975, p. 35). Nevertheless, Hume has been misinterpreted by many of his contemporaries as well as later thinkers; many people see him as a radical sceptic of induction. This is one of the reasons why his critics try to argue against his view on induction.

One question comes to mind. Why did it take so long for someone to point out such an important problem? It is likely that induction has been either overlooked by the ancient Greeks—Aristotle, for example, was more interested in *a priori* or *deductive* logic—or taken for granted by most people. Only when people began to realize the indispensability of induction did they seriously reflect on it and it took someone no less than Hume to point out the problem.

Since Bacon's revival of induction, it gained wider acceptance among scientists and philosophers alike. But after Hume's doubts on induction, people began to feel uncertain about knowledge derived from inductive inferences and many philosophers tried to offer justification for induction.

It is worth noting that, although Hume is generally considered as an inductive sceptic, he seldom uses the term 'induction,' which is almost completely absent in his writings. J. R. Milton (1987, p. 50) claims that it appears only once in the *Treatise,* and once in the *Enquiry concerning the Principles of Morals.* Be that as it may, it is quite convenient to refer to Hume's method of inference as 'inductive inference,' or simply as 'induction.'

1.1.2 Deduction, Induction, and Related Concepts.

Traditionally, logical arguments have been divided into two broad types, namely, deduction and induction (Gordon, 2006, para. 1), whose distinction is discussed below.

Deduction versus induction. Deduction is an inference in which the conclusion follows *necessarily* from the premises. In a valid deductive inference, if the premises are true

then the conclusion must be true. The necessity is implied in the premises; it is a contradiction to accept the premises while denying the conclusion. Induction, on the other hand, is an inference in which the conclusion goes beyond what is given in the premises, so necessity is lacking in the case of induction (Rhoda, 2003, pp. 10-11).

There is a misconception that deduction is the method of drawing inferences from universals to particulars, and that induction is the method of drawing inferences from particulars to universals. A. J. Ayer (1956, p. 72) points out, correctly in my view, that inductive inferences may proceed directly by analogy from one particular instance to another. C. G. Hempel (2001, p. 30) has a similar idea. He says that, 'Induction does not always proceed from the particular to the general or from statements about the past or present to statements about the future.' An example of particular-to-particular inference is in the form of 'All observed A's are B's, therefore, the next A will be B.' By the same token, deduction may proceed from particulars to particulars, such as 'A is A.'

Deductive and inductive processes. The difference between deduction and induction may be better understood in terms of their processes. We start the process of deduction with some statements, called 'premises,' which are taken to be true; then we consider what can be concluded from them. For example, we may begin by assuming that all men are mortal and work from there. In mathematics we may begin with some axioms and then see what follows from them. Thus deduction can provide absolute certainty to our conclusions, assuming that the premises are true (Gordon, 2006, para. 2).

We may start the process of induction with some data; then we think of general conclusions or theories that can be inferred from those data (Gordon, 2006, para. 3). Here is an example: It has been observed that there is a greater probability of becoming diabetic if at least one parent is diabetic; from this information, we conclude that diabetes may be hereditary. This is a reasonable hypothesis under the available information. But the inductive process does not prove that our theory is correct because there may be other conflicting theories that are

also supported by the same information, such as, the behavior of the diabetic parent may cause the child to be diabetic. The important point of induction is that the theory gives a probable explanation of available information.

Therefore, inductive inferences cannot be proved deductively. In other words, even if the premises are true, the conclusion may be false because the unobserved may not follow the observed. Even so, we can reasonably believe that the premises can make the conclusions likely, despite their lack of certainty. In fact, there are several ways of drawing conclusions from data without the guarantee of truth. Often, they are generally called inductive inferences (Maher, 1998, introduction).

It is quite obvious that induction is more problematic than deduction. Because of this, induction is also more difficult to define. But we cannot continue without some kind of definition of induction, since it is the subject matter of this writing. So, let us start with a simple and concise definition which conforms to our discussion so far:

> Induction is the inferential process by which observation, suitably controlled, is regarded as conferring an affidavit of reliability on what extends beyond it. In other words, it has to do with the process of reasoning that leads people to conclude that observational data obtained in suitably rigorous ways confirm some general hypothesis. (Howson, 2000, p. 6)

Induction is the primary method of inference in natural science. It is used whenever we believe that some evidence supports a hypothesis, to a certain extent. Induction is 'ampliative,' because we amplify a small number of observed objects or events to cover the whole class (Norton, 2003, p. 2). For example, we note that some metals expand when heated and infer that all do.

Abduction. A concept closely related to deduction and induction is that of abduction. C. S. Peirce (1839-1914) coined the term 'abduction' as a distinct method of inference.

Abduction is also known as 'inference to the best explanation' (Howson, 2000, pp. 112-113). An abductive argument goes something like this: 'All balls in this urn are red; all balls in this particular random sample are red; therefore, all balls in this particular random sample are taken from this urn.' This form of probable argument is entirely different from both deduction and induction. It depends on conjectures or 'educated' guesses. This type of argument Peirce also called retroduction, or hypothesis (Burch, 2006, sect. 3, para. 3).

The main idea of abduction is that the best explanation of our evidence is our guide to inference (Lipton, 1993, p. 22). This view is quite reasonable, since explanations do quite often give us a reason to believe that an event has occurred. However, being able to give reasons for one's beliefs is neither a necessary nor sufficient condition for explanation (Lipton, 1993, pp. 26-27). And of course, it is possible that there are many explanations for any event (Howson, 2000, p. 114). This leads to the question of justifying the method of selecting the best explanations.

The distinction between abduction, induction, and deduction may be drawn from the role they play in the process of inquiry. Roughly speaking, abductive inference is explanatory; it reasons from effect to a hypothetical cause. Inductive inference is evaluative; it assesses the truth or falsity of a hypothesis by examining its consequences. And deductive inference is explicative; it reasons from a hypothesis to its consequences (Rhoda, 2003, p. 4).

Abduction, or inference to the best explanation, is claimed to give us an alternative to inductive reasoning. However, it is applicable only under certain circumstances when available information is inadequate for induction; and even then the standard of reasoning for abduction is lower than that for induction (Fumerton, 1980, pp. 589-590). Therefore, henceforth in this writing, abduction will be treated as an offshoot of, and subsumed under, induction, until there arises a need to draw the distinction between them.

Counter-induction. Another related concept is called 'counter-induction.' According to the principle of counter-induction, it's time for a change (Lipton, 1993, p. 11). When

counter-inductivists observe that a number of A's are all B's, they conclude that the next A will *not* be a B. They argue that, in the past, people have counter-induced, resulting in false conclusions; so they conclude in a counter-inductive way that the next time they counter-induce they will get a true conclusion (Papineau, 1992, pp. 17-18). In short, counter-induction claims that it will work in the future because it has failed in the past (Lipton, 1993, p. 161). This concept is self-refuting and is ignored by most people. However, it may be applied to certain situations by some people. For example, when a gambler loses three bets in a row, he or she will usually think that it is time for a change, that is, it is time to win the next bet.

1.1.3 Significance of Study

The importance of induction is most prominent in science and in our everyday life. Russell (1912, p. 38) says that many scientific theories, for example the law of nature and the concept of cause and effect, depend on the inductive principle. People believe in them because they have found many positive instances and no negative instances about them. But it does not follow that the same will be true in the future, unless the inductive principle is presupposed. Without this presupposition, there is no basis for the transition from the past to the future.

So, if induction is not completely reliable because it does not yield complete certainty, does it mean that all scientific knowledge becomes useless or that there is no difference between inductive inferences and pure guesses? If there is no foundation on which the principle of induction can be based, does it mean that no new knowledge is possible apart from what is actually perceived? We can see that the problem of induction has an immense impact on our life. Hence, the need for an answer to the problem is understandable.

Although there is no consensus on the meaning of induction, we do know certain characteristics and benefits of induction as opposed to those of deduction. Inductive inferences are contingent, whereas deductive inferences are necessary. Deductive inference cannot lead us to make contingent judgements like weather forecasts, or the discovery of a new virus.

Inductive inference can do these things quite successfully because, as mentioned earlier, induction is *ampliative;* it can amplify and generalize our experience, broaden and deepen our empirical knowledge. Deduction, on the other hand, is *explicative*, that is, it rearranges our knowledge without acquiring new information. However, because induction is contingent, it has some risks of error. Even the most careful inductive inferences arrived at via all available information may yield the wrong result, and when the result is right, induction can only give a conclusion with a certain degree of probability (Vickers, 2006, sect. 1-2). Such are the limitations of induction.

The significance of studying induction. There are several reasons supporting the research on induction, for example:

1. Very few people will deny that induction is indispensable in everyday life. Everyday, people take actions based on inductive inferences. So research about induction should be useful to a lot of people. Furthermore, inductive reasoning is related to probabilistic reasoning, which is approximate and uncertain (Heit, n.d., p. 1). The concept of probability is an essential part of many fields of study.
2. Inductive inferences allow researchers to discover new phenomena (Heit, n.d., p. 1). Some people may not be aware that they are using induction, but upon reflection it is clear that discoveries concerning matters of fact are not possible without the help of induction.
3. Induction is related to other cognitive activities, such as categorization, similarity judgement, and decision making. Many accounts of induction are based on similarity as their main characteristic. This means that the study of induction is theoretically informative. It is possible to learn about reasoning and cognition by studying induction (Heit, n.d., pp. 1-2).
4. In scientific research we often rely on the inductive method for accepting theories since generalizations about matters of fact are based on incomplete information (Hempel, 2001, p. 344).

Due to the seriousness of the problem of induction, it is the intention of this research to try to go to the root of the problem and find its solutions, if possible. Therefore, the significance of this research is that its findings will tell us whether there is any justification for knowledge derived from inductive inferences. If not, what is its significance and what can be done to remedy the problem?

1.1.4 Implications and Consequences

The fact that induction seems to have no foundation gives rise to an important implication: It appears to undermine science and commonsense (BonJour, 1998, p. 191). Modern logic cannot show that scientific theories are truly correct. Based on uncertainty and doubtful probability, why should we accept any of the results of modern science? (Dubs, 1935, p. 256). The only way out is to resort to scepticism, or so it seems.

The paradox of induction. Despite the seeming unjustifiability of induction, we still prefer to be guided by scientific research rather than by pure guesses or superstition; that is, we still think that induction does make a difference (Howson, 2000, p. 109). This is the paradox of induction waiting to be solved. There must be something mysterious about induction that escapes our careful scrutiny.

Surely, we have good reason to believe that the sun will rise tomorrow, even though it is possible that it won't; and surely, we have good reason to believe certain scientific claims (Dubs, 1935, p. 256); yet we are incapable of showing that our belief is justified. The implications of the problem of induction and its consequences are well expressed by Colin Howson in the following passage:

> The initial problem of how to justify induction—'the problem of induction'—difficult enough in itself as it began to turn out, became modulated into the far more serious *Hume's Problem,* the problem of reconciling the continuing failure to rebut Hume's argument with the undoubted fact that induction not only seemed to work but to work

> surpassingly well. The Cambridge philosopher C. D. Broad's famous aphorism that induction is 'the glory of science and the scandal of philosophy' (1952, p. 143) was both a tribute to Hume and a token of the exasperation that Broad felt at the stubborn resistance of Hume's argument to refutation. (Howson, 2000, p. 10)

Is there a way to reconcile the problem of induction with the success of science so that the problem ceases to be a scandal while retaining its glory? A positive answer to this question will definitely be invaluable, not merely desirable.

1.2 The Problem of Induction

In this section, I shall first discuss the history of induction. Then, I shall discuss what the problem of induction really is. Finally, I shall explain the main issues of the problem.

1.2.1 History of Induction

Contrary to popular belief, Hume was not the first philosopher to be sceptical of inductive inference. In fact, claims Ruth Weintraub (1995, p. 460), that honor goes to Sextus Empiricus (2nd and 3rd centuries A.D.), the ancient Greek sceptic, who rejected the method of induction. It is very likely that there had been inductive sceptics before Sextus, but they were not so explicit in their opinions.

A good starting point for the study of the history of induction is with Aristotle. J. R. Milton (1987, p. 51) claims that Aristotle was the first philosopher to use a specific technical term 'epagoge' for induction, and to give an account of inductive reasoning. Aristotle's theory of science used both deduction and induction, but he did not pay much attention to induction and was often obscure about it.

Aristotle's inductive inferences are of two types, namely, rhetorical and philosophical. Rhetorical induction is broadly concerned with common-sense arguments; their purpose is to

lay common grounds for human life and conduct. Philosophical inductions are more abstract arguments for establishing theoretical points in philosophy (Milton, 1987, p. 53).

After Aristotle, there were both proponents and opponents of induction. The Epicureans were some of the strongest proponents of induction. They based their concept of induction on inferences from similarity and thus advocated analogical inferences. The Stoics, on the other hand, were opponents of induction. For the Stoics, the uncertainty of inductive inferences was a good reason for refusing induction because fallible inferences do not lead to knowledge. The Stoics' conception of knowledge was that it could not be weakened by further evidence or arguments, unlike beliefs or opinions, which were uncertain and therefore inferior to knowledge. One Stoic objection was that we could not observe all the instances, and this made it possible that we might have overlooked negative instances which would disprove our inductive inferences (Milton, 1987, pp. 54-55).

Let us turn to Sextus again. What he claimed was similar to a modern difficulty that the conclusion of an inductive argument might be false even while the premises were true. Therefore, induction was not reliable (Weintraub, 1995, p. 461). However, it should not be understood in such a way that Sextus considered inductive inferences to be epistemically worthless. What Sextus rejected were inductive inferences from observables to unobservables, such as Epicurean atoms or Aristotelian elements (Milton, 1987, pp. 55-56).

During the Middle Ages, philosophers were more interested in deduction than induction. This is not surprising since Aristotle's influence was so great at the time. Most of the logic textbooks contained discussion of induction, but it was usually brief. J. R. Milton's study (1987, p. 57) has found that Ockham's treatment of induction, for example, was rather unilluminating; and that Duns Scotus also raised the question of induction although his discussion was not convincing. However, the latter had a lot of influence on many philosophers after him.

Francis Bacon was the most prominent proponent of induction in the seventeenth

century. His great work, *Novum Organum,* was a watershed for natural philosophy that transformed into what we now call 'natural science' (Milton, 1987, p. 57). It has been claimed that Bacon was the first philosopher to promote induction as the chief method of inference in the natural sciences.

Apart from Bacon, none of Hume's British predecessors paid much attention to induction. Milton's study (1987, pp. 60-61) also showed that Hobbes did not say much about the experimental philosophy, but Locke had slightly more to say. Although Locke was not against the use of non-demonstrative arguments, he held that they did not lead to true knowledge. Locke, like many other philosophers of his time, distinguished between knowledge and belief or opinion, and he insisted that all true knowledge must be certain. Locke's theory of knowledge was to have great influence on one of his successors, namely, David Hume.

Although Hume was not the first philosopher to cast doubt on the legitimacy of induction, his argument against induction did sensationalize the problem of induction, so much so that Hume's problem has become synonymous with the problem of induction. However, it is not easy to say what the problem really is.

1.2.2 What Really is the Problem of Induction?

According to P. Lipton (1993, pp. 6-8), there are two central questions in the problem of induction, namely, description and justification. Both the question of description and the question of justification are caused by under-determination, or the insufficiency of available information to yield definite answers. In this sense, all inductive inferences are, by definition, under-determined by the evidence or the rules, or both.

The problem of describing induction. It may seem strange to find how difficult it is to describe induction accurately. Although there are many accounts of induction, they seem to be incompatible with each other. One reason for the difficulty is that there is a big difference

between what we do and how we describe it. For example, we may know how to think, but we may not be able to give a systematic description of it. The situation is similar to inductive inference in general. We are not aware of the exact principles of induction that we apply to our thoughts and actions (Lipton, 1993, pp. 14-15).

Despite the difficulty, there are several good descriptions of induction. Here are some of the more popular accounts, together with their difficulties:

1. Some people may describe the pattern of inductive inference as 'more of the same.' However, this description does not truly reflect our actual practice. Sometimes, we may infer that things will remain the same; but quite often, we expect that things will change. Furthermore, we may need to draw inferences from the observed to the unobserved or to unobservable entities (Lipton, 1993, p. 16), in which case their sameness cannot be determined.
2. The hypothetico-deductive model. This is a very popular model. The basic idea is that a hypothesis is confirmed by its positive instances. One of its strengths is that it can deal with both observable and unobservable entities. Another strength is that it employs both deduction and induction to support hypotheses. However, an objection is that some hypotheses are not supported by their positive instances. Yet another objection is that some data may support a hypothesis which does not entail them (Lipton, 1993, pp. 18-19).
3. Causal inference. This is a more pragmatic model of describing induction. In everyday life, we often draw inferences from effects to their probable causes. Likewise in science, many scientific inferences are drawn from data to theoretical explanation. However, we still lack a satisfactory theory of causation (Lipton, 1993, pp. 20-33).

The above examples indicate that the question of describing induction remains to be solved and the prospects of an uncontroversial solution are not very good.

The problem of justifying induction. The justification of induction is a normative project since it is an attempt to show why it is rational to use the inductive principles in

practice. Apparently, this is a different and much more ambitious project than the descriptive one (Okasha, 2005, p. 257). Because of this, when philosophers speak about the problem of induction, they usually take it to mean the problem of justifying inductive practices.

This means that the question of justification is the core problem of induction. It aims to give a satisfactory solution to the question of whether there is a good reason to accept an inductive conclusion as true or probably true, given its inductive premises and evidence (BonJour, 1998, p. 200). But inductive inference is concerned with likelihood, not proof. Perfect reliability for induction is unattainable because even a good inductive argument cannot guarantee that its conclusion is absolutely true (Lipton, 1993, pp. 6-8). So there is a conflict between the nature of induction and its justification.

The problem of justification has two major components, namely, under-determination and circularity. Under-determination arises out of the inadequacy of information in the premises, together with the inductive rules, since those premises and rules are compatible with many conflicting inferences. On the other hand, circularity is unavoidable because there is no way to support the very principles at issue without begging the question (Lipton, 1993, p. 9). In short, the main issues in the problem of justifying induction are inductive rules caused by under-determination, and the principle of induction that leads to circularity. We turn now to the discussion of these two issues.

1.2.3 Main Issues in the Justification of Induction

Although there are many issues concerning the justification of induction, two of them are important to its success. They are discussed below.

Deductive and inductive rules. One way of analyzing the problem of justification is via the comparison between rules of induction and rules of deduction. A major difference is that valid deductive rules are necessarily truth-preserving while inductive rules are not so (Harman & Kulkarni, 2005, p. 1). This is in accordance with the nature of deduction and

induction discussed earlier. But there is a major role for these rules to play in the inferential process.

The role of any inference rule is to allow the rational transition from premises to their conclusion. For example, a rule may be in the form of 'if this premise is true, then this conclusion *must be* true' in the case of deduction; and 'if this premise is true, then this conclusion *is probably* true' in the case of induction. The distinction between 'must be' and 'is probably' is crucial here because of the different properties and nature of the two forms of inference. Since deductive rules do not allow any addition of new information to the conclusion, their justification is quite simple: We just analyze the premises to get a logical conclusion (Rhoda, 2003, pp. 38-39).

On the other hand, inductive rules allow conclusions to go beyond their premises. Because of this, we can always think of more than one case in which the inductive rules apply. This makes the justification of inductive rules problematic because we cannot find the necessary connection no matter how we analyze the premises and their conclusions; there is no such necessary connection (Rhoda, 2003, p. 39).

Apart from the lack of necessary connection, inductive rules are multifarious. W. C. Salmon (1967, pp. 50-51) gives three examples of inductive rules that are incompatible with each other: 1) Enumerative rule; 2) A priori rule; and 3) Counter-inductive rule. Given m/n of observed A's are B's, the first rule says that we should infer the long-run relative frequency of B's among A's to be m/n, meaning that positive instances confirm the hypothesis that all A's are B's. With the same evidence, the second rule says that the long-run relative frequency of B's among A's is 1/k, where k is the a priori number of possible outcomes, irrespective of observed positive instances. The third rule says that we should infer the long-run relative frequency of B's among A's to be (n-m)/n, because positive instances disconfirm our hypothesis. Therefore, to be able to select the 'correct' conclusion, we must first select the 'correct' rule. If Rule 1 is correct, the evidence supports the conclusion. If Rule 2 is correct,

the conclusion is entirely independent of the observational evidence. If Rule 3 is correct, the conclusion is opposite to evidence. The problem then is how to provide adequate grounds for the selection of inductive rules.

Apparently, there is no single rule, or single set of rules, applicable to all inductive inferences. This is one of the reasons why the justification of induction is problematic.

The principle of induction. How to formulate the principle of induction is a multi-faceted problem. It is related to several other problems, such as the problem of projectibility and the problem of approximation (Pollock, 1986, pp. 17-18). It is also related to the problem of under-determination, as mentioned earlier.

What the principle of induction says is simply that the future will resemble the past or that unobserved cases will resemble observed cases. In other words, it says that nature is uniform. This implies that, for every inductive argument, the principle of induction serves as a suppressed premise (BonJour, 1998, p. 190). But this suppressed premise is itself unjustified because:

> The assumption [that nature is uniform] is not demonstrable; the denial that nature is uniform is not self-contradictory. Neither is there any means of showing, without logical circularity, that the assumption is even probable. For the only way of showing that it was probable would be to produce evidence which confirmed it, and it is only if there are fair samples in nature that any evidence can be confirmatory.... But whether there are fair samples in nature is just the point at issue. The same considerations apply if we seek to justify some more specific hypothesis, or would-be law of nature. Unless it is treated as a definition, in which case the problem is merely transferred to that of making sure that the definition is ever satisfied, such a proposition will not be demonstrable; the denial of it will not be self-contradictory. And once again the arguments which are meant to show that it is probable will themselves invoke the assumption that inductive reasoning is to be relied on. (Ayer, 1956, pp. 71-72)

The above passage emphasizes the fact that the uniformity of nature cannot be logically established. Most people have the instinctive feeling that past success gives them good reason for believing that it will continue in the future. This argument is itself inductive, so it cannot provide a reason for trusting induction (Lipton, 1993, p. 161). This is another major obstacle to the justification of induction.

A related concept has been proposed by J. R. Milton (1987, pp. 69-72). He claims that there may be some similarity between the principle of induction and the problem of universals. If there is a way to prove that universal entities exist, then universal propositions are true if they conform to their respective universal entities. He gives an example of Plato's theory of Ideas. Propositions about lines and circles are true because they conform to Ideas, without any need to refer to actual lines and circles. However, Milton is also aware of an opposite nominalist position, which claims that a universal proposition, by definition, involves an unlimited number of particulars, so it could be true only if all the particulars were true. This would lead to an infinite regress since it is impossible to enumerate all the particular instances. Apparently, the appeal to universals does not seem to help in the project of justification anymore than other methods.

There is yet another way of formulating the problem of justification. On this view, induction is divided into two separate stages, namely, empirical and rational. Empirical induction states only the occurrence of events by describing the uniform sequence of events that is observable. Then, rational induction attempts to establish some kind of connection that explains observed events by means of a hypothesis that entails the sequence of events (Dubs, 1935, p. 259). However, it is not difficult to see that this alternative formulation does not help much either, for it merely describes the inductive process but does not justify it.

So much for the discussion of the problem of induction in general. The problem will be taken up again in chapter 3 in the context of the particular view of David Hume.

1.3 Research Methodology

In this section, I shall give the thesis of this writing, together with the research methods and other information related to the research.

1.3.1 Thesis Statements and Objectives of Study

The theses of the research can be stated as follows:

1. Hume's argument that there is no philosophical foundation for the principle of induction is irrefutable. In other words, there is no logical justification for the principle of induction.
2. Hence, all claims of solution to Hume's argument, so far proposed, are merely 'alleged' solutions, each of which can be refuted one way or another.
3. However, it does not follow that induction is useless and should be discarded.

The objectives of this research are as follows:

- To discuss Hume's epistemology leading to his sceptical view on induction.
- To critically analyze Hume's view and argument.
- To critically analyze responses to Hume's argument.
- To identify ways to circumvent Hume's argument.

1.3.2 Research Methods

The research will be based mainly on qualitative techniques, with an extensive use of books from the AU library and other places. As a critical research, it requires both primary and secondary sources. Relevant theses and dissertations, when available, will be reviewed. Philosophical journals will be consulted for current issues related to the topic. Supporting evidence may be gathered from reliable web sites. The investigation will include description, analysis, evaluation, criticism, and contribution.

1.3.3 Literature Review

A review of related literature has been done and can be divided into three groups:

1. Theses and dissertations. A few are related to the proposed topic, such as:

- *Hume, Induction, and Probability.* 1996. A PhD dissertation written by Peter J.R. Millican, University of Leeds, England. The first part analyzes Hume's argument and the second part is a response from the mathematical point of view (probability).
- *Scepticism and Practical Reasoning in Hume's Ethical Theory.* 2000. A master's-degree thesis written by Paul B. Boaheng, Simon Fraser University, Canada. It is partly concerned with Hume's theory of knowledge.

2. Books. Several books are available from the AU library. For example:

- *Hume's Problem: Induction and the Justification of Belief.* 2000. A book written by Colin Howson, published by Clarendon Press, Oxford. Howson responds to Hume's view in mostly statistical terms.
- *Hume's Reason.* 1999. A book written by David Owen, published by Oxford University Press. It deals mainly with how Hume argues for his claims in his works.
- *Inductive Inference and its Natural Ground.* 1995. Written by Hilary Kornblith, this booklet is an essay in Naturalistic Epistemology in general.

3. *Other literature.* For example:

- *Routledge Encyclopedia of Philosophy.* 1998. Version 1.0 [CDROM], London. There is an article called 'Induction, epistemic issues in,' written by Mark Kaplan. It contains several interesting responses to Hume's view.
- *Secular Responses to the Problem of Induction.* 2000. This is an article written by Prof. James N. Anderson, posted on his own web site. It also contains several interesting responses to Hume's view.
- *The Stanford Encyclopedia of Philosophy.* 2001. There is an article called 'David Hume'

written by William Edward Morris. It contains general information on Hume's life and works.

The review of literature shows that most of the systematic responses to Hume's argument are from the mathematical point of view such as statistical probability while non-mathematical responses are not systematic, that is, loosely organized, incomplete and informally presented. There are also many other responses posted on several web sites.

1.3.4 Scope and Limitations

The scope of this research is set to be within the following boundaries:

- The research will emphasize the concept of induction as proposed and explicated by Hume in his *Enquiry Concerning Human Understanding.* However, Hume's *A Treatise of Human Nature* will be consulted when more details are needed.
- Only secular and philosophical responses to Hume's view will be included. Religious responses will not be discussed. Mathematical responses will not be emphasized.

Some of the limitations of this research are as follows:

- Only the more popular responses to Hume's view will be discussed since it is nearly impossible to include all of them.
- Accessibility to books and journals is confined to the AU library and inter-library loan, if available. However, additional books may be imported if necessary.

1.3.5 Definition of Terms

Some of the frequently used terms are briefly defined here to prepare readers to get familiarized with them.

⇨ *Induction:* The process of drawing inferences from the observed or the past to the unobserved or the future respectively. This term is not used by Hume. Instead, he uses such expressions as 'the future will resemble the past' or 'the future will be conformable

to the past.'

- ⇨ *Impression:* Direct perception, that is, what is perceived through the senses.
- ⇨ *Idea:* Indirect perception, that is, what is recalled from memory.
- ⇨ *Association of ideas:* Ideas can be related in three ways, namely, 1) resemblance; 2) contiguity in time and place; and 3) cause and effect.
- ⇨ *Intuition:* The process of gaining *immediate* a priori knowledge; for example, a triangle has three sides.
- ⇨ *Demonstration:* The process of gaining *inferential* a priori knowledge; for example, the square of the hypotenuse is equal to the sum of the squares of the two sides.
- ⇨ *Relation of Ideas:* Knowledge derived from either intuition or demonstration. This is a priori knowledge.
- ⇨ *Matter of fact:* Knowledge derived from experience. This is a posteriori knowledge.
- ⇨ *Demonstrative reasoning:* Reasoning concerning relations of ideas.
- ⇨ *Moral or probable reasoning:* Reasoning concerning matters of fact.

1.3.6 Special References

A few references are abbreviated for convenience and brevity as follows:

- Essay X: x.n. This abbreviation refers to John Locke's *An Essay concerning Human Understanding.* For example, 'Essay I: ii.3' refers to book I, chapter ii, and paragraph 3 of Locke's *Essay.*
- Treatise X: x.x. This abbreviation refers to David Hume's *A Treatise of Human Nature.* For example, 'Treatise I: ii.iii' refers to book I, part ii, and section iii of Hume's *Treatise.*

Chapter 2

Hume's Epistemology

Understanding Hume's epistemology is crucial to our analysis of Hume's view on induction, but Hume is also highly influenced by some of his predecessors. So, in this chapter, I shall first discuss a prelude to Hume, followed by Hume's own theories, and finally I shall discuss several salient points in Hume's epistemology.

2.1 A Prelude to Hume's Epistemology

In traditional epistemology, there are two popular schools of thought on how knowledge is acquired, namely, rationalism and empiricism. Rationalists believe that reason is sufficient to discover truth. Plato (427-347 B.C.) is believed to be the first rationalist to put forth a comprehensive theory of knowledge. He draws the distinction between sense perception and reason. Sense perception is unreliable because the objects of perception themselves are impermanent. Therefore, knowledge must go beyond the sense perception to universal ideas or forms (Pojman, 2001, p. 16).

Empiricists, on the other hand, hold that reason alone is insufficient for discovering knowledge of the world. They reject the rationalists' a priori foundations for constructing a theory of the world (Miller, 2007, p. 31). For empiricists, all knowledge comes from sense experience. John Locke, for example, argues that claims to knowledge make sense only when they are derived from the world of experience. Our ideas, in turn, are derived from sensory impressions. Other than this, no reliable knowledge is to be gained (Pojman, 2001, p. 20).

When we look at influences on Hume's thought we should not ignore Descartes (1596-

1650). Descartes is commonly referred to in the history of philosophy as the first great Continental rationalist, and Hume is commonly referred to as the last great British empiricist (Noonan, 1999, p. 27). However, Locke's influence on Hume is more direct as Hume got several concepts from Locke and refined them considerably. It would be a great help to our understanding of Hume's epistemology if we understood both Descartes' and Locke's theories of knowledge.

2.1.1 Descartes' Quest for Certainty

Certainty is a very important concept in the history of philosophy. Many philosophers prior to the modern period held that, without certainty, knowledge was either impossible or unreliable. Furthermore, without certainty, nothing could be even probable. However, it is not clear exactly what the quest for certainty was all about. The term 'certainty' was often used as a synonym for 'necessity' or for 'a priori knowledge' (Ayer, 1956, p. 41).

The modern quest for certainty is usually associated with the philosophy of Descartes, who attempts to give knowledge a solid foundation, which would make such knowledge free from any doubts (Ayer, 1956, p. 44). This conception of knowledge is quite revolutionary and it marks the beginning of what is considered as modern philosophy. Descartes differs from his predecessors in that he asks not only what the world is like, but also how we can know what it is like (Noonan, 1999, p. 27).

It should be noted that Descartes is only a methodological sceptic, that is, he uses scepticism to arrive at indubitable knowledge of metaphysics (Pojman, 2001, p. 43). In this sense, Descartes is not a real sceptic; scepticism is merely a means to, or an instrument for, confirming what is certain and what is not.

In his famous work, *Meditations*, Descartes begins by saying that sensory perception is not reliable since we are often deceived by it and we do not know how to tell the difference between illusions and real perceptions. L. P. Pojman's study (1993, p. 27) shows that

Descartes' argument involves a multi-step process: To have knowledge, we must be able to differentiate between a hallucination (deception) and a perception; but it is not possible to do so because we might be misled by a powerful but malicious demon; therefore, we cannot trust any perception.

Descartes' method of universal doubt allows him to reject what he has already known and to start from scratch, so to speak. He explains it in this way:

> I was convinced that I must once for all seriously undertake to rid myself of all the opinions which I had formerly accepted, and commence to build anew from the foundation, if I wanted to establish any firm and permanent structure in the sciences. (Descartes, 1993, p. 28)

Then, Descartes tries to build the solid foundations for knowledge. These foundations accept only what is indubitable, what cannot be doubted at all (Pojman, 1993, p. 193), that is, what is true in all possible worlds.

The next question for Descartes is whether there is anything that is not susceptible to the demon's power. He thinks that there is one such thing, which is his famous 'cogito ergo sum' or 'I think, therefore I am' (Ayer, 1956, p. 45). His reasoning is that, even if a demon is deceiving him about everything else, it cannot deceive him about his own existence. This is how he puts it:

> Let him [the demon] deceive me as much as he will, he can never cause me to be nothing so long as I think that I am something. So that after having reflected well and carefully examined all things, we must come to the definite conclusion that this proposition: I am, I exist, is necessarily true each time that I pronounce it, or that I mentally conceive it. (Descartes, 1993, p. 194)

Descartes, then, discovers that he is essentially mind and concludes that he can have infallible knowledge about psychological states. He uses this method of understanding innate

ideas to prove the existence of God:

> It only remains to me to examine into the manner in which I have acquired this idea from God; for I have not received it through the senses, and it is never presented to me unexpectedly, as is usual with the ideas of sensible things when these things present themselves, or seem to present themselves, to the external organs of my senses; nor is it likewise a fiction of my mind, for it is not in my power to take from or to add anything to it; and consequently the only alternative is that it is innate in me, just as the idea of myself is innate in me. (Descartes, 1993, p. 205)

Having established the existence of God, Descartes claims that God, as perfect being, would not deceive us and would not allow us to be deceived about our normal empirical judgements. Descartes thinks that we have a priori knowledge of certain metaphysical truths, for example, that there must be as much reality in the total cause as in the effect, as he says:

> It is manifest by the natural light that there must at least be as much reality in the efficient and total cause as in its effect. For, pray, whence can the effect derive its reality, if not from its cause? And in what way can this cause communicate this reality to it, unless it possessed it in itself? And from this it follows, not only that something cannot proceed from nothing, but likewise that what is more perfect—that is to say, which has more reality within itself—cannot proceed from the less perfect. (Descartes, 1993, p. 200)

In sum, Descartes proved his own existence by claiming that he was doubting and therefore thinking and thinking implied a thinker. This only piece of certain knowledge was his criterion of certainty. What is certain is what is known by intuition, what is clear, distinct, and indubitable, with no fear of error. Basic knowledge must be infallible and indubitable or it must be derived from other basic knowledge through deductive proof (Sosa, 1980, p. 146).

Therefore, self-knowledge is self-authenticating. It is clear and distinct, self-evident. From this, Descartes infers that the existence of God is such a clear and distinct idea, or is deduced from ideas that are clear and distinct (Pojman, 2001, pp. 41-42). Descartes' reasoning is quite straightforward: 'God exists; no omnipotent perfectly good being would descend to deceit; but if our common-sense beliefs were radically false, that would represent deceit on His part. Therefore, our common-sense beliefs must be true or at least cannot be radically false' (Sosa, 1980, p. 146).

Criticism. Many philosophers disagree with Descartes' theory of knowledge. A major reason is that it permits too much into what is innate and what is clear and distinct (Sosa, 1980, p. 146). The problems with Descartes' theory may be summarized into four points:

1. Arguments for the existence of God;
2. The notion that, 'There is as much reality in the total cause as in the effect';
3. The notion of clear and distinct ideas; and
4. The notion of infallibility or incorrigibility. (Pojman, 1993, p. 189)

According to Pojman (1993, p. 189), Descartes fails to establish 1, 2, and 3 while point 4 is a matter of debate because it can be either way.

It is not difficult to point out that Descartes is reasoning in a circle. From the claim that what is clear and distinct is true, he infers the existence of God, but this claim is actually based on the notion that God is not a deceiver. Likewise, Descartes' justification of our knowledge of the external world rests ultimately on God's existence and perfection. Unless one accepts that Descartes has established the existence of a perfect God, his argument for the reality of the external world does not hold (Pojman, 2001, pp. 41-42).

Apparently, Descartes' certainty does not come to very much. His argument does not prove that he, or anyone, knows anything (Ayer, 1956, p. 46). In order to support his reasoning towards certainty, Descartes makes use of various notions that are less than certain (Sosa, 1980, p. 146). He started with a universal doubt but ended by jumping to conclusions. This

shows that rationalists are not always rational.

2.1.2 Descartes' Conception of Knowledge

Because of his preference for certainty, Descartes naturally takes 'knowledge' to mean that which can be obtained with certainty. He accepts only two ways to attain such knowledge: intuition and deduction. By intuition, he means the indubitable conception of a clear and attentive mind that works through reason. It is simpler and therefore more certain than deduction. By deduction, Descartes means the inference of something that follows necessarily from some other certain knowledge. It is different from our modern account of deduction in that it relies on intuition. In other words, the certainty of deduction depends on the certainty of intuition, not on the form of inference that leads to valid arguments (Owen, 1999, pp. 17-18).

Descartes holds that, in intuition, the truth of a proposition is known all at once in just one simple operation; we just become aware of it. But deduction involves a series of inference from one intuition to another. Because of this chain of inference, deduction has a lower degree of certainty (Owen, 1999, pp. 20-22). Descartes uses reasoning to discover new truths. This is why he does not think highly of syllogisms, which were only good for presenting truths already known (Owen, 1999, p. 7).

So much for Descartes' quest for certainty and his theory of knowledge. If human knowledge is limited to a priori reasoning alone, the prospects of discovering new truths look very bleak indeed. Next, we shall see whether empiricism can fare any better.

2.1.3 Locke's Theory of Ideas

One of Locke's famous works is his *Essay Concerning Human Understanding* (*Essay* for short). B. Stroud (1977, p. 17) says that it contains the most detailed formulation of the theory of ideas, while Pojman (1993, p. 69) is of the opinion that Locke's epistemological theory is the first systematic attack on Descartes' rationalistic way of acquiring knowledge.

Here, I shall discuss Locke's salient points concerning his theory of ideas.

Ideas. The concept of Idea is extremely important in Locke's epistemology. Locke holds that everything in the mind is either an idea or includes an idea, and all human knowledge originates from ideas. The term 'idea' is used more often in the *Essay* than any other noun (Chappell, 2006, p. 26).

Locke's conception of ideas is much less abstract than that of Descartes. For Locke, all ideas have their origin in experience, either from sensation or reflection. Ideas are abstract objects of the intellect (Owen, 1999, p. 8). Locke denies Descartes' notion that we have innate ideas; he devotes the whole of Book I of his *Essay* to rejecting innate ideas. The fact that this first Book is entitled *Neither Principles nor Ideas Are Innate* shows how important it is for Locke to refute innate ideas to clear the ground for empiricism.

According to Locke, the human mind is, at birth, a blank slate, just like white paper, without any ideas. In Locke's own words:

> All ideas come from sensation or reflection. Let us then suppose the mind to be, as we say, white paper, void of all characters, without any ideas:- How comes it to be furnished? Whence comes it by that vast store which the busy and boundless fancy of man has painted on it with an almost endless variety? Whence has it all the materials of reason and knowledge? To this I answer, in one word, from EXPERIENCE. In that all our knowledge is founded; and from that it ultimately derives itself. (Essay II: i.2)

Locke defines 'idea' as 'whatsoever the mind perceives in itself, or is the immediate object of perception, thought or understanding' (Essay II: viii.8). According to Locke, all mental activities occur with the passage of ideas before the mind and this passage of ideas is all that is required for any mental activity. This is the case every time we perceive through any of our five senses (Noonan, 1999, pp. 51-52). Therefore, having thoughts and having ideas are one and the same thing. Ideas are the materials of thinking (Stroud, 1977, pp. 17-18).

Locke distinguishes between simple and complex ideas. The distinction between these two types of ideas is explained in the following passages:

> The ideas they [qualities of things] produce in the mind enter by the senses simple and unmixed.... And there is nothing plainer to a man than the clear and distinct perception he has of those simple ideas; which, being each in itself uncompounded, contains in it nothing but one uniform appearance, or conception in the mind, and is not distinguishable into different ideas. (Essay II: ii.1)
>
> These simple ideas, the materials of all our knowledge, are suggested and furnished to the mind only by those two ways above mentioned, viz. sensation and reflection. When the understanding is once stored with these simple ideas, it has the power to repeat, compare, and unite them, even to an almost infinite variety, and so can make at pleasure new complex ideas. (Essay II: ii.2)

In the case of simple ideas, the mind is only a passive receiver of perception (sensation or reflection). But the mind has the ability to perform various operations on these simple ideas to arrive at more complex ideas. Thus, the mind can generate all the materials of thought from those which it receives through sensation and reflection (Noonan, 1999, p. 53).

It is worth mentioning that, for Locke, there is an external world that underlies the ideas derived from experience, although what this external world really is cannot be ascertained. The problem, then, is: Do the ideas in the mind accurately reflect the external world? The solution to this problem lies in Locke's distinction between two types of qualities of physical objects: primary and secondary (Pojman, 2001, pp. 67-69).

Locke defines 'quality' as 'the power [of an object] to produce any idea in our mind' (Essay II: viii.8). Primary qualities 'are utterly inseparable from the body' and even if an object is divided into small pieces, we can never take away its 'solidity, extension, figure, or mobility' (Essay II: viii.9). Secondary qualities are 'such qualities which in truth are nothing

in the objects themselves but power to produce various sensations in us by their primary qualities.' Examples of secondary qualities are colors, sounds, and tastes (Essay II: viii.10). Thus, primary qualities accurately represent the external world whereas secondary qualities do not (Pojman, 2001, pp. 68-69). Such is Locke's ingenious way of solving a difficult metaphysical problem.

Perception. For Locke, perception is 'the first step and degree towards knowledge' and 'the inlet of all the materials of all knowledge' (Essay II: ix.15). He explains it thus:

> PERCEPTION, as it is the first faculty of the mind exercised about our ideas; so it is the first and simplest idea we have from reflection, and is by some called thinking in general (Essay II: ix.1). Reflection alone can give us the idea of what perception is. What perception is, every one will know better by reflecting on what he does himself, when he sees, hears, feels, &c., or thinks, than by any discourse of mine. Whoever reflects on what passes in his own mind cannot miss it. And if he does not reflect, all the words in the world cannot make him have any notion of it (Essay II: ix.2). Fire may burn our bodies with no other effect than it does a billet, unless the motion be continued to the brain, and there the sense of heat, or idea of pain, be produced in the mind; wherein consists actual perception (Essay II: ix.3).

It can be seen from the above passages that Locke has a causal theory of perception. Pojman (2001, pp. 67-68) has summarized Locke's Causal Theory of Perception this way:

- Objects and Events in the real world (Energy coming to sense organs) →
- Sense Organs (Signals to brain) →
- Brain Events (Transformation from physical to mental event) →
- Perceptual Experience (Mechanical input yields the non-mechanical idea in the mind).

From a physical and mechanistic process, we arrive at a mental event—the perceptual experience, or sense impression. We do not perceive the thing in itself, but only the idea that

represents the object. We can say that we are indirectly aware of the object, since the object is the cause of the idea (Pojman, 2001, pp. 67-68).

Intuition and demonstration. Locke's explication of intuition and demonstration is quite simple and he seems to take it for granted that his readers are familiar with the two concepts. Here is how he explains them:

> Sometimes the mind perceives the agreement or disagreement of two ideas immediately by themselves, without the intervention of any other: and this I think we may call intuitive knowledge. For in this the mind is at no pains of proving or examining, but perceives the truth as the eye doth light, only by being directed towards it. Thus the mind perceives that white is not black, that a circle is not a triangle, that three are more than two and equal to one and two. Such kinds of truths the mind perceives at the first sight of the ideas together, by bare intuition; without the intervention of any other idea: and this kind of knowledge is the clearest and most certain that human frailty is capable of.... Certainty depends so wholly on this intuition, that, in the next degree of knowledge which I call demonstrative, this intuition is necessary in all the connexions of the intermediate ideas, without which we cannot attain knowledge and certainty. (Essay IV: ii.1)

Locke's account of intuition is expressed in terms of the perception of the agreement or disagreement of any of our ideas. Intuition is the clearest and most certain activity of the mind and is not characterizable in other terms. It is the immediate perception of the agreement or disagreement between two ideas without the intervention from other ideas (Owen, 1999, p. 40). Demonstration, on the other hand, is simply a chain of ideas. The important point that Locke emphasizes is that the intermediate ideas must be intuitively certain. If any intermediate idea in the chain is not certain, the reasoning is not demonstrative but merely probable (Owen, 1999, p. 36).

2.1.4 Locke's Conception of Knowledge

Knowledge. Locke defines knowledge as 'the perception of the agreement or disagreement of two ideas,' explaining that knowledge is 'nothing but the perception of the connexion of and agreement, or disagreement and repugnancy of any of our ideas,' and that, without this perception, 'we always come short of knowledge. For when we know that white is not black, what do we else but perceive, that these two ideas do not agree? (Essay IV: i.2).

There are, for Locke, four kinds of such agreement or disagreement:

- *Identity or diversity;* for example, 'blue is not yellow.'
- *Abstract relations between ideas;* for example, 'two triangles upon equal bases between two parallels are equal.'
- *Existence, or necessary connexion;* for example, 'iron is susceptible of magnetical impressions.'
- *Real existence;* for example, 'God exists.' (Essay IV: i.3-7).

According to Locke, there are different degrees of certainty in knowledge, resulting in three kinds of knowledge. They are:

- *Intuitive knowledge.* This kind of knowledge, as its name implies, comes directly from intuition. Thus, it has the highest degree of certainty.
- *Demonstrative knowledge.* This kind of knowledge comes from demonstration, which requires intervention from intermediate ideas to make a chain of reasoning, as mentioned earlier. Therefore, it has a lesser degree of certainty than intuitive knowledge.
- *Sensitive knowledge.* At first, Locke was not sure about this kind of knowledge. But in the end he accepts it, saying 'So that, I think, we may add to the two former sorts of knowledge this also, of the existence of particular external objects, by that perception and consciousness we have of the actual entrance of ideas from them' (Essay IV: ii.14), on the condition that, 'It is therefore the actual receiving of ideas from without that gives us

notice of the existence of other things, and makes us know, that something doth exist at that time without us, which causes that idea in us; though perhaps we neither know nor consider how it does it' (Essay IV: xi.2). Thus, sensitive knowledge has the least degree of certainty among the three kinds of knowledge (Owen, 1999, p. 47), but it is still considered by Locke as knowledge because it is the direct and immediate receiving of ideas from external sources (Owen, 1999, p. 33).

So, Locke has four ways in which ideas can agree or disagree (identity, relation, co-existence, and real existence) and three ways in which we can perceive such agreement (intuition, demonstration, and perception of external existence that results in sensitive knowledge) (Owen, 1999, p. 40).

Belief. For Locke, belief is not knowledge because it lacks the certainty that knowledge requires. He associates belief with probability, as he says:

> Probability is likeliness to be true, the very notation of the word signifying such a proposition, for which there be arguments or proofs to make it pass, or be received for true. The entertainment the mind gives this sort of propositions is called belief, assent, or opinion, which is the admitting or receiving any proposition for true, upon arguments or proofs that are found to persuade us to receive it as true, without certain knowledge that it is so. (Essay IV: xv.3)

Locke further differentiates between knowledge and belief in this way: 'To infer, is nothing but by virtue of one proposition laid down as true, to draw in another as true, i.e. to *see* or *suppose* such a connexion of the two ideas of the inferred proposition' (Essay IV: xvii.4, italics added). What this means is that, when the connection is 'seen,' it is a demonstrative inference and therefore knowledge, but when the connection is 'supposed,' it is a probable inference and therefore a belief (Owen, 1999, p. 33).

Despite its lack of certainty, belief is as important as, if not more important than,

knowledge. Belief is needed when knowledge is lacking since knowledge is very narrow in scope, and we are incapable of finding truth about many things. Under such circumstances, we must be content with belief or opinion, based on judgement (Owen, 1999, p. 47). However, there are degrees of belief as well, ranging from near certainty right down to unlikeliness, even to impossibility. Because our assent (judgement) is based on probability, our degrees of assent range from full assurance and confidence, down to conjecture, doubt, and distrust (Essay IV: xv.2).

In sum, Locke's account of probable reasoning (probability) is similar to his account of demonstrative reasoning. Both are based on relations of ideas, and involve a chain of intermediate ideas. As demonstrative reasoning extends intuition, so probable reasoning extends sensitive knowledge. But the main difference is that demonstrative reasoning gives rise to demonstrative knowledge, while probable reasoning results in belief or opinion (Owen, 1999, p. 34).

Leibniz's critique of Locke. Before ending this sub-section, I think it is worth mentioning that Leibniz gave an extensive point-by-point commentary on Locke's *Essay,* and he called it *New Essays Concerning Human Understanding* (*New Essays* for short). The commentary is in the form of a dialogue between Philalethes (lover of truth) representing Locke, and Theophilus (lover of God) representing Leibniz. Leibniz criticizes the very starting point of Locke's *Essay:* The refutation of innate ideas. Leibniz thinks that there are necessary truths in metaphysics, ethics, logic, and mathematics; they are true without having to refer to experience, and, therefore, can be known innately, or via innate principles (Thomson, 2001, p. 76).

According to Leibniz, the senses are necessary for all knowledge but they are inadequate because:

> The senses never give us anything but *instances*, i.e. particular or singular truths. But however many instances confirm a general truth, they aren't enough to establish its

> universal necessity; for it needn't be the case that what *has* happened always *will* - let alone that it *must* - happen in the same way. (Leibniz, 2005, p. 2)

Therefore, necessary truths must be based on principles that do not depend on instances (derived from the senses), even though the senses cause us to think of them in the first place. Leibniz draws the distinction between 'prompted by the senses' and 'proved by the senses.' The proof of necessary truths can only come from inner principles, which are always innate (Leibniz, 2005, p. 2).

As a rationalist, Leibniz naturally gives much importance to reason. In the case of regularity, he says, we should probe into its underlying reason. Reason alone can 'establish reliable rules, make up the deficiencies of rules that have proved unreliable, by allowing exceptions to them, and lastly construct *necessary* inferences, involving *unbreakable* links.' Reason allows us to foresee events without having to refer to experience (Leibniz, 2005, p. 3).

Leibniz argues that Locke's own position implicitly admits of innate ideas. There are at least two reasons for this argument:

- Firstly, Locke claims that our ideas come from experience in two ways: Sensation and reflection (Essay II: i.2). But Leibniz argues that reflection is itself innate: 'To *reflect* is simply to *attend to what is within us*, and **something that we carry with us already is not something that came from the senses!'** This means that there are many ideas that are innate in our minds. Leibniz's examples include the ideas of being, unity, substance, duration, change, action, perception, pleasure, and other intellectual ideas (Leibniz, 2005, p. 3).
- Secondly, Locke accepts innate capacities and dispositions (Thomson, 2001, p. 76), but these qualities, Leibniz claims, are very close to innate ideas. Leibniz uses the analogy of a veined block of marble (representing an innate idea) as opposed to an entirely homogeneous block (representing an empty page). If a block of marble is veined in such a way that it marks out the shape of Hercules rather than other shapes, it would be more

> inclined to take Hercules' shape, and Hercules would be *innate* in it. Ideas are innate in us as inclinations, dispositions, tendencies, or natural potentialities, not as actual thoughts which merely accompany those potentialities (Leibniz, 2005, p. 3).

Leibniz makes a comparison between himself and Locke: 'Our systems are very different. His is closer to Aristotle and mine to Plato.' Aristotle and Locke maintain that the soul (mind) is, at birth, a blank page, whereas Plato and Leibniz disagree (Leibniz, 2005, p. 1). For Leibniz, minds without ideas have no individuating characteristics, so the mind cannot be blank at birth; there must be innate ideas (Thomson, 2001, p. 77). Leibniz parodies Locke's blank-page claim thus: 'Nothing is in the intellect that wasn't first in the senses - *except the intellect itself*' (Leibniz, 2005, p. 33, italics added).

Unfortunately, Locke did not live long enough to have the opportunity to read the *New Essays* (Thomson, 2001, p. 75), so we do not know what his responses might have been. As with many philosophical issues, the debate between rationalism and empiricism has raged on to this day, with no end in sight.

Although there is much more to say about Descartes, Locke, and Leibniz, the brief discussion above should suffice for our purpose. It is now time to turn to the philosophy of Hume, who is the main character in this writing.

2.2 Hume's Theory of Knowledge

In order to understand Hume's view on the problem of induction, we should know certain points of his epistemology. But first, a few words about Hume and his works.

2.2.1 Hume's Life and Works

David Hume (1711-1776) is generally regarded as the most important philosopher ever to write in English. He is one of the great trios of 'British empiricists,' and is also a historian

and essayist. Hume's major philosophical works include (Morris, 2001, introduction):

- A Treatise of Human Nature (1739-1740)
- An Enquiry concerning Human Understanding (1748, commonly referred to as the first *Enquiry*)
- An Enquiry concerning the Principles of Morals (1751)
- Dialogues concerning Natural Religion (1779, published after his death)

Hume's works are involved with almost every aspect of human enquiries (Stroud, 1977, p. ix). All Hume's writings are still widely influential today, although they were denounced by many of his contemporaries as works of scepticism and atheism. Hume's influence is evident in the moral philosophy and economic writings of his close friend Adam Smith. Immanuel Kant admits that Hume has awakened him from his 'dogmatic slumbers.' Hume's influence shows that his works contain not only richness but also diversity. His philosophy is mainly concerned with empiricism and naturalism (Morris, 2001, introduction).

Treatise versus Enquiry. As far as critical issues are concerned, Hume's *Treatise* has a wider scope than his *Enquiries.* For example, the first *Enquiry* discusses the problem of causation only in particular causal judgements, that is, it merely asserts that this or that effect is due to this or that cause, whereas in the *Treatise,* the general theme is to postulate that events must always be causally determined and the question is how to justify such causation (Smith, 1915, pp. 288-289).

Hume's work was abusively attacked by some of his contemporaries, so much so that Hume had to distance himself from his *Treatise* by saying that it was his 'juvenile work' and insisting that only the *Enquiries* were to be regarded as expressing his true opinions. Be that as it may, many philosophers agree that to follow Hume's request would be to miss one of the greatest works (Noonan, 1999, p. 5).

2.2.2 An Outline of Hume's Theory of Knowledge

What follows is an outline of Hume's theory of knowledge. For the sake of brevity, it is based mainly on Hume's first *Enquiry.* However, more information will be drawn from Hume's *Treatise* when necessary.

According to Hume, all perceptions of the mind can be divided into two classes or species, on the basis of their different degrees of force and vivacity (Hume, 1975, p. 18). The two classes of perceptions are as follows:

1. *Impressions.* These are the more forcible and lively perceptions of the mind, when we hear, or see, or feel, or love, or hate, or desire, or will (Hume, 1975, p. 18). In short, these are direct perceptions.
2. *Ideas.* These are the less forcible and lively perceptions. We are conscious of them when we reflect on any of the impressions that we already have, or when we anticipate them by our imagination (Hume, 1975, pp. 17-18). In short, these are indirect perceptions.

Hume claims that there is considerable difference between the two classes of perceptions such that they can never be totally indistinguishable from one another; 'the most lively thought is still inferior to the dullest sensation' (1975, p. 17). What he means is that it is unlikely to mistake an impression for an idea, or vice versa.

Hume explains the concept of thought as follows. Human thought may seem, at first glance, to have no limits. For example, a person can easily and instantly think of anything within the universe, or even beyond it, and so, nothing is beyond the power of thought, except what implies an absolute contradiction. However, on closer examination, we will find that the creative power is rather limited; it is merely the faculty of compounding, transposing, augmenting, or diminishing the materials given to us by the senses and experience. For example, when a person thinks of a golden mountain, he only joins the two ideas with which he is familiar: the idea of gold and that of mountain. Furthermore, if we analyze our more complex thoughts or ideas, we will find that they can be broken down into simple ones, which

were copied from impressions already in the mind. In this sense, all ideas are copies of impressions, either direct or indirect (Hume, 1975, pp. 18-19).

Hume claims that his classification of perceptions into ideas and impressions is useful in helping to resolve disputes and metaphysical reasonings (Hume, 1975, pp. 21-22). Hume explains it so convincingly, thus:

> Here, therefore, is a proposition, which not only seems, in itself, simple and intelligible; but, if a proper use were made of it, might render every dispute equally intelligible, and banish all that jargon, which has so long taken possession of metaphysical reasonings, and drawn disgrace upon them.... When we entertain, therefore, any suspicion that a philosophical term is employed without any meaning or idea (as is but too frequent), we need but enquire, from what impression is that supposed idea derived? And if it be impossible to assign any, this will serve to confirm our suspicion. By bringing ideas into so clear a light we may reasonably hope to remove all disputes, which may arise, concerning their nature and reality. (Hume, 1975, pp. 21-22)

Hume also claims that there is a universal principle of connection, which does the work of connecting ideas together to become a succession of thought. This happens even in our dreams. The principle is called the *Association of Ideas,* and can be further divided into three distinct types of relation as follows (Hume, 1975, pp. 23-24):

1. *Resemblance.* For example, 'a picture naturally leads our thoughts to the original.'
2. *Contiguity in time and place.* For example, 'the mention of one apartment in a building naturally introduces an enquiry or discourse concerning the others.'
3. *Cause and effect.* For example, 'if we think of a wound, we can scarcely forbear reflecting on the pain which follows it' (Hume, 1975, p. 24).

Furthermore, Hume divides all the objects of human reason or enquiry into two kinds (Hume, 1975, p. 25), namely:

1. *Relations of ideas.* They consist of the sciences of Geometry, Algebra, and Arithmetic. Affirmation is derived either intuitively or demonstratively. For example, three times five is equal to the half of thirty, or a triangle has three sides. Propositions of this kind do not depend on the actual existence of objects.
2. *Matters of fact.* The contrary of every matter of fact is still possible and never implies a contradiction. Both can be conceived by the mind to conform to reality without any difficulty. For example, the statement 'The sun will not rise to-morrow' cannot be demonstrated to be false (Hume, 1975, pp. 25-26).

Hume goes on to divide reasonings, based on the objects of enquiry mentioned above, into two kinds (Hume, 1975, p. 35), namely:

1. *Demonstrative reasonings.* These are reasonings concerning relations of ideas. This kind of reasoning, as its name implies, can be demonstrated a priori to be true or false.
2. *Moral reasonings.* These are reasonings concerning matters of fact and existence. This kind of reasonings can never be proved false by any demonstrative argument or abstract reasoning a priori, and arguments from past experience to future judgements must be probable only (Hume, 1975, p. 35).

Please note that Hume uses the term 'probable' in the sense of being less than certain, not in any mathematical sense. Also, he uses the term 'moral' in the eighteenth-century sense in which 'moral evidence' means evidence that is merely probable and not demonstrative, and they need not have anything to do with morality or ethics or even with the 'moral sciences,' such as economics or politics (Millican, 2002, p. 118). We should note also the distinction between relations of ideas as objects of enquiry and our reasonings concerning relations of ideas. Likewise, there is a distinction between matters of fact as objects of enquiry and our reasonings concerning matters of fact. These distinctions are important when we come to the analysis of Hume's argument.

2.3 Hume's Salient Points

The above outline of Hume's theory of knowledge contains several salient points that need further elaboration, with supporting information from both Hume's *Treatise* and first *Enquiry.*

2.3.1 Hume's Theory of Ideas (Perception)

Although Hume takes several concepts from Locke, he uses several terms in different meanings from Locke's. For example, Hume claims that, 'Perhaps I rather restore the word, idea, to its original sense, from which Mr. LOCKE had perverted it, in making it stand for all our perceptions' (Treatise I: i.i). Hume calls all the objects of the mind not 'ideas' but 'perceptions,' and divides perceptions into 'impressions' and 'ideas.' He says further that, 'We shall here content ourselves with establishing one general proposition, that all our simple ideas in their first appearance are derived from simple impressions, which are correspondent to them, and which they exactly represent' (Treatise I: i.i). This is how Hume establishes the first general concept in the science of man (Stroud, 1977, p. 24). It is obvious that Hume's general concept is incompatible with innate ideas.

Like Locke, Hume distinguishes between perceptions of sensation and perceptions of reflection, resulting in a four-way distinction between:

- Impressions of sensation, e.g. seeing a color or feeling a pain;
- Impressions of reflection, e.g. feeling fear;
- Ideas of sensation, e.g. the thought of a color or pain; and
- Ideas of reflection, e.g. the thought of fear. (Noonan, 1999, p. 54)

Again, like Locke, Hume distinguishes between simple and complex ideas, but Hume denies that there is any necessary connection between simple ideas, whereas Locke accepts it, and so some ideas which are considered as simple for Locke—extension and space, for

example—are treated as complex for Hume (Noonan, 1999, p. 54).

Complex ideas are created by what Hume calls 'operation of the mind,' which allows us to acquire, manipulate, shuffle and even confuse the perceptions that come to us (Stroud, 1977, p. 23). However, we have no way of ascertaining whether the complex ideas really represent reality (Pojman, 1993, p. 31). Because Hume refuses to go beyond experience (Owen, 1999, p. 9), our sensory limitations give rise to limitations in thought; for example, when a person was born blind, he or she cannot have impressions of colors and therefore cannot have ideas of colors (Noonan, 1999, pp. 66-67).

Impressions and ideas. Hume's impressions correspond to feeling or experience and his ideas correspond to thinking (Noonan, 1999, p. 6). Here is how he explains the difference between the two:

> Those perceptions, which enter with most force and violence, we may name impressions: and under this name I comprehend all our sensations, passions and emotions, as they make their first appearance in the soul. By ideas I mean the faint images of these in thinking and reasoning; such as, for instance, are all the perceptions excited by the present discourse, excepting only those which arise from the sight and touch, and excepting the immediate pleasure or uneasiness it may occasion. (Treatise I: iii.iii)

Thus, for Hume, the distinction between impressions and ideas lies in the amount of liveliness, vividness, or forcefulness. It is not a difference in kind but a difference in degree. This is supported by his thesis that ideas are faint images of impressions (Noonan, 1999, p. 60). Just as one can see a cat, so can one imagine a cat. Just as one can hear a song, so can one imagine its tune in one's mind. Hume thinks that the distinction between impressions and ideas does not need much explanation. We know there is a difference between actually perceiving something and just thinking about that thing in its absence (Stroud, 1977, p. 19).

However, Hume observes further that the constant conjunction between impressions and ideas is an indication of causal dependence. Because impressions always come before their corresponding ideas, our impressions must be the causes of our ideas (Noonan, 1999, p. 63). But he notes that there is one exception which may prove that it is not absolutely impossible for ideas to appear before their corresponding impressions. This phenomenon is Hume's notorious shade of blue (Noonan, 1999, p. 64). Hume argues in this way:

> There is, however, one contradictory phenomenon, which may prove that it is not absolutely impossible for ideas to arise, independent of their correspondent impressions.... Suppose, therefore, a person to have enjoyed his sight for thirty years, and to have become perfectly acquainted with colours of all kinds except one particular shade of blue, for instance, which it never has been his fortune to meet with.... Now I ask, whether it be possible for him, from his own imagination, to supply this deficiency, and raise up to himself the idea of that particular shade, though it had never been conveyed to him by his senses? I believe there are few but will be of opinion that he can: and this may serve as a proof that the simple ideas are not always, in every instance, derived from the correspondent impressions; though this instance is so singular, that it is scarcely worth our observing, and does not merit that for it alone we should alter our general maxim. (Hume, 1975, pp. 20-21)

And so, what Hume does with his notorious shade of blue is to ignore it because it is so insignificant that it is not even worth our consideration.

Principles concerning ideas. According to H. W. Noonan (1999, pp. 8-9), three of Hume's fundamental principles are:

- *The Separability Principle.* It states that, 'Whatever objects are different are distinguishable, and whatever objects are distinguishable are separable by the thought and imagination' (Treatise I: i.vii).
- *The Conceivability Principle.* It states that, 'Nothing of which we can form a clear and

distinct idea is absurd and impossible' (Treatise I: i.vii).

- *The Principle of Association of Ideas.* This principle accounts for the relationship between our ideas in the mind, and it also explains the origin of our beliefs concerning matters of fact beyond our memory and senses (Noonan, 1999, p. 9).

The first two principles together imply that distinct objects can exist separately. Hume uses this separability to reject the necessary connections between distinct objects and between causes and effects (Noonan, 1999, pp. 8-9). Hume's concept of causation will be discussed further below.

The third principle is used by Hume to account for all the operations of the mind. It allows one idea to naturally give rise to another (Stroud, 1977, p. 36). At first glance, it may be hard to believe that every transition in thought can be explained by a single principle (Noonan, 1999, p. 71). Hume is aware of this possible objection, so he explains further that the three relations of this principle—resemblance, contiguity, and causation—may work jointly and may include their negations. He gives the following example:

> For instance, Contrast or Contrariety is also a connexion among Ideas: but it may, perhaps, be considered as a mixture of *Causation* and *Resemblance.* Where two objects are contrary, the one destroys the other; that is, the cause of its annihilation, and the idea of the annihilation of an object, implies the idea of its former existence. (Hume, 1975, p. 24)

2.3.2 Hume's Fork

'Hume's Fork' refers to Hume's dichotomy between relations of ideas and matters of fact. Relations of ideas are 'discoverable by the mere operation of thought, without dependence on what is anywhere existent in the universe.' Matters of fact 'are not ascertained in the same manner' because 'the contrary of every matter of fact is still possible' and 'can never imply a contradiction' (Hume, 1975, p. 25).

Hume holds that all propositions concerning relations of ideas are knowable either by intuition or demonstration. Such propositions also have several other features:

- They can be known to be true by thought alone, that is, without having to check whether they are true in experience. Hume regards them as a priori knowable.
- They are necessary and not contingent truths, and so not vulnerable to refutation.
- They are the only propositions that are knowable. Propositions concerning matters of fact and existence are not knowable but only probable. (Noonan, 1999, pp. 94-95)

Hume's Fork includes three elements of distinction, namely, between 'necessary' and 'contingent,' between 'a priori' and 'a posteriori,' and between 'analytic' and 'synthetic' (Honderich, 1995, p. 285).

The a priori-a posteriori distinction is an epistemological distinction. A proposition is justified a priori if it is justified independently of any appeal to experience and by appeal to reason or pure thought alone. The notion of experience includes not only sense experience, but also introspection, memory, and clairvoyance or telepathy (if they exist). These varieties of experience may be justified a posteriori (BonJour, 1998, pp. 6-8).

The necessary-contingent distinction is a metaphysical distinction. It deals with the status of a proposition in relation to the ways the world might have been. A proposition is necessarily true if it is true in all possible worlds; it is contingent if it is true in some possible worlds and false in other worlds (BonJour, 1998, p. 11).

The analytic-synthetic distinction is a semantical distinction (Pojman, 2001, p. 19). In Kant's definition, an analytic judgement is one in which 'the predicate B belongs to the subject A, as something which is (covertly) contained in the concept A.' Kant called such judgements 'explicative,' contrasting them with synthetic judgements which are 'ampliative' (Bealer, 1998, introduction). More about this in chapter 4.

The point worth noting here is that Hume seems to treat the three distinctions as one and the same. Many people have challenged this kind of treatment. For example, it is claimed

that Hume's treatment leaves no room for synthetic a priori judgements, the concept of which is Kant's fundamental point in his metaphysics; nor for contingent a priori and necessary a posteriori propositions (Honderich, 1995, p. 285).

2.3.3 Hume's Reason and Reasoning

Hume's arguments on many issues are based on reason and reasoning. For example, he attempts to show that probable reasoning or causal inference is not founded on reason, he is sceptical on reason, and he gives more importance to passions than reason (Owen, 1999, p. 1). Hume says that, 'Reason is, and ought only to be the slave of the passions, and can never pretend to any other office than to serve and obey them' (Treatise II: iii.iii). This view is quite revolutionary because it goes against the traditional conception that human beings are rational. In the traditional conception, rationality is simply imposed a priori on human beings (Stroud, 1977, pp. 11-14), but Hume claims that the passions—the 'master' of reason—are not directly subject to rational evaluation (Schmitter, 2008, sect. 7).

Hume uses the terms 'reason' and 'the understanding' interchangeably (Owen, 1999, pp. 1-2). For Hume, the term 'reason' refers to the capacity to determine truth and falsity (Sayre-McCord, 2006, p. 2), while reasoning is just a matter of relating several ideas in order to get a belief (Schmitter, 2008, sect. 7). So, Hume has a rather narrow conception of reasoning (or inference), quite different from ours, and this conception is crucial to our understanding of Hume's view on the problem of induction.

Hume pays special attention to the analyzing of practical reasoning. Because of the subordination of reason to the passions, the latter are the motivation, or driving force, for actions. Reason cannot create any impulse by itself (Schmitter, 2008, sect. 7). Of course, Hume is aware that reason can influence our behavior by changing our view of the world, but insofar as our judgements are concerned, reason remains subordinate to our passions (Sayre-McCord, 2006, p. 1) as Hume maintains that:

> It is *not contrary to reason* to prefer the destruction of the whole world to the scratching of my finger.... Abstract or demonstrative reasoning, therefore, *never* influences any of our actions, but only as it directs our judgement concerning causes and effects; which leads us to the second operation of the understanding. (Treatise II: iii.iii, italics added).

When Hume talks about 'a train of reasoning and enquiry' (Hume, 1975, p. 163), what he means is a chain of related ideas or demonstrative reasoning, as discussed earlier. Hume got this conception of reasoning from Descartes and Lock, but he refined it and gave it certain Humean characteristics. Another point to be noted is that, when Hume claims that we are not determined by reason in our probable reasoning, it should not be understood as a claim about the reasonableness or unreasonableness. What Hume is arguing is merely that *reason cannot explain* our beliefs produced by such reasoning; reason by itself cannot explain our holding of such beliefs (Owen, 1999, pp. 2-6).

Hume's argument is that, if we are determined by reason in our probable reasoning, then it will be the same as demonstrative reasoning. Hume tries to show that the intermediate ideas for probable reasoning do not exist; therefore, probable reasoning is not based on reason or the understanding as Locke thought (Owen, 1999, p. 130). Thus, Hume's account of demonstration is more restrictive than Locke's in the sense that it is limited to relations of quantity and number. This limitation is necessitated by Hume's conceivability principle: If the negation of a proposition does not imply a contradiction, then that proposition is not demonstrable. It is obvious that most propositions do not pass this test (Owen, 1999, pp. 98-99).

Hume does not use the term 'deduction' as often as Locke did, but appears to use it in the same non-formal sense of reasoning, referring simply to arguments either demonstrative or probable. If we think of deduction in the present sense, we will fail to understand what Locke

and Hume have to say. Our concept of deductive validity has little to do with Hume's conception of demonstration. Hume's emphasis is on certainty, not necessity or validity (Owen, 1999, pp. 6-9).

2.3.4 Causation and Necessary Connections

Most of our beliefs are at least partly about the unobserved and we normally infer from what has been observed to what is not, on the assumption that there is some kind of connection between them. Hume argues that all such inferences or reasonings are based on the relation of cause and effect. So, in order to understand the unobserved, we should understand what causation is all about (Stroud, 1977, pp. 42-43). Since the concept of causation is very important in Hume's argument against induction, it should be discussed at some length. In his *Treatise,* Hume poses and examines two central questions concerning causation as follows:

> Firstly, For [sic] what reason we pronounce it necessary, that every thing whose existence has a beginning, should also have a cause.
>
> Secondly, Why [sic] we conclude, that such particular causes must necessarily have such particular effects; and what is the nature of that inference we draw from the one to the other, and of the belief we repose in it? (Treatise I: iii.ii)

The two questions are related. Hume answers the first question, partially, by claiming that, 'All certainty arises from the comparison of ideas, and from the discovery of such relations as are unalterable, so long as the ideas continue the same,' and this precludes causation because causation is not 'intuitively certain.' Then he argues that causation is not 'demonstrably certain' either, because 'all distinct ideas are separable from each other' and 'the ideas of cause and effect are evidently distinct.' Therefore, the idea of causation must come from experience. The remainder of the first question then is, 'How experience gives rise to such a principle?' This remaining part of the question, says Hume, can be solved by

answering the second question (Treatise I: iii.iii).

Experience tells us that there are constant conjunctions but it does not tell us any causation. Hume explains that:

> No object ever discovers, by the qualities which appear to the senses, either the causes which produced it, or the effects which will arise from it.... The mind can never possibly find the effect in the supposed cause, by the most accurate scrutiny and examination. For the effect is totally different from the cause, and consequently can never be discovered in it. (Hume, 1975, pp. 27-29)

If the idea of causation does not come from observation, it must be derived from some relation among objects. Hume explains that, 'An object may be contiguous and prior to another, without being considered as its cause. There is a NECESSARY CONNEXION to be taken into consideration' (Treatise I: iii.iii). So, Hume's next move is to find the necessary connection between objects. Since causation allows us to go beyond the senses, it must do so by virtue of necessary connection. A constant conjunction of two objects, together with a necessary connection between them, is obviously a good basis for inferring one of the objects upon the appearance of the other (Noonan, 1999, pp. 99-101). The problem then is how to argue for such necessary connections.

Hume claims that he cannot perceive any necessary connection in any situation of constant conjunction from which the idea of necessary connection may be derived. When Hume observes what occurs in such a situation, what he perceives is the outer appearance of the objects that is assumed to be cause and effect (Noonan, 1999, p. 102).

Next, Hume argues that necessary connection is not a necessary truth because its negation is not a contradiction (Noonan, 1999, p. 104). Probable reasoning will not do either. Hume's argument is that, 'From the mere repetition of any past impression, even to infinity, there never will arise any new original idea, such as that of a necessary connexion' (Treatise I:

iii.vi) because that is the point to be proved. So, there is no non-circular argument for the supposition that the future will resemble the past. Hume concludes that reason can convince us of neither the truth of causation nor necessary connections between particular causes and particular effects (Noonan, 1999, p. 110).

Then, how do constant conjunctions ever give rise to the idea of necessary connection? Hume hints that, 'Perhaps it will appear in the end, that the necessary connexion depends on the inference, instead of the inference's depending on the necessary connexion' (Treatise I: iii.vi). After some lengthy discussion, Hume concludes that, 'Necessity is something that exists in the mind, not in objects' (Treatise I: iii.xiv). We ascribe necessity to objects or events, or at least to the connections between them (Stroud, 1977, p. 82). Hume explains it in this way:

> It is a common observation, that the mind has a great propensity to spread itself on external objects, and to conjoin with them any internal impressions, which they occasion, and which always make their appearance at the same time that these objects discover themselves to the senses.... Mean while it is sufficient to observe, that the same propensity is the reason, why we suppose necessity and power to lie in the objects we consider, not in our mind that considers them. (Treatise I: iii.xiv)

In sum, Hume's position is that any causes might produce any effects, and that the very object which is the cause might have existed in a world in which the very object which is the effect did not exist, and vice versa (Noonan, 1999, pp. 113-115). The maxim on which Hume bases his argument against necessary connections is that anything may exist separately from every other thing (Milton, 1987, p. 68). Thus Hume appeals to both the conceivability principle and the separability principle, mentioned earlier, in his argument.

However, it is worth noting that Hume does not deny the principle of causation or the idea of necessary connection (Owen, 1999, p. 116). In fact, he wants to know where such an idea comes from. Hume's answer is both ingenious and simple: It comes from memory. The

origin of causation is related to that of the self. Hume explains that the idea of the human mind (self) is 'a system of different perceptions or different existences, which are linked together by the relation of cause and effect.' If we had no memory:

> ... we never should have any notion of causation, nor consequently of that chain of causes and effects, which constitute our self or person. But having once acquired this notion of causation from the memory, we can extend the same chain of causes, and consequently the identity of our persons beyond our memory.... Memory does not so much produce as discover personal identity, by shewing us the relation of cause and effect among our different perceptions (Treatise I: iv.vi)

So, for Hume, the idea of causation can arise only if we *remember* the constant conjunctions between events—the mere occurrence of such constant conjunctions is not enough (Norton, 1993, p. 49).

It may be said that Hume is unable to find the existence of necessary connections in nature, but he discovers it in our thought (Milton, 1987, p. 67). We cannot logically prove that every event has a cause nor that the same cause will always have the same effect. From constant conjunctions, we mistakenly infer necessary connections and impose them on objects, but actually we do not have a priori knowledge of such connections, nor can we infer them from other truths. Causation is simply a psychological habit derived from our experience (Pojman, 2001, pp. 43-44). 'All our reasonings concerning causes and effects are derived from nothing but custom; and that belief is more properly an act of the sensitive, than of the cogitative part of our natures' (Treatise I: iv.i).

E. Sosa (1980, p. 146) comments that Hume's scope of knowledge is extremely narrow. Hume accepts only a very small portion of common-sense knowledge and rejects the rest. For Hume, both science and common sense made claims far beyond their rightful limits. Pojman (2001, p. 43) agrees. He says that, if Hume is right, we can have no metaphysical knowledge. We cannot even know anything about causation, induction, matter, the self, the existence of

God, or free will because we lack impressions of them.

This brings us to one of the most important concepts of Hume's works and also one of the most important parts in this writing, namely, his view on induction. It will be analyzed in detail in the next chapter.

Chapter 3

Hume's View on Induction and its Problem

In this chapter, I shall discuss Hume's view on induction and analyze his argument against inductive inference, to be followed by my criticism of his theories, concepts, and arguments.

3.1 Hume's Sceptical View on Induction

Hume is famous for, among other things, his scepticism. I shall start this section with a discussion of his scepticism before discussing his view on induction.

3.1.1 Hume's Scepticism

Section IV of the first *Enquiry* is entitled *Sceptical Doubts concerning the Operations of the Understanding,* and Section V is entitled *Sceptical Solution of these Doubts.* It is quite interesting that Hume should use the term 'sceptical' on his own doubts and solution. What kind of a sceptic is he, then?

Different people use the term 'scepticism' differently (Owen, 2004, p. 24). According to Pojman (2001, pp. 37-38), there are two types of sceptics, namely, global sceptics and local sceptics. The global sceptic holds that we can know nothing or next to nothing. The local (mitigated) sceptic holds that we can have knowledge of some general and specific truths, but not knowledge about the external world.

The two types of sceptics may be traced back to the two classic types of scepticism founded in ancient Greek philosophy: Pyrrhonian scepticism and Academic scepticism. Pyrrhonian scepticism, named after Pyrrho of Elis (about 360 to 270 B.C.), held that we could

have no knowledge and should suspend all judgements. Academic scepticism was first formulated in Plato's Academy (Pojman, 1993, pp. 25-26). It admitted of the idea of probabilism that, while we cannot know anything, some things are more probable than others, and probability should be the guide of life. Thus, the Pyrrhonists accused the Academics of being only half-sceptics. However, although the Pyrrhonian sceptic rejected the idea of probability in believing, they accepted some kind of living 'as if' a proposition were true (Pojman, 2001, pp. 31-32).

Hume discusses both schools of ancient scepticism, the Pyrrhonian and the Academic, but it is the latter kind of scepticism that Hume associates himself with. He says:

> The great subverter of Pyrrhonism or the excessive principles of scepticism is action, and employment, and the occupations of common life.... There is, indeed, a more mitigated scepticism or academical philosophy, which may be both durable and useful, and which may, in part, be the result of this Pyrrhonism, or excessive scepticism, when its undistinguished doubts are, in some measure, corrected by common sense and reflection. (Hume, 1975, pp. 158-161)

According to Milton (1987, pp. 61-62), during the 120 years which separated Bacon's *Novum Organum* and Hume's *Treatise,* few philosophers were free from doubts about inductive inference but these doubts were quite different from one philosopher to another. So, a distinction between sceptics and anti-sceptics would not help much. A more detailed classification of inductive reasoning will be more helpful to our understanding of the situation:

1. There are reservations about inductive reasoning which arise merely because inductive arguments are not deductively valid.
2. There is the view that inductive arguments are inherently and irredeemably fallible: although such arguments may make their conclusions probable, they can never make them certain.

3. Finally, there is the view that no inductive arguments, whether to particular or to general conclusions, can be given any rational foundation whatever. Hume clearly holds this position (Milton, 1987, p. 62).

D. Owen's study (2004, pp. 25-26) showed that Hume's scepticism is characterized by his awareness of the limitations and imperfections of human understanding. But Hume would not claim, on the grounds of such imperfections, that knowledge is impossible or that all our beliefs are unjustified. In fact, Hume claims that moderate scepticism is beneficial compared with extreme scepticism embraced by Descartes. Hume explains it in this way:

> It recommends an universal doubt, not only of all our former opinions and principles, but also of our very faculties.... The Cartesian doubt, therefore, were it ever possible to be attained by any human creature (as it plainly is not) would be entirely incurable; and no reasoning could ever bring us to a state of assurance and conviction upon any subject. It must, however, be confessed, that this species of scepticism, when more moderate, may be understood in a very reasonable sense, and is a necessary preparative to the study of philosophy, by preserving a proper impartiality in our judgements, and weaning our mind from all those prejudices, which we may have imbibed from education or rash opinion. (Hume, 1975, pp. 149-150)

In sum, Hume is a moderate sceptic. His scepticism-is even milder than Academic scepticism since he accepts knowledge of relations of ideas and knowledge of observed matters of fact. What he rejects is knowledge that goes beyond experience, including inductive knowledge.

Now that we know what kind of a sceptic Hume is, let us start our detailed discussion of his view on the problem of induction.

3.1.2 Hume's View on Induction

The problem of induction is one of the most widely discussed epistemological problems. Many thinkers believe that induction is not philosophically rational. This belief is also held by Hume when he writes on how we can acquire knowledge of matters of fact (Payne, 2003, introduction). Hume's contention is with what we now call 'ampliative inference.'

Compared with the problem of induction in general (discussed in chapter 1), Hume's problem is narrower. He is concerned only with cases in which 'all observed cases of A are cases of B,' and 'the intended conclusion is that being A is the cause of being B' (BonJour, 1998, p. 190). In the *Treatise*, Hume's arguments are mainly based on such inferences about particulars, or 'the inference from the impression to the idea' (Treatise I: iii.vi). Also in the first *Enquiry*, Hume's examples are inferences from particulars to particulars, such as 'whether the sun will rise tomorrow.'

Hume's conclusion, as we shall see, is that we have no good reason to think that inductive inferences are justified. In a way, the problem of induction can be interpreted as the problem of responding to Hume by giving good reasons to support the inductive principle (Anderson, 2000, introduction). Over time, Hume's doubts about probable reasoning have become known simply as 'Hume's problem' (Vickers, 2006, sect. 2) and have been treated by many philosophers as synonymous with 'the problem of induction' (Owen, 1999, p. 113),

Hume's argument. Hume formulates his version of the problem of induction in his *Treatise* (I: iii.vi) and in section IV of his first *Enquiry* (1975, pp. 25-39). The question that Hume poses is as follows:

> Since it appears, that the transition from an impression present to the memory or senses to the idea of an object, which we call cause or effect, is founded on past experience, and on our remembrance of their constant conjunction, the next question is, Whether experience produces the idea by means of the understanding or imagination; *whether*

> *we are determined by reason to make the transition, or by a certain association and relation of perceptions.* If reason determined us, it would proceed upon that principle, that instances, of which we have had no experience, must resemble those, of which we have had experience, and that the course of nature continues always uniformly the same. (Treatise I: iii.vi, italics added)

Hume's argument is that the uniformity of nature cannot be logically established because a change in the course of nature is always possible and implies no contradiction. This is the conventional interpretation. On this interpretation, Hume's conclusion would be perfectly correct. No set of statements about what has been observed ever logically implies anything about what has not been observed (Stroud, 1977, p. 56). Hume's argument is based on two principles that he establishes, as follows:

> Let men be once fully persuaded of these two principles, *that there is nothing in any object, considered in itself, which can afford us a reason for drawing a conclusion beyond it;* and, *that even after the observation of the frequent or constant conjunction of objects, we have no reason to draw any inference concerning any object beyond those of which we have had experience.* (Treatise I: iii.xii)

Alternatively, Hume's argument may be formulated in terms of epistemological distinction. For induction to be rational, it must be justified-either by a priori or a posteriori reasoning. Hume argues that neither of these reasonings is justifiable (Payne, 2003, introduction). We can consider Hume's argument as a dilemma as follows (Vickers, 2006, sect. 7):

1. Induction cannot be deductively justified. Whatever is established deductively is necessarily true, but inductions are never necessarily true, so no deductive justification of induction is possible.

2. Induction cannot be inductively justified. Inductive justification of induction would be circular because it already assumes the justification to be proved. (Vickers, 2006, sect. 7)

Let us discuss the dilemma in more detail. Hume says that our expectations of future matters of fact are based on the relation of cause and effect. But, as we have seen, the principle of causation can neither be established by a priori reasoning nor by a posteriori reasoning via sense experience. Since matters of fact imply no contradiction, to suppose that a regularity will continue is no better than to suppose that it will not. In order to legitimately extend regularities to the future, we need an intermediate premise, which is the principle that the future will resemble the past. Let us call this principle 'Nature's Uniformity Theory' or NUT for short.

NUT, in turn, must also be justified. Hume argues that we can justify NUT in the same manner as we justify the relation of cause and effect, that is, either by a priori or a posteriori reasoning. But we cannot prove it a priori because it is conceivable that the course of nature may change; and to prove it by a posteriori reasoning is circular because every inductive argument includes NUT among its premises. Hume concludes that our prediction of future events based on past observations is not a rational activity, but just a matter of custom or habit (Hume, 1975, p. 43). The concept of custom is Hume's own solution to the problem of induction. It will be discussed in the next chapter.

From Hume's Fork, we know that objects of human enquiry are divided into relations of ideas and matters of fact. Hume's argument is to show that NUT is derived neither from relations of ideas nor matters of fact. Thus, the argument contains three elements of contention as follows:

1. NUT is not founded on any reasoning of matters of fact and existence.
2. NUT is not founded on any reasoning concerning relations of ideas.
3. These two cases are exhaustive.

It should be noted that Hume treats several terms to mean the same thing and uses them interchangeably. For example, he says:

- We have said that all **arguments** concerning **existence** are founded on the relation of cause and effect (Hume, 1975, p. 35).
- All **reasonings** concerning **matter of fact** seem to be founded on the relation of Cause and Effect (Hume, 1975, p. 26).
- ... nor can our reason, unassisted by experience, ever draw any inference concerning real **existence and matter of fact** (Hume, 1975, p. 27).
- All reasonings may be divided into two kinds, namely, demonstrative reasoning, or that concerning relations of ideas, and moral reasoning, or that concerning **matter of fact and existence** (Hume, 1975, p. 35).

From the above quotes, we can see that 'reasonings' and 'arguments' seem to express the same meaning; so do 'matter of fact' and 'existence' and these last two terms are sometimes combined as 'existence and matter of fact' or 'matter of fact and existence.'

The above discussion should suffice for our understanding of Hume's argument. Next, I shall analyze how Hume proceeds with his argument.

3.2 Analysis of Hume's Argument

In this section, I shall follow up with the three contentious elements in Hume's argument against induction. The analysis is based on Hume's argument in his first *Enquiry*. Here, it is necessary to refer frequently to Hume's original texts so that the reader may directly 'feel' his argument.

3.2.1 The First Element in Hume's Argument

The first element in Hume's argument is to prove that NUT is not founded on any

reasoning of matters of fact and existence.[2] Hume proceeds as follows:

Claim C1: Reasonings of matters of fact and existence are founded on the relation involving cause and effect. This relation makes it possible to go beyond memory and senses (Millican, 2002, p. 124). Hume argues that:

> All reasonings concerning matter of fact seem to be founded on the relation of Cause and Effect. By means of that relation alone we can go beyond the evidence of our memory and senses.... A man finding a watch or any other machine in a desert island, would conclude that there had once been men in that island. (Hume, 1975, p. 26)

Claim C2: Sensible qualities of an object reveal neither its cause nor effect, so, their relation is not inferred from the object (Millican, 2002, p. 124). Hume makes this claim in the following passages:

> No object ever discovers, by the qualities which appear to the senses, either the causes which produced it, or the effects which will arise from it.... It is allowed on all hands that there is no known connexion between the sensible qualities and the secret powers; and consequently, that the mind is not led to form such a conclusion concerning their constant and regular conjunction, by anything which it knows of their nature. (Hume, 1975, pp. 27-33)

Claim C3: Any effect is distinct from its cause and different effects from the same cause are conceivable (Millican, 2002, p. 124), as Hume says:

> Every effect is a distinct event from its cause. It could not, therefore, be discovered in the cause, and the first invention or conception of it, a priori, must be entirely arbitrary. And even after it is suggested, the conjunction of it with the cause must appear equally arbitrary; since there are always many other effects, which, to reason, must seem fully as consistent and natural. (Hume, 1975, p. 30)

Claim C4: From claims C2 and C3, it can be inferred that relations involving cause and effect

---

[2] Adapted from Millican, 2002, pp. 121-139.

cannot be known a priori but from experience (Millican, 2002, p. 124). Hume infers this claim in this way:

> I shall venture to affirm, as a general proposition, which admits of no exception, that the knowledge of this relation [of cause and effect] is not, in any instance, attained by reasonings a priori; but arises entirely from experience, when we find that any particular objects are constantly conjoined with each other.... In vain, therefore, should we pretend to determine any single event, or infer any cause or effect, without the assistance of observation and experience. (Hume, 1975, pp. 27-30)

Claim C5: From claims C1 and C4, it can be concluded that all reasonings of matters of fact and existence are founded on experience (Millican, 2002, p. 124). Hume writes:

> ... nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact. (Hume, 1975, p. 27)

Claim C6: All inferences from experience are founded on NUT (Millican, 2002, p. 127). This claim is explained by Hume thus:

> But notwithstanding this ignorance of natural powers and principles, we always presume, when we see like sensible qualities, that they have like secret powers, and expect that effects, similar to those which we have experienced, will follow from them.... For all inferences from experience suppose, as their foundation, that the future will resemble the past, and that similar powers will be conjoined with similar sensible qualities. If there be any suspicion that the course of nature may change, and that the past may be no rule for the future, all experience becomes useless, and can give rise to no inference or conclusion. (Hume, 1975, pp. 33-38)

Claim C7: From Claims C5 [or C1+C4] and C6, it can be inferred that all reasonings of matters of fact and existence are founded on NUT (Millican, 2002, p. 127). This claim is implicit in Hume's argument that:

> If we be, therefore, engaged by arguments to put trust in past experience, and make it

> the standard of our future judgement, these arguments must be probable only, or such as regard matter of fact and real existence.... We have said that all arguments concerning existence are founded on the relation of cause and effect [C1]; that our knowledge of that relation is derived entirely from experience [C4]; and that all our experimental conclusions proceed upon the supposition that the future will be conformable to the past [C6]. (Hume, 1975, p. 35)

Claim C8: To say that NUT is founded on reasonings of matters of fact and existence, or derived from experience, is circular (Millican, 2002, p. 131), as Hume argues that:

> To endeavour, therefore, the proof of this last supposition [that the future will be conformable to the past] by probable arguments, or arguments regarding existence, must be evidently going in a circle, and taking that for granted, which is the very point in question.... It is impossible, therefore, that any arguments from experience can prove this resemblance of the past to the future; since all these arguments are founded on the supposition of that resemblance. (Hume, 1975, pp. 35-38)

Claim C9: Therefore, it can be concluded from claims C7 and C8 that NUT is not founded on any reasoning of matters of fact and existence. QED.

3.2.2 The Second Element in Hume's Argument

Hume's second element is to prove that NUT is not founded on any reasoning concerning relations of idea.[3] Hume proceeds in this way: -

Claim C10: NUT is not based on intuition because there is no logical connection between past cause-and-effect and future cause-and-effect (Millican, 2002, p. 128). Hume argues that:

> These two propositions are far from being the same, *I have found that such an object has always been attended with such an effect,* and *I foresee, that other objects, which are, in appearance, similar, will be attended with similar effects.* I shall allow, if you

[3] Adapted from Millican, 2002, pp. 121-139.

> please, that the one proposition may justly be inferred from the other: I know, in fact, that it always is inferred. But if you insist that the inference is made by a chain of reasoning, I desire you to produce that reasoning. The connexion between these propositions is not intuitive. There is required a medium, which may enable the mind to draw such an inference, if indeed it be drawn by reasoning and argument. What that medium is, I must confess, passes my comprehension. (Hume, 1975, p. 34)

Claim C11: NUT is not based on demonstration because a change in the course of nature is possible (Millican, 2002, p. 131), as Hume contends thus:

> That there are no demonstrative arguments in the case [that past cause-and-effect will apply in the future] seems evident; since it implies no contradiction that the course of nature may change, and that an object, seemingly like those which we have experienced, may be attended with different or contrary effects. May I not clearly and distinctly conceive that a body, falling from the clouds, and which, in all other respects, resembles snow, has yet the taste of salt or feeling of fire?... Now whatever is intelligible, and can be distinctly conceived, implies no contradiction, and can never be proved false by any demonstrative argument or abstract reasoning a priori. (Hume, 1975, p. 35)

Claim C12: Therefore, it can be concluded from claims C10 and C11 that NUT is not founded on reasoning a priori. In other words, NUT is not founded on any reasoning concerning relations of ideas. QED.

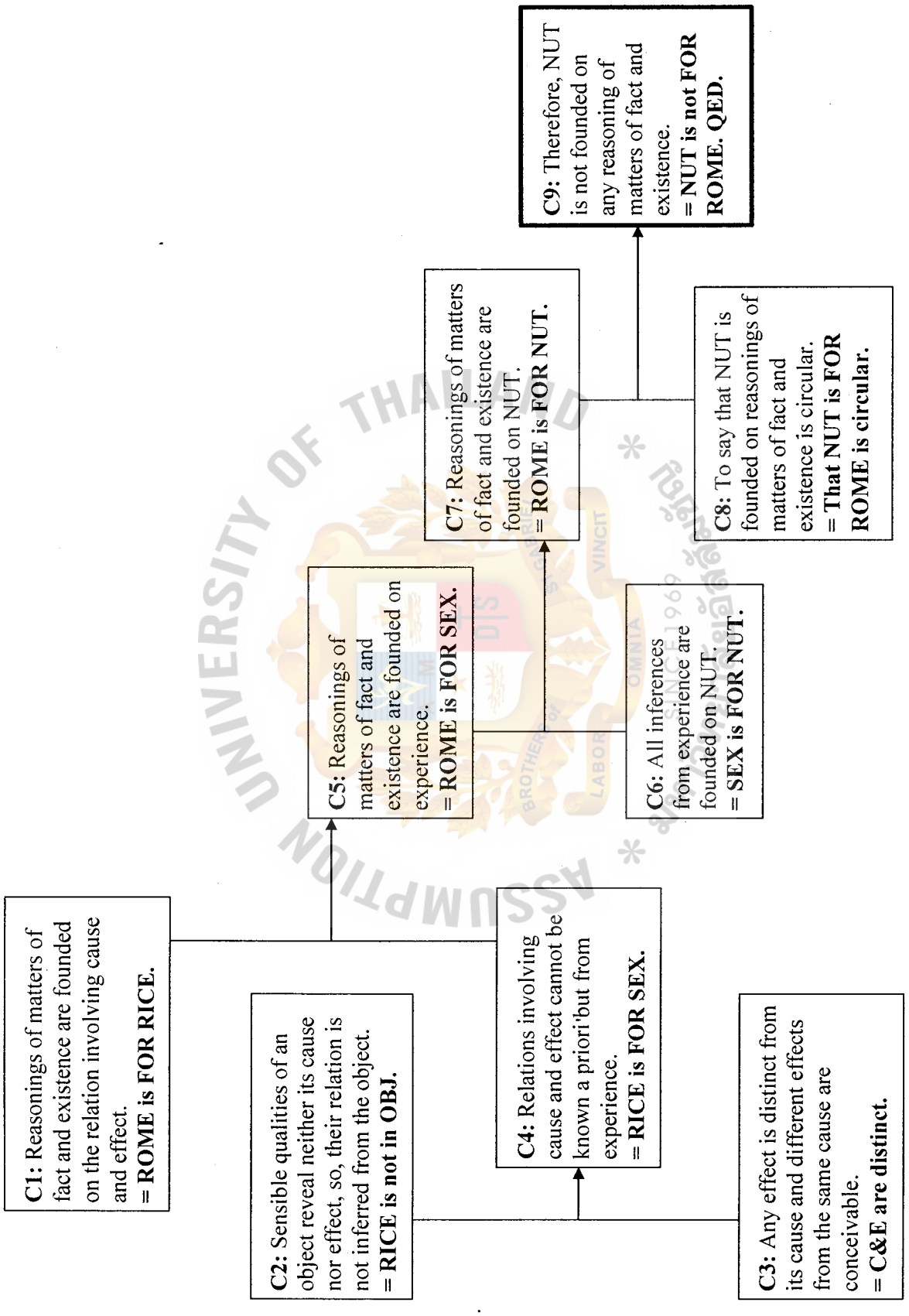
3.2.3 The Logic Behind Hume's Argument

The diagram on the next page is a schematic representation of Hume's chain of reasoning.[4] The following symbolic abbreviations will help to facilitate my explanation of Hume's logic:

ROME	= **R**easoning **O**f **M**atters of fact and **E**xistence
FOR	= **F**ounded **O**n the **R**eason of
RICE	= **R**elation **I**nvolving **C**ause and **E**ffect
OBJ	= **OBJ**ect
C&E	= **C**ause **&** **E**ffect considered separately
SEX	= **S**ense **EX**perience
NUT	= **N**ature's **U**niformity **T**heory (already mentioned in sub-section 3.1.2)

[4] Adapted from Millican, 2002, pp. 147 & 171.

A schematic expression of the logic behind Hume's argument.



Hume's chain of arguments can be explained in symbols as follows:[5]

- C1: ROME is FOR RICE (This claim is true by the association of ideas).

- Because of C2: RICE is not in OBJ (True by observation).
- And because of C3: C&E are distinct (True by observation and reflection).
- Therefore, C4: RICE is FOR SEX (True by inference: since the relation involving cause and effect is not revealed in the object, it can only be known by observation of their constant conjunction, that is, from sense experience).

- Because of C1: ROME is FOR RICE.
- And because of C4: RICE is FOR SEX.
- Therefore, C5: ROME is FOR SEX (True by virtue of the law of transitivity).

- Because of C5: ROME is FOR SEX.
- And because of C6: SEX is FOR NUT (The presupposition of NUT is necessary for making inferences from the past to the future).
- Therefore, C7: ROME is FOR NUT (True by virtue of the law of transitivity).

- Because of C7: ROME is FOR NUT.
- And because of C8: That NUT is FOR ROME is circular (And therefore unacceptable).
- Therefore, C9: NUT is not FOR ROME.

I have hitherto used the schematic and symbolic representation to prove the point that

[5] Adapted from Millican, 2002, pp. 146-159.

NUT is not founded on any reasoning of matters of fact and existence. As for the other point that NUT is not founded on any reasoning concerning relations of ideas, there is no need for a schematic representation because this point is quite simple and short. A symbolic explanation will therefore suffice, thus:

- Because of C10: NUT is not based on intuition (There is no logical connection a priori between past and future).
- And because of C11: NUT is not based on demonstration a priori (A change in the course of nature is possible).
- Therefore, C12: NUT is not founded on reasoning a priori. In other words, NUT is not founded on any reasoning concerning relations of ideas.

3.2.4 The Third Element in Hume's Argument

The third element is to argue that Hume's first two elements are exhaustive. As Hume's Fork has shown, there are two kinds of objects of enquiry, namely:

1. *Relations of ideas.* These can be known either immediately by intuition or inferentially by demonstration.
2. *Matters of fact.* These can be known either immediately by direct perception or inferentially by probable reasoning.

This fourfold distinction can be summed up in the table below (Owen, 1999, pp. 84-85).

	Immediate	**Inferential**
Relations of Ideas	Intuition	Demonstration
Matters of Fact	Perception or Memory	Probable Reasoning

In Hume's view, there is no other kind of reasoning apart from reasoning concerning relations of ideas and reasoning concerning matters of fact, therefore, it can be concluded that Hume's argument is exhaustive.

Conclusion of Hume's argument. It is generally assumed that the more often a constant conjunction is repeated, the more likely it is going to continue. If there is a way to justify this assumption, the problem of induction would be solved. But it does not seem that the assumption can be justified. If circular proofs are not acceptable, there can be no proof. A proof which is formally correct will not do the work, and a proof which does the work will not be formally correct (Ayer, 1956, pp. 74-75). The final conclusion of Hume's argument is that there is no justification for regarding the past as a guide to the future (Howson, 2000, p. 1), so it is reasonable for philosophers to cast doubts on the supposition that the future will be conformable to the past. Such is the problem of induction as Hume formulates it.

3.3 Criticism of Hume's Theory and Argument

In this section, I shall criticize both Hume's argument against induction and his theory of knowledge on which his argument is based. The criticism will be in the form of strengths, weaknesses, ambiguities, and so forth.

3.3.1 Strengths

The strengths of Hume's theory and argument lie in their influence on other philosophers. As mentioned, Hume's problem is still one of the most widely debated problems in epistemology. Hume's theory not only interrupted Kant's dogmatic slumber but also stimulated him to write his *Critique of Pure Reason* (Noonan, 1999, pp. 30-31). In the twentieth century, Hume's influence was prominent in the logical positivists. The importance of Hume's theory of knowledge cannot be denied. His influence results in a revolution in the

way philosophy was conceived, and both his general approach and particular doctrines are still relevant today (Noonan, 1999, pp. 32-33).

Hume's reputation is based partly on his doctrine of empiricism, that is, the view that all our ideas and beliefs originate from experience. He is also considered to be an anti-metaphysical philosopher. Hume's Fork leaves no room for genuine metaphysics—either it reduces to science or it does not lead to knowledge (Stroud, 1977, pp. 219-220).

Hume is a naturalistic philosopher. His interest in human nature is in how and why human beings think, feel, and act in the ways they do. He wants to answer the philosophical questions of how people come to know the world and themselves, and he does it scientifically. He answers these questions in the only way possible—by observation and inference from what is observed. Hume thinks that we can understand what human beings do, and why and how they do it, only by studying them as part of nature (Stroud, 1977, p. 222).

As science progresses, some old theories are replaced by new ones. For example, the new theories of relativity and quantum mechanics have shown that Newton's theory is just an approximation, and may yield incorrect results under certain circumstances. The unreliability of such an important scientific theory as Newton's lends support to Hume's sceptical doubts on induction (Gillies, 1993, p. 21).

C. Howson (2000, p. 111) claims that Hume advocates the harmony between our beliefs and Nature, and that Darwin's grandfather was influenced by Hume's thought. Darwin, in turn, was much influenced by his grandfather, and his theory of evolution is considered by many people to complement Hume's thought.

3.3.2 Weaknesses

Over almost three centuries since the publication of the *Treatise,* Hume's theory and argument have been criticized by many people. These criticisms may be divided into three main groups: constraints, criteria, and contravention.

Constraints. Many people believe that Hume is constrained by his own theory and argument. The restrictions and limitations that Hume imposes on himself make his theory and argument less convincing and sometimes even incompatible with scientific knowledge. Here are some examples of such constraints:

- Hume's Copy Principle, that all ideas are copies of impressions, does not allow him to search for an account of the origins of space, time, identity, external existence, necessary connection and the self (Noonan, 1999, p. 7). Furthermore, a lot of events take time and go beyond the limit of single impressions. Strictly speaking, impressions alone can yield only momentary states of affairs and their succession, which are too restrictive to give us even a notion of an event, or a description of those states of affairs (Stroud, 1977, p. 231). Another aspect of the problem is that some events and entities cannot be experienced, for example, the biological evolution or the molecule and the electron, and yet they are widely accepted today. Hume's theory of ideas cannot account for such events or entities (Dubs, 1935, pp. 258-259).
- Hume's theory of ideas leads him to oversimplify things. He concentrates more on the 'explanation' than on what is to be explained. Explanation for Hume means basically how to get to the origins of our thoughts, beliefs, feelings, actions and reactions. His main concern is always with the origin of perceptions in the mind, and not primarily with their contents (Stroud, 1977, p. 224). In fact, contents should be as significant as, if not more significant than, their explanation.
- Some philosophers think that Hume's description of induction is too narrow and inadequate to represent the whole problem of induction. Hume seems to focus exclusively on one form of inductive inference, that is, simple enumeration or extending past regularities into the future. Many philosophers think that a complete account of inductive reasoning should include some forms of hypothetico-deduction and 'inference to the best explanation,' which Hume does not discuss (Okasha, 2005, pp. 258-259).

Criteria. Hume's theories contain many criteria that are used for his arguments. Many people consider some of Hume's criteria to be inadequate or ineffective. What follows is a discussion of some of such objections.

- Hume's criterion for the distinction between impressions and ideas is the degrees of force and vivacity with which they strike upon the mind. Hume's purpose is to distinguish between perceiving and thinking. The question is whether the two distinctions are really the same (Stroud, 1977, pp. 27-28). Under certain circumstances, they are not. For example, when I am reading a fairytale, my thinking (imagination) is totally different from my perceiving (mere words), even though my ideas are still copies of former impressions. Furthermore, Hume's account of belief also depends on the same notion of vivacity. But beliefs are neither impressions nor ideas, so their degree of vivacity must fall somewhere between that of impressions and that of ideas. But where exactly? In fact, the situation is even worse in the case of memories. The concept that all of these differ only in one respect of vivacity is unconvincing. Memories apply to past experience but beliefs may involve the future so that an increase in the vivacity of a belief cannot change it into a memory of the past (Noonan, 1999, pp. 137-138).
- Hume's criterion for the distinction between simple and complex ideas is unclear. Barry Stroud (1977, p. 21) says that Hume does not give us any general guidance on how to tell that we have got down to a simple perception. If we use the vague criterion of simplicity that Hume proposes, it is possible that the idea of a particular red is complex if we consider its particular hue and specific intensity. So, one and the same thing can be simple or complex, depending on how we look at it.
- Hume's dichotomy between demonstrative reasoning and probable reasoning is inadequate because not all non-demonstrative reasonings are probable. A non-demonstrative inference is simply one that fails to be demonstrative because its conclusion is not entailed by its premises; that is, the conclusion could be false even if the premises are true. According to

W. C. Salmon (1967, pp. 8-11), the category of non-demonstrative inferences may contain non-probable reasonings, such as fallacious inferences. If we disregard synthetic a priori truths for the moment, we are still left with a trichotomy of inferences: valid deductive inference, correct inductive inference, and assorted fallacies.

Contravention. Hume is sceptical of a lot of things, even of his own theories. For example, at the end of Book I of his *Treatise,* Hume says that:

> I am ready to reject all belief and reasoning, and can look upon no opinion even as more probable or likely than another. Where am I, or what? From what causes do I derive my existence, and to what condition shall I return? Whose favour shall I court, and whose anger must I dread? What beings surround me? and on whom have, I any influence, or who have any influence on me? I am confounded with all these questions, and begin to fancy myself in the most deplorable condition imaginable, invironed with the deepest darkness, and utterly deprived of the use of every member and faculty. (Treatise I: iv.vii)

Some of Hume's arguments seem to conflict with his own theories. Here are a few examples:

- It has been pointed out that Hume's theory of causation is itself causal because it explains how and why we come to believe that certain objects and events in our experience are causally connected. Hume's argument is that we have no reason to believe in any causal connections between things. If that is the case, we have no reason to believe Hume's theory of causation. Hume cannot have it both ways. Hume's theory goes beyond what can be observed (Stroud, 1977, p. 92) since we never have any impression that causation comes from custom or habit.
- Hume makes many important claims on the basis of inductive arguments. For example, his claim that all ideas are caused by impressions is supported by observations (Rosenberg, 2006, p. 76). If inductive inferences are unjustifiable, so are Hume's inductive claims and any theories resulting from them. Moreover, Hume says that if any volume does not

'contain any abstract reasoning concerning quantity or number' and does not 'contain any experimental reasoning concerning matter of fact and existence,' then it should be committed to the flames 'for it can contain nothing but sophistry and illusion' (Hume, 1975, p. 165). By the same token, most of Hume's works should be committed to the flames because they deal with neither 'quantity or number' nor 'experimental reasoning.'

- Hume's attitude towards the missing shade of blue is extremely puzzling. If there can be simple ideas without corresponding simple impressions, how can Hume argue against a philosophical issue on the grounds that it lacks a corresponding impression? (Noonan, 1999, pp. 64-65). If exceptions to a theory have been found, why should the theory not be modified or abandoned? (Stroud, 1977, pp. 33-34). A related issue is that Hume presupposes the belief in an external world. He says that, 'It is in vain to ask, Whether there be body or not? That is a point, which we must take for granted in all our reasonings' (Treatise I: iv.ii). It is not clear when we can make presuppositions and when we are not allowed to do so.

Admittedly, the above-mentioned criticisms may be unfair to Hume because some of them are raised out of context or are one-sided. Hume's genius does not prevent him from being criticized. On the contrary, criticisms may be a sign of strength as they point to the amount of attention that great works receive.

3.3.3 Misunderstandings and Ambiguities

Hume was misunderstood by many, probably most, of his contemporaries. This is an indication of how radical, or 'revolutionary,' his ideas were at the time. N. K. Smith, a sympathetic reader of Hume, had an interesting observation:

> It is a very remarkable historical fact that notwithstanding the clearness and cogency of Hume's argument, and the appearance of such competent thinkers as Thomas Reid in Scotland, Lambert and Crusius in Germany, no less than thirty years should have

> elapsed from the publication of the *Treatise* before Hume found a single reader capable of appreciating his results at their true value. (Smith, 1915, p. 291)

The 'single reader' that Smith referred to is none other than Immanuel Kant. Kant himself lamented that:

> Hume was understood by no one. One cannot, without feeling a certain pain, behold how utterly and completely his opponents, Reid, Oswald, Beattie, and finally Priestley, missed the point of his problem.... The question was not, whether the concept of cause is right, useful, and, with respect to all cognition of nature, indispensable, for this Hume had never put in doubt; it was rather whether it is thought through reason a priori.... The discussion was only about the origin of this concept, not about its indispensability in use. (Kant, 1997, pp. 8-9)

Apart from such misunderstandings, there are also many ambiguous points in Hume's writings. Even today, many ambiguities in Hume's works have not been cleared. Samir Okasha, an avid Hume scholar, says that, 'Despite the attention which Hume's argument has received, there appears to be little consensus on what exactly the argument shows, nor on how the threat of inductive scepticism should be met' (2001, p. 308). Some of the major ambiguities are discussed below.

Hume's argument on induction. There is more than one way to interpret Hume's argument against induction. Firstly, there is the traditional view in which Hume's argument is treated as radically sceptical; this means that all our inferences from the observed to the unobserved are unwarranted or unjustifiable. More recently, however, more and more people have argued that the scope of Hume's scepticism is much narrower. They claim that Hume does not reject all accounts of probable inferences, but only a 'rationalist' or 'deductivist' account (Owen, 2004, p. 1). The cause of the ambiguity here is whether Hume is a deductivist. If he is, then his argument is against all inductive inferences. If he is not, then his argument is

merely that induction is unjustifiable for deductivists but may be justifiable by probable reasoning.

A natural consequence of this ambiguity is that different interpretations result in different attitudes towards the problem of induction. For example, those who hold the traditional view see Hume's argument as a paradox against common sense, and they try to find fault with the argument's supposed premises or with his reasoning (Millican, 1996, p. 4).

Demonstrative and probable reasoning. This ambiguity is concerned with whether Hume's dichotomy between demonstrative reasoning and probable reasoning is analogous to the present dichotomy between deductive reasoning and inductive reasoning. P. Millican (1996, pp. 17-18), for example, claims that there are good grounds for thinking that both distinctions are comparable, with the condition that inductive reasoning is understood in the broad sense and covers inferences of particular instances and general laws

A different view has been offered by Owen (1999, pp. 4-5). He claims that Locke's and Hume's distinction between demonstrative and probable inference is quite unlike our distinction between deductive and inductive inference. A deductive argument is valid by virtue of its form or syntax, whereas Hume's demonstrative reasoning is non-formal, that is, he has a semantic conception of inference. Hume's inference or reasoning has to do with ideas, and since ideas are pure content, inference is more a matter of content than of form. Likewise, inductive reasoning depends on its form; the truth of the premises makes the conclusion more likely. But Hume's probable reasoning depends on its content; its premises have a lower degree of certainty and this lesser degree is transferred to the conclusion. We are familiar with the notion that a deductively valid argument may be unsound.

Nature's uniformity theory (NUT). There are at least two problems with Hume's conception of nature's uniformity: one problem has to do with its meaning and the other with its function. From Hume's argument, it is not clear how uniform nature is. As discussed earlier, not everything in nature is uniform and not every constant conjunction is projectible. This

ambiguity is still unresolved.

As for the function of the uniformity theory, it cannot be determined whether the theory serves as a presupposition (a suppressed premise) or not, and if it does, what does it actually do? According to Millican (1996, pp. 35-39), there are two interpretations of the function of NUT. The first is that it is an implicit but necessary premise or 'middle term' of any inductive inference, without which the inference would be unjustified. Since NUT itself cannot be rationally justified, probable inference, which depends on it, is unwarranted. The second interpretation is that NUT serves as a 'probable medium,' linking the conclusion to its premises without the guarantee of deductive certainty. This sense has been used by Locke and it is likely that Hume inherits it from Locke together with the dichotomy between demonstrative and probable reasoning. Again, this ambiguity has not been resolved.

Production of ideas. A less obvious ambiguity has been noted by David Owen (2004, pp. 7-8). The point of contention is whether Hume's primary concern is with the justification of induction as is traditionally interpreted. Owen thinks that this is not the case; the problem of justification is the problem of induction in general, not Hume's problem. When Hume asks 'Whether experience produces the idea by means of the understanding or imagination; whether we are determined by reason to make the transition, or by a certain association and relation of perceptions' (Treatise I: iii.vi), he is talking about the 'production' of ideas and the 'transition' from observed impressions to unobserved ideas. Hume's point is 'How do we make this step?' not 'Once made, how is this step justified?' Thus, in Owen's view, Hume's problem is that reason cannot explain the production of a certain class of ideas, not the problem of justification of those ideas.

Despite the relative clarity of Hume's writings, ambiguities are unavoidable. Some people may choose to go with the majority, but the majority could be wrong. So, it looks like many ambiguities will remain with us for a long time to come.

3.3.4 Hume's Pattern of Argument[6]

It should be helpful to sketch Hume's pattern of argument before discussing how others respond to it. Hume's basis of inductive logic may be broadly divided into two main parts. The first is concerned with the formulation of universal causation and the second with particular causation, or causal laws of nature (McLendon, 1952, p. 146). Universal causation is the concept that every effect must have a cause whereas particular causation is the concept that a particular cause must have a particular effect, as discussed in the previous chapter. Thus, the pattern of Hume's sceptical argument may be said to contain the following steps:

1. *Induction must be based on either universal causation or particular causation.* This is the indispensability of causation in all inductive inferences. Knowledge of unobserved matters of fact depends upon a relation of causation between what is observed and what is not observed; only such a relation enables one to infer the latter from the former (McLendon, 1952, p. 146).
2. *Universal causation is not justifiable.* Firstly, the principle of universal causation is a contingent proposition because its negation is not self-contradictory. Secondly, the principle of universal causation cannot be verified by direct perception and memory alone. Thirdly, the principle of universal causation cannot be inferred from particular facts, since these facts alone provide only particular propositions. Therefore, the principle of universal causation is an unsupported principle (McLendon, 1952, p. 147).
3. *Particular causation is not justifiable either.* Particular causation is dependent on experience, but experience can neither deductively nor inductively justifies particular causation.
4. *Induction cannot be justified.* This is Hume's sceptical conclusion that many philosophers try to refute, as we shall see in the next chapter.

---

[6] Adapted from The Pattern of Sceptical Arguments, in A. J. Ayer, 1956, *The Problem of Knowledge* (pp. 76-78).

Chapter 4

Responses to Hume's Argument

The so-called 'Problem of Induction' or 'Hume's Problem' turns out to be one of the most enduring problems of epistemology. Many philosophers have tried to meet the challenge, resulting in many creative attempts to solve (or dissolve) the problem (Anderson, 2000, introduction). A good solution should be able to give the justification for using the available premises as evidence that the conclusion is true. However, how to attain it is still unclear and has been the focus of philosophical investigation (Kaplan, 1998, introduction).

The term 'justification' has several meanings. A literature review on induction shows that there are generally two kinds of justification, namely, validation and vindication. To validate is to confirm or verify; to vindicate is to justify by evidence or argument (Oxford Dict., 1998). Thus defined, validation has a stronger sense than vindication. Also, validation is less problematic than vindication because the latter is susceptible to degrees.

Vindication may be called 'practical' or 'pragmatic' justification because it applies mainly to actions. In the case of induction, this action is about making predictions and establishing rules that help to make the predictions successful (Feigl, 1961, p. 212). For example:

> The ascription of a certain degree of probability (i.e. degree of confirmation or evidential support) can be validated in the light of the available evidence and a rule of induction (or a definition of 'degree of confirmation'). But when we ask for a justification of the given rule of induction, or for a given definition of 'degree of confirmation,' the justification amounts to a vindication. (Feigl, 1961, p. 212)

Because of the impossibility of guaranteeing that induction must, or will probably, lead

to true predictions, the vindication for any inductive inference is to seek the most satisfactory means for forming expectations (Clendinnen, 1965, p. 370) and to avoid the circularity of guaranteeing the truth of inductively based predictions (Clendinnen, 1966, p. 215).

Hume probably would have preferred validation to vindication because his conception of knowledge requires strict certainty. But philosophers who try to meet Hume's challenge do so in different ways:

> There have been direct attacks upon some of Hume's arguments. Attempts to provide inductive arguments to support induction and attempts to supply a synthetic a priori principle of uniformity of nature belong in this category. Some authors have claimed that the whole problem arises out of linguistic confusion, and that careful analysis shows it to be a pseudo-problem. Some have even denied that inductive inference is needed, either in science or in everyday affairs. (Salmon, 1967, pp. 11-12)

Responses to Hume's argument are sometimes called 'approaches,' 'answers,' or 'solutions' to Hume's problem of induction. We turn now to the discussion of these responses. For clarity, they are divided into four groups.

4.1 Group 1: Induction Does not Need Justification

Some people take induction for granted. They do not see the need to justify it. Below are a few examples of responses in this group.

4.1.1 The Presupposition Approach.

This approach claims that the world is governed by some kind of natural law so that observed samples are representative of the populations from which they are drawn. In other words, it claims, in Hume's words, that, 'The future is conformable to the past,' meaning that nature is uniform (Kaplan, 1998, sect. 1). So, this presupposition allows us to go from the

observed to the unobserved.

This approach raises several problems. Firstly, observed samples are not always representative of the populations from which they are drawn, especially with small samples. Secondly, it says also that samples not yet observed are equally representative in this way. Thus, the very claim which this approach uses to justify the conclusion is one that requires justification (Kaplan, 1998, sect. 1).

4.1.2 The Naive Response

When people are asked why they think that the future will resemble the past, most of them will answer that it is so because it has been true in the past. Their reasoning is that, since it has always been the case that unobserved instances have been found at a later time to resemble observed instances, we can thus conclude (at least probably) that *all* unobserved instances will resemble observed instances (Anderson, 2000, the naive). This response may be expressed in a typical conversation as follows:

Husband:	I'm going out for a walk, Honey.
Wife:	Take the umbrella. It's going to rain. Dark clouds are hanging low.
Husband:	Why do dark clouds mean it's going to rain?
Wife:	Don't be silly. It has always been like that.
Husband:	But David Hume says that the course of nature may change.
Wife:	David who?
Husband:	David Hume.
Wife:	Never mind. Are you taking the umbrella?
Husband:	Yes Honey, just in case. Thanks for reminding me.

Hume or no Hume, it is better to be safe than sorry. However, the problem with this response is that it is circular, for it presupposes the very conclusion it wants to make.

Naive realism. A related but somewhat more profound concept is naive realism. The position of the naive realist is that we are capable of directly perceiving physical objects, including such things as atoms and electrons, that, under certain favorable circumstances, we can inspect the minds of others, that memory leads us directly to the past, and that induction is justified by our understanding of necessary connections between objects and events. This is a kind of intuitionism similar to how philosophers maintain their intuition of moral values (Ayer, 1956, p. 79).

Naive realists claim that it is a fact of life that some inductive inferences are rational while some others are irrational, and still some others are neither rational nor irrational. They are incapable of being proved and need not to be proved. However, a main drawback of this view is that it fails to distinguish good from bad inductive inferences (Hajek & Hall, 2002, pp. 154-155), and thus it is not philosophically enlightening; to say that something is known by intuition or by direct perception is equivalent to saying that we just know it without explaining how (Ayer, 1956, pp. 81-82). Another drawback is that the same inductive inference may be rational to some people but irrational to others. Without justification, the disagreement cannot be settled.

4.1.3 The Naturalist Approach

Many species of animals depend to a great extent on inductive practices for their survival even though they are incapable of understanding any argument in support of such practices. Thus, justification is not necessary for inductive practices. A weakness of this approach is that, if justification for one's opinion is not necessary, it would mean that our opinions are not any more worth holding than those we would acquire by superstition (Kaplan, 1998, sect. 6).

A related concept is the evolutionist approach. Many philosophers think that natural selection is truth-conducive because truths have survival values. Those who have wrong beliefs tend to die before being able to reproduce their offspring and the fittest who survive tend to have knowledge that is nearer to truth or is an approximation of truth. Over time, our knowledge becomes more refined. Therefore, correct knowledge is a necessary result of biological evolution (Pojman, 2001, p. 190). Since induction is the main method of acquiring knowledge of the world, it follows that inductive inference is truth-conducive.

There are several problems with this approach. Survival values may have little to do with truth. It is possible that most of our beliefs are false, but good enough for survival (Pojman, 2001, p. 190). For example, we may falsely believe that there are killer-demons roaming the forest at night, so we avoid going into the forest after dark. Although the belief is false, it has the effect of preventing us from being harmed by wild nocturnal animals. As Hume would have said, there is no necessary connection between truth and survival values.

4.1.4 Criticism of Group 1

To claim outright that induction does not need justification is the same thing as to evade the problem altogether. Here is a succinct explanation of the issue:

> Induction does require a justification. There are alternatives to induction that are all too often employed in forming expectations about the future; for example relying on hunches, accepting the prejudices and superstitions current in various social groups, and generalizing from obviously limited and atypical samples. Thus it is not possible to say that induction simply is the method used in predicting. Various people use various methods; those who adopt and advocate the inductive method do so believing that it is in some sense clearly superior to any of the alternatives. Thus it would be extra-ordinary if it were not possible to say why this is the proper procedure, or at least to explicate the sense in which it is superior to the alternatives. (Clendinnen, 1966, p. 215)

4.2 Group 2: Induction is not Needed

Most people would agree that induction is indispensable both in science and in everyday life. Karl Popper is a notable exception. He thinks that induction plays no role in science and claims that he has solved the problem of induction. In this section, I shall first discuss Popper's response and then discuss Samir Okasha's approach.

4.2.1 Popper's 'Solution'

Popper's main strategy is to:

- Attack induction and its principle, regularities, probability, verification, and the old system of knowledge; and
- Propose his idea of falsification, including the concepts of conjectures and refutations, and a new system of knowledge.

Popper's attack. Popper disagrees with the conventional view that natural science uses inductive methods, claiming that we are not justified in inferring universal statements from singular ones because such conclusions may turn out to be false (Popper, 1959, p. 27). Thus, Popper agrees with Hume that induction cannot be logically justified and that scientific theories can never be inferred from observation statements, or rationally justified by them. Hume's refutation of inductive inference is, for Popper, clear and conclusive (Popper, 1989, p. 42). In fact, Popper gives a lengthy discussion of his denial of the use of induction but there is no need to go into the detail here. Suffice it to say that:

> The success of science is not based upon rules of induction, but depends upon luck, ingenuity, and the purely deductive rules of critical argument. Induction, that is, inference based on many observations, is a myth. It is neither a psychological fact, nor a fact of ordinary life, nor one of scientific procedure. (Popper, 1989, p. 53)

Popper then goes on to attack the concept of regularity, claiming that we have a propensity to search for regularities, even where there are none, because we habitually expect regularities everywhere. We try to discover similarities in nature, and to interpret it in terms of laws invented by us (Popper, 1989, pp. 46-49).

Popper's next attack is on the concept of probability. He says that shifting the emphasis from 'truth' to 'probability' is rather misleading. The concept of probability may be suitable for physics and the theory of games of chance, but extending it to include the so-called 'inductive probability' or the 'probability of hypotheses' is doomed to failure (Popper, 1959, p. 316).

Popper is also opposed to the concept of verification in science. In his view, theories are never empirically verifiable (Popper, 1959, p. 40). His criticism of the verifiability criterion is that it allows many metaphysical statements but it excludes important scientific theories and universal laws of nature (Popper, 1989, p. 281).

Historically, scientific knowledge was treated as a system of true knowledge—as certain as it could be made. This is wrong, says Popper, because absolutely certain truth is not attainable. Instead, science should be considered as a system of hypotheses; that is, as a system of unjustifiable guesses with which we work as long as they stand up to tests (Popper, 1959, pp. 316-317).

The doctrine of falsification. Having attacked the use, or abuse, of induction and its related concepts, Popper then turns his attention to proposing his own alternative. He says that the actual work of the scientist consists in putting forward and testing theories. How new ideas are produced is irrelevant to the logical analysis of scientific knowledge. We should distinguish between the process of conceiving a new idea, and the methods and results of examining it logically (Popper, 1959, p. 31). Popper's view of scientific procedure is as follows:

> From a new idea, put up tentatively, and not yet justified in any way, conclusions are drawn by means of logical deduction. These conclusions are then compared with one another and with other relevant statements, so as to find what logical relations exist between them. (Popper, 1959, p. 32)

The relation between verifiability and falsifiability, according to Popper, is asymmetrical; universal statements are never verified by singular statements, but can be falsified by singular statements (Popper, 1959, p. 41). Thus, natural laws or theories are partially decidable, that is, they are, for logical reasons, not verifiable but falsifiable only by being submitted to systematic attempts to falsify them (Popper, 1959, pp. 312-313).

Although theories are not verifiable, they can be corroborated. Degree of corroboration is used by Popper to describe the degree to which a hypothesis has stood up to severe tests (Popper, 1959, p. 251). The degree of corroborability increases with its testability (Popper, 1989, p. 287). Corroboration is an evaluating report of past performance. But it says nothing whatever about future performance, or about the reliability of a theory (Popper, 1979, p. 18).

Popper claims that the procedure of testing theories is deductive. Supported by previously accepted statements, certain 'predictions' are deduced from a theory and put to tests. If the theory passes the severe tests and is not overthrown by a better theory, it is 'corroborated' by past experience. No induction is involved here (Popper, 1959, p. 33).

No theory can be shown to be true, claims Popper, so we should not rely on any theory. But we have to make a choice, and the best choice is the best-tested theory (Popper, 1979, pp. 21-22). Non-falsified theories are preferable because they may still be true whereas falsified theories are believed to be false. Furthermore, not all non-falsified theories are equal; some are better than others because they solve our problems, or because we hope they will stand up to further tests (Popper, 1989, p. 56).

Popper claims that his approach is fundamentally different from induction in its negative arguments, such as negative instances and attempted refutations while induction emphasizes positive instances and confirmation (Popper, 1979, p. 20).

Criticism. Popper's 'alleged' solution, as is well known, involves a complete rejection of induction (Salmon, 1981, p. 116). Many people reject Popper's view on the grounds of its absurdity. He seems to ignore the fact that we do use evidence from the past and present as a basis for making practical decisions (Hajek & Hall, 2002, p. 154). Besides, although many scientific laws have been discovered on the basis of theoretical assumptions, the knowledge-claims made by these laws are obviously inductive (Feigl, 1961, pp. 215-216). Popper's denial of the use of induction may be his strongest point of argument, but it is the least convincing point for many philosophers. W. C. Salmon puts it this way:

> Popper's theory does not pretend that basic statements plus deduction can give us scientific theory; instead, corroboration is introduced. Corroboration is a non-demonstrative form of inference. It is a way of providing for the acceptance of hypotheses even though the content of these hypotheses goes beyond the content of the basic statements. *Modus tollens* without corroboration is empty; *modus tollens* with corroboration is induction. (Salmon, 1967, p. 26)

In practice, there is no limit to the number of possible hypotheses (Dubs, 1935, p. 263), so, it is unlikely that scientists spend their time trying to falsify them. It is more likely that they will select the best hypothesis that can explain a phenomenon. And when they put a theory to test, they will almost always search for evidence to support it, not against it (Okasha, 2001, p. 326). Scientific theories in general come from identifying a local regularity of phenomena and then extending it globally (Rescher, 2000, p. 38). In scientific inquiry, we scan nature for interesting phenomena and then elaborate whatever useful regularities they may suggest (Rescher, 2000, p. 53).

Popper's method is not really deductive. It may be true that a hypothesis necessarily entails its conclusion, but when it comes to testing, we are concerned with whether we should accept the hypothesis in question. In this sense, the hypothesis is not a premise but a conclusion to be supported by evidence. And this inference from evidence to hypothesis must be counted as inductive (Salmon, 1967, p. 19).

Another objection is due to W. V. Quine. He says that theories are never tested in isolation. The failure of an outcome falsifies a block of theory as a whole, which contains a collection of statements. The failure merely implies that one or more of those statements are false, but we do not know which ones (Quine, 1993, p. 324). 'Any statement can be held true come what may, if we make drastic enough adjustments elsewhere in the system' (Quine, 1993, p. 405).

Even if Popper's account of scientific method were correct, it would not be able to do away with the problem of induction. For there is no point in testing a hypothesis except to confirm it. And a failed hypothesis is discarded precisely because it is unreliable; that is, it is likely to fail again (Ayer, 1956, p. 74). Without induction, all hypotheses are equally worthless for any future application. In the end, what is a myth is not induction, but Popper's denial of induction.

4.2.2 Okasha and Bayesianism

Okasha's approach bears some resemblance to Popper's in their denial of induction and its problem. But while Popper responds from the field of science, Okasha does from the field of probability. Another difference is that Okasha denies only the use of inductive rules, not induction itself. He claims that, 'If we do not in fact arrive at our opinions by using inductive rules, then Hume's sceptical argument cannot be converted into a sound one,' so 'our actual inductive practices are not susceptible to Humean attack;' Okasha's maxim is 'no rules of induction, no Humean argument (Okasha, 2001, p. 315). He explains it thus:

> If we believe that some observed correlations between properties will continue to hold in the future, that does not mean we are using the inductive rule to 'infer that properties correlated in the past will be correlated in the future,' for there are plenty of instances of that rule we do not accept. With rules of inference we really do use, e.g., modus ponens, we accept *all* substitution-instances that we can recognize as such. (Okasha, 2001, p. 318)

So, induction is not rule-governed because it does not apply to all constant conjunctions—what Okasha calls correlations. Okasha says that, 'Induction, or learning from experience, is just the process of revising probability assignments in the light of additional information' (Okasha, 2001, p. 320). Since we can revise only what we already know, background beliefs play an important role in our reactions to experience because the same experience may result in different expectations if background beliefs are different (Okasha, 2001, p. 318). The use of background beliefs is an important characteristic of Bayesianism.

When using the Bayesian model, one begins by allocating a subjective probability to a proposition. To learn from experience, what one has to do is to subject one's prior probability function to new evidence and adjust it accordingly. Okasha claims that this kind of Bayesian updating does not count as inductive inference in the strict sense because 'the state of opinion you end up in depends on the state you were in previously,' not on any inductive rules as in the case of induction. So the crucial difference is that inductive rules depend on the world being arranged in a particular way, while Bayesianism does not have this requirement (Okasha, 2001, p. 316). Bayesian updating will increase one's confidence of the generalization or proposition in question. So, no inductive rules are involved here (Okasha, 2001, p. 319).

Criticism. Okasha claims that Hume's scepticism on the problem of induction arises out of Hume's own misconception of inductive rules which need to be justified (Okasha, 2001, p. 323). The strategy of Okasha's argument is to deny inductive rules at all costs. It may be

summarized as follows:

1. There are no 'inductive rules whose existence I (Okasha) am disputing' (Okasha, 2001, p. 316).
2. If there are inductive rules, they are not known because 'no one has yet come close to saying what these rules actually are' (Okasha, 2001, p. 317).
3. If inductive rules are known, 'we do not use any of the inductive principles [or rules] that have so far been proposed' (Okasha, 2001, p. 319).
4. If we use inductive rules, they do 'not count as inductive inference' but are called 'Bayesian updating' instead (Okasha, 2001, p. 316).

Despite his denial of inductive rules, Okasha is able to give a definition: 'An inductive or ampliative rule, if such a thing existed, would be a rule for forming new beliefs on the basis of evidence, where the evidence does not entail the belief.' He even gives three examples of such 'non-existent' rules (Okasha, 2001, p. 315). He is probably confused between the lack of inductive rules and the lack of consensus on inductive rules. There is no shortage of inductive rules. In fact, there must be more than one inductive rule due to the fact that inductive conclusions are not entailed by their premises and that there are many different accounts of inductive inference.

Okasha then denies the use of inductive rules, whether they exist or not, by appealing to Bayesianism, and especially to Bayesian updating, which, he claims, does not count as inductive. But what is the point of updating a probability if it is not for the purpose of forming future expectations? There is a natural connection between inductivism and Bayesianism. Inductive inference often results in generalizations and predictions. Once obtained, a generalization or prediction may be assigned its probability value given the evidence. This next step may be done with the help of Bayesian updating (Gillies, 1993, p. 16).

Bayesianism is attractive because it offers a simple mathematical formula for changing one's beliefs in the light of evidence (Gillies, 2000, p. 82). But the application of probability is

itself an inductive process; therefore, theory of probability cannot be used as a basis for justifying our inductive process (Gillies, 2000, p. 99). A probability may give rise to an expectation, but this expectation must rest on the uniformity assumption, otherwise there is no ground for basing future expectations on past data. Thus, probability cannot be used to refute the need for the uniformity assumption (Murdoch, 2002, p. 189). Any inductive inference based on a probabilistic argument assumes that it should be regarded as probable. Hume's reasoning against circularity applies to both mathematical probability and all kinds of probable inference (Howson, 2000, p. 14). The probability calculus may be used in conjunction with empirical premises, but these premises need justification which the probability calculus cannot provide (Ayer, 1956, pp. 72-73).

Okasha's appeal to background beliefs does not help much either, since these beliefs are about contingent facts and thus stand in need of justification. The sceptic will demand the warrant for every background belief until there is nothing left (Lange, 2002, p. 232). And to support background beliefs with inductive reasoning is tantamount to shifting the problem back to its original place. The Bayesian model allows plenty of room for background knowledge, but it leaves no room for the belief that the future will resemble the past (Lange, 2002, pp. 226-227). W.C. Salmon concludes the issue of probability this way:

> As Hume has shown, we have no reason to suppose that probable conclusions will often be true and improbable ones will seldom be true. This dilemma is Hume's problem of induction all over again. We have been led to an interesting reformulation, but it is only a reformulation and not a solution. (Salmon, 1967, p. 52)

4.2.3 Criticism of Group 2

It does not seem to matter much what we call inference from experience, be it corroboration, Bayesian updating, or induction; whatever we call it, it is not necessarily truth-preserving because it goes beyond evidence. The problem of justification raised by Hume

applies to all kinds of non-demonstrative inference (Salmon, 1967, p. 27). Popper and Okasha try to put old wine in a new bottle, so to speak, thinking that by discarding the bottle, the problem will go away with it, but in fact the problem is with the wine; and so the problem remains.

4.3 Group 3: Induction is Justifiable

Group 3 is the most interesting of all. The reason is that members of this group try to meet the challenge head-on, resulting in many creative responses. What follows is a discussion of some of them.

4.3.1 Kant and Synthetic a Priori Knowledge

Kant says that, 'Though all our knowledge begins with experience, it by no means follows that all arises out of experience' (2003, introduction, sect. I). He says further that the old division between a priori and a posteriori truths is inadequate for knowledge; there must be a distinction between analytic and synthetic truths as well (McCormick, 2006, sect. 2). Kant claims that there is a third kind of knowledge which is synthetic and yet can be known a priori (Pojman, 2001, p. 19). Synthetic a priori knowledge is Kant's implicit response to Hume's scepticism in general and to his doubt on induction in particular. Kant begins by explaining the difference between analytic and synthetic judgements in general as follows:

> There is a distinction between judgements according to their content, by dint of which they are either merely explicative and add nothing to the content of the cognition, or ampliative and augment the given cognition; the first may be called analytic judgements, the second synthetic. For example, all bodies are extended (analytic), some bodies are heavy (synthetic). (Kant, 1997, p. 16)

Kant explains further the characteristics of each type of judgements. He says that all analytic judgements are necessarily a priori and are based on the principle of contradiction. The reason is that the predicate of an affirmative analytic judgement is already contained in the concept of the subject, it cannot be denied of that subject without contradiction. But synthetic judgements are different. They can be both. There are synthetic judgements known a posteriori originating from experience and synthetic judgements a priori certain arising from pure understanding and reason (Kant, 1997, pp. 16-17).

According to Kant, all mathematical judgements are synthetic. For example, the proposition '7 + 5 = 12' is synthetic because the concept of 'twelve' is added to the concept of 'seven plus five.' This can be seen all the more clearly when larger numbers are involved. However, there are some geometrical propositions that are actually analytic; but they merely serve as 'links in the chain of method.' Examples of such propositions are 'the whole is equal to itself,' and 'the whole is greater than its part.' Kant criticizes Hume for the thought that pure mathematics contains only analytic propositions (Kant, 1997, pp. 18-20) and that concepts are derived only from experience. In fact, claims Kant, concepts arise from the pure understanding (Kant, 1997, p. 10).

What Kant has to prove, then, is the existence of synthetic a priori knowledge, since it does not rest on the principle of contradiction (Kant, 1997, p. 27); that is to say, its negation is not self-contradictory even though it can be known a priori. Kant then gives a detailed defense of his synthetic a priori knowledge.

Kant claims that no a priori intuition is possible if it is conceived of as representing things as they are in themselves. The only way in which a priori intuition may occur is that it contains only forms of sensibility, or forms of appearance, not matters of appearance. Forms of sensibility precede all actual impressions and allow us to interact with objects. For example, space and time are the intuitions upon which all pure mathematical judgements are based because mathematics must first express its concepts in intuition. So, space and time are mere

forms of our sensibility that must precede all empirical intuition (Kant, 1997, pp. 34-35).

Next, Kant turns to the problem of causation. We do have knowledge of a pure natural science; for example, everything that happens has a cause. The question is: How is this kind of knowledge possible? (Kant, 1997, p. 48). Kant explains by dividing *empirical judgements* into two types, namely:

1. *Judgements of perception,* which are only subjectively valid; for example, the room is warm; the sugar is sweet.
2. *Judgements of experience,* which are objectively valid; for example, the air is elastic. (Kant, 1997, pp. 51-52)

According to Kant, all judgements begin as judgements of perception, with subjective validity. But before they can be transformed into judgements of experience, there must be an intervening force, provided by a priori intuition, to give them universal or objective validity. Since the given intuition is a pure a priori concept of the understanding and since the concept of cause is such a concept, it follows that causation is a pure concept of the understanding (Kant, 1997, pp. 52-54). Kant concludes that:

> It is completely the same, whether I say: A judgement of perception can never be considered as valid for experience without the law, that if an event is perceived then it is always referred to something preceding from which it follows according to a universal rule; or if I express myself in this way: Everything of which experience shows that it happens must have a cause. (Kant, 1997, p. 50)

The implication is that, once the origin of causation is known, Hume's problem of induction is solved. Kant argues that our knowledge of the law of causation, such as 'every event must have a cause,' is a priori because it is a pure concept of the understanding, and *at the same time* it is synthetic because the concept of 'cause' is not contained in the concept of 'event.' The possibility of synthetic a priori propositions includes those in mathematics,

natural science, and metaphysics (Kant, 1997, p. 31); so, the existence of synthetic a priori knowledge not only solves Hume's Problem but also makes possible an abundance of abstract knowledge.

Criticism. It is quite obvious that Kant's project of synthetic a priori knowledge is much larger than a mere response to Hume's problem of induction; it is an epistemological project in its own right. However, what concerns us here is limited to the question whether Kant's theory solves Hume's problem.

Kant's theory depends on a pair of distinctions. The first distinction, between a priori and a posteriori knowledge, is not due to Kant; it is a traditional one, prevalent before his time. The second distinction, between analytic and synthetic judgements, is really Kant's own invention (Gillies, 1993, p. 76). Kant's main concern is to defend his theory of synthetic a priori knowledge—knowledge that is a priori in its justification and yet synthetic in its logical form (BonJour, 1998, p. 21); and our main concern here is to find out whether his defense is convincing.

Unfortunately, there is no consensus as to whether there exists such knowledge as synthetic a priori knowledge since there are both advocates and opponents. H. W. Noonan (1999, p. 94) gives a few examples of necessary a posteriori truths: Water is H_2O; gold is an element; this table was originally made from a particular piece of wood. These propositions, which state either the properties of natural kinds or the origins of particular objects, are good counter-examples to Hume's denial of necessary connections between distinct existences.

On the other side of the argument, W. V. Quine (1993, pp. 396-397) claims that the distinction between analytic and synthetic statements is unclear. Analytic statements are often defined as 'statements whose denials are self-contradictory.' But this definition does not explain much because the term 'self-contradictory' needs to be clarified as much as the term 'analytic.' Furthermore, there are weaknesses in Kant's conception of containment—the idea that a predicate is, or is not, contained in the subject. One weakness is that its application is

restricted to statements of subject-predicate form; the other weakness is that 'containment' implies 'synonymy,' which stands in as much need of clarification as 'analytic' itself.

The progress of natural science has rendered Kant's examples of synthetic a priori knowledge less credible. A case in point is Einstein's theories of space, time, and motion. According to Friedman (2002, p. 172), the Newtonian laws of mechanics are no longer universally valid, thanks to Einstein's discoveries.[7] Another example is the oft-cited case of non-Euclidean geometry, which is considered by many to have overthrown Euclidean geometry. If Euclidean geometry, which was once the paradigm of a priori knowledge of nature, is revisable, then everything is revisable. I should add here that there are other opposing opinions. Stephen Palmquist (2001, sect. 3), for example, claims that Euclidean geometry is (as Kant argued) the form of our intuition of space and therefore a priori, whereas non-Euclidean geometry can only be a posteriori because curved space is not picturable, but purely conceptual. In other words, our knowledge of the applicability of any non-Euclidean geometry will be contingent because it presupposes experience, whereas that of Euclidean geometry is necessary because it prefigures experience. Moreover, in the case of space and time, Kant treats them as 'mere forms of our sensibility,' (that is, not real existences), so, in this sense, Kant's concept of space and time is much closer to Einstein's than Newton's theory.

A related objection has been raised by W.C. Salmon (1967, p. 38). He says that there is a case to make against the doctrine that geometry and arithmetic are synthetic a priori. Take the case of geometry; it is useful to distinguish pure and applied geometry. Pure geometry is concerned exclusively with what theorems follows deductively from what postulates, so it is a priori, but it is not synthetic. Applied geometry is to describe the behavior of physical objects by means of observation, so it is synthetic, but it is not a priori. The same is true in the case of arithmetic. Therefore, Kant's theory of causation and his notion of synthetic a priori

---

[7] To make it more balanced, it is worth mentioning that Einsteinian relativity and quantum mechanics are not universally valid either.

knowledge are not convincing for some philosophers.

Several other philosophers also have negative opinions on Kant's theory. Karl Popper (1989, p. 48), for example, thinks that Kant was right when he said that we impose laws on nature, but Kant was wrong 'in thinking that these laws are necessarily true, or that we necessarily succeed in imposing them upon nature.' Although there are many more comments, both positive and negative, on Kant, what I have mentioned should suffice to show that Kant's concept of synthetic a priori knowledge is still a controversy.

So, it looks like Kant's theory is ineffective in solving Hume's problem of induction. After Kant, many philosophers have tried to justify induction, resulting in various types of argumentation, three of which are especially popular: the sophisticated inductivism, the pragmatic argument, and the dissolution argument (Pojman, 1993, p. 431). My next task is to analyze some of these popular attempts at justifying induction to see whether any of them is successful.

4.3.2 The Sophisticated Inductive Response

Some philosophers use induction itself to support induction. Frederick L. Will is such a philosopher. He claims that we have a way to know that the future will resemble the past. He makes an analogy that the sceptics think of themselves as living in a static enclosure in which knowledge of the future is impossible; in fact, says Will, we live in an ever-expanding enclosure with a constantly receding border. We constantly confirm our predictions of the future, resulting in our knowledge of nature's laws and the future (Pojman, 1993, p. 442).

Will begins by asking the question, 'Is inductive reasoning really circular?' His answer is that, under certain circumstances, it is not. In his view, there are certain specific generalizations in which 'mere differences of position in time and space are regarded as irrelevant,' because they merely 'describe the conditions under which certain objects exist and events occur' (Will, 1993, p. 445). In other words, certain regularities in nature are proofs of

natural laws and these laws apply to all cases, regardless of spatio-temporal differences. Will's task is to explain how his claim can be supported by induction without circularity, and he does it with an interesting analogy.

Will imagines the world to be an enclosure, which he calls Past, and the territory beyond this enclosure is called Future. No one can go to Future or make any observations about it. Now suppose that someone in the land of Past wants to know whether the proposition 'roosters fight more than hens' is true in the land of Future. All records revealed by the ever-receding border in the land of Past have confirmed that it is true, and there has not been one negative instance so far. So, the present evidence does verify the proposition in question. Since the border is constantly receding, more evidence will come in to support it. In this way, it is possible to derive hypotheses from what has already been revealed and to test them by the progressive revelations of Future. Thus, the sceptics are wrong in thinking that we are in no better position to know about Future things than we would be if the enclosure is static (Will, 1993, p. 447).

Will goes on to support his claim with yet another example. Suppose that in 1936, a person claimed that the future would be like the past. In 1936, if it could somehow be shown that 1937 would be like 1936, this would have verified his or her claim. But in 1937, when he or she did establish that 1937 was like 1936, it was no more evidence. In Will's opinion, this is equivalent to saying that tomorrow never comes because, when tomorrow comes, it won't be tomorrow; it will be today, which is absurd (Will, 1993, p. 448). Will concludes that, as time passes, more knowledge about the future is being gained, with the effect that we are better able 'to learn more and more accurately what the laws of nature's behavior are and how therefore the future will be like the past' (Will, 1993, p. 449).

Criticism. A major problem with Will's response is that it misses the point. We cannot take events in the land of Future as evidence *until they are observed.* So, we do not know, before observing them, that any particular Future instance will resemble Past events (Anderson,

2000, sophisticated). Thus, Will's argument is inherently circular. Bertrand Russell explains this problem very well in the following passage:

> It has been argued that we have reason to know that the future will resemble the past, because what was the future has constantly become the past, and has always been found to resemble the past, so that we really have experience of the future, namely of times which were formerly future, which we may call past futures. But such an argument really begs the very question at issue. We have experience of past futures, but not of future futures, and the question is: Will future futures resemble past futures? This question is not to be answered by an argument which starts from past futures alone. We have therefore still to seek for some principle which shall enable us to know that the future will follow the same laws as the past. (Russell, 1912, pp. 35-36)

Will's inductive response may be sophisticated, but it is just an analogy, not a solution to Hume's problem of induction. The analogy merely compares the past to an enclosure and the future to what is beyond it. The problem is not solved by the mere change of terminology. Furthermore, Will's illustrations do not lend any weight to his argument. The example of roosters and hens hardly proves or confirms a natural law; the habits of animals may change due to domestication or evolution; they may even become extinct. Will's example of the year 1937 being like the year 1936 is even less credible. Firstly, not everything in 1937 was like what it had been in 1936. Secondly, even if 1937 was exactly like 1936, it might be due to chance; it does not prove that the years after 1937 would be like 1936. Since the future is infinite, no amount of observation will suffice to prove a law inferred from generalization. Therefore, Will's argument fails to inductively justify induction.

4.3.3 The Pragmatic Justification of Induction

This approach was first proposed by Hans Reichenbach (1891-1953) and it is also

known as the vindication of induction (BonJour, 1998, p. 192). Reichenbach agrees with Hume that it is not possible to justify inductive inference either deductively or inductively. Be that as it may, there are good practical grounds for trusting induction. The principle of induction is our best bet because it is the only hope for guidance in life and in science (Pojman, 1993, p. 450).

Reichenbach argues that Hume's demand is excessively restrictive; Hume's justification amounts to a proof that the conclusion of every inductive inference is true. Surely, this demand cannot be met (Reichenbach, 1993, pp. 452-453). The question is whether it is necessary, for the justification of inductive inference, to show that its conclusion is true. Reichenbach's answer is negative. His reasoning is that, 'A justification of the inductive inference does not imply a proof of the truth of the conclusion' because 'the proof of the truth of the conclusion is only a sufficient condition for the justification of induction, not a necessary condition' (Reichenbach, 1993, p. 451).

The aim of inductive inference is to give us the best assumption about the future. Even though we have no way of knowing the truth concerning the future, it is possible to find out a best assumption about it, relative to what we know. This possibility is used by Reichenbach as his justification of the principle of induction (Reichenbach, 1993, p. 451).

Reichenbach's argument may be divided into two versions, namely, the more formal version and the less formal version (Hajek & Hall, 2002, p. 152). In the more formal version, he defines the aim of induction as 'to find series of events whose frequency of occurrence converges toward a limit.' This formulation is suitable because we need probabilities for predictions and a good way of thinking about probability is to treat it as the limit of a frequency. According to Reichenbach, nothing is lost in practice by determining the principle of induction in this way; for these limits of frequency are all we need in making good predictions. And if any method can lead to the limit of the frequency, the inductive method can as well; that is to say, if there is a limit of the frequency, the inductive principle is a

sufficient condition to find it (Reichenbach, 1993, p. 452).

If several methods, when they are sufficiently continued, can lead to the same limits of frequencies, then why is the inductive method preferable to others? Reichenbach's answer is quite simple. Other methods, if they work, are to be 'submitted to the control of scientific methods, i.e., by the principle of induction.' In short, they are inductive (Reichenbach, 1993, p. 452).

In the less formal version, Reichenbach says that what we obtain from his method is a wager. This is the best wager we can get under the condition that true predictions are beyond our power (Reichenbach, 1993, p. 452). This version may be expressed in this way. Nature is either uniform or not uniform. Let us consider the outcomes of using and not using the inductive principle (for brevity, call the latter 'pure guess'):

- If nature is uniform, induction is highly reliable but pure guess is uncertain.
- If nature is not uniform, induction is useless, so is pure guess. (Payne, 2003, sect. 3)

The following table sums up the outcomes of using induction and pure guess:

	Nature is Uniform	**Nature is not Uniform**
Using induction	Succeeds in predicting the future	Fails in predicting the future
Using pure guess	Fails in predicting the future	Fails in predicting the future

Thus, pure guess is not reliable no matter whether nature is uniform or not. As for induction, it will certainly be helpful at least in the case when nature is uniform. Therefore, it is rational for us to prefer this method of inference over others (Payne, 2003, sect. 3).

Reichenbach concludes that, even though induction cannot be justified by any philosophical principle, we do not renounce it. We know that the inductive method is the best among all procedures for predicting the future. Despite the lack of justification for our belief,

we are able to justify the structure of inference concerning the practical results of our prediction about the future (Reichenbach, 1993, p. 452).

According to Reichenbach, philosophers have failed in their attempt to justify induction because they have been misled by the logical aspect of the problem; that is, they try to look for necessary qualities in nature that would guarantee the success of inductive inference. To solve this problem, claims Reichenbach, we should change our old conception that knowledge consists of a system of true propositions. Instead, knowledge should be treated as a system of posits, or wagers. On this view, the question then is whether scientific knowledge (induction) is our best wager. Since true predictions are beyond our reach, the next best thing is to know how to arrive at the best wagers (Reichenbach, 1993, p. 454).

Criticism. Many philosophers have responded to Reichenbach's argument, both favorably and unfavorably. W. C. Salmon (1967, p. 52) is a sympathetic reader of Reichenbach's, saying that Reichenbach's pragmatic justification is the most promising among all the solutions and dissolutions proposed to deal with Hume's problem of induction. Salmon has noted that it was not Reichenbach's intention to prove nature's uniformity. Rather, what Reichenbach tries to show is that the inductive method is the best method for ampliative inference, whether it turns out to be successful or not (Salmon, 1967, p. 53). Salmon concludes that it is 'reasonable to act in terms of inductive inferences, because if any path leads to successful action this one will.' For this reason, using the results of induction is justified; we have everything to gain and nothing to lose (Salmon, 1953, p. 47).

H. Feigl (1961, pp. 213-214) agrees with Reichenbach on the point that, if nature is uniform in certain respects, the method of induction will be able to find it. Any types of inference, if successful, are indications of the uniformity of nature, and as such they are subjected to induction. For example, assuming that crystal gazing were a reliable indicator of future events, its success would be observed from the regularity in the behavior of crystal-balls, or crystal gazers, and some subsequent events.

For every sympathizer of Reichenbach's, there are several objectors. Although Reichenbach's argument does make it reasonable to use induction, it does not explain why it is reasonable to expect that the general method of predicting will continue to work on the basis that it has worked in the past (Clendinnen, 1966, p. 217). In other words, it fails to justify induction unless the principle of uniformity is presupposed.

Another objection is raised against the concept of limits that can be reached in the long run. We can never know that the limit of a frequency has been identified, or it may take such a long time to get to the limit that it is irrelevant for practical use. Furthermore, in the short run, it is possible that the inductive method fails while other methods succeed (Friedman, 1975, p. 177).

Pojman (2001, pp. 57-58) points out that Hume does not dispute the practical value of living by probability (induction) since only a fool or madman would think otherwise (Hume, 1975, p. 38). In this sense, Reichenbach's pragmatic justification fails to respond to the point at issue, so Hume's point still stands. BonJour (1998, p. 195) agrees with Pojman, saying that this kind of justification does not even claim to resolve the doubts of inductive sceptics. In fact, it has the opposite effect because the argument tends to support the sceptical view that induction is not based on logical reasoning.

Since Reichenbach's pragmatic justification of induction is not intended to justify induction itself, but only its use, it is non-epistemic in the same sense as Pascal's wager (Payne, 2003, sect. 3), which may offer motivation for believing in God, but leaves us none the wiser as to whether He actually exists. Likewise, the pragmatic argument may encourage us to use induction, but it does not explain whether the inductive results are true (Anderson, 2000, pragmatic). In a way, Reichenbach's approach is just a distraction; it turns our attention away from the real issue and concentrates on a less severe problem that can be solved, a case of attacking the 'strawman,' so to speak..

4.3.4 The Dissolution Approach

Some philosophers claim that the problem of induction is a pseudo-problem. Peter F. Strawson is one of them. He argues that those who ask whether induction is justified do not really understand the meaning of induction (Pojman, 1993, p. 455). Once the real meaning of induction is understood, the problem of induction disappears.

Strawson admits that we have the habit to form expectations, but he denies that we should doubt this habit. This doubt, he claims, is due to a confusion, and many attempts to clear away the doubt fail because they tend to preserve the confusion (Strawson, 1993, p. 455).

The said confusion is about the lack of validity in our inductive processes; so, there is a demand for the justification of induction. Because of the confusion, the demand turns out to be that induction must be proved to be deductively valid, which is impossible; if inductive arguments were deductively valid, they would be deductive arguments. Therefore, inductive reasoning must be evaluated by inductive standards (Strawson, 1993, p. 456). Strawson's argument is based on the concept of analyticity. He explains it in this way:

> 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 an analytic proposition, though not a proposition of mathematics, that, other things being equal, the evidence for 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. (Strawson, 1993, p. 457)

To support his point of analyticity, Strawson draws an analogy between induction and the law. He says that we never ask whether the law is legal. That is because the law must be legal, for there are no higher standards to appeal to. It is alright to doubt a particular action whether it is legal, but not the legal system as a whole. Likewise, it is generally proper to ask whether a particular belief is justified; this makes sense because we can find out whether the

belief conforms to our inductive standards. But it makes no sense to doubt the application of inductive standards for the same reason as in the case of the law (Strawson, 1993, pp. 457-458).

Strawson claims further that, although there may be several specific methods of prediction that can be applied to different situations, all of them are based on the principle of induction (Strawson, 1993, p. 458); a method is considered to be successful only after it has been repeatedly applied with success, so it is an analytic proposition, since it is self-contradictory to say that a successful method is not inductive. However, Strawson hastens to point out that induction is not justified by its success but success implies inductive support (Strawson, 1993, p. 459). This last point should be kept in mind since, without it, Strawson might be misinterpreted as claiming success for every inductive inference.

Criticism. It has been pointed out that Strawson's analogy between induction and the law is not convincing. Although it is true that we have no standards by which to judge the legality of the law, a legal system can nevertheless be judged in other respects like justice and public order (Weintraub, 1995, p. 467). For example, a racist law may be legal but unfair. By the same token, induction may be reasonable but unreliable; since we do not have an effective way of distinguishing between good and bad inductive arguments, it is reasonable, in Strawson's sense, to treat bad arguments as good ones (Friedman, 1975, pp. 180-181).

Samir Okasha (2001, pp. 324-325) accuses Strawson of avoiding the problem of induction by 'shifting the goalposts.' Okasha is unconvinced by Strawson's argument that, 'It is true by definition that the use of induction is rational, though not that it will be successful.'

K. S. Friedman (1975, p. 179) claims that Strawson's argument is prone to several counter-examples, such as, positive instances of a hypothesis may, under certain circumstances, lower the probability of that hypothesis. Another counter-example has been given by J. N. Anderson (2000, the ordinary). Suppose there is a community in which wishful thinking is a reasonable way of coming to conclusions about the future. The statement 'wishful

thinking is reasonable' would be analytically true, but no rational people would agree with it.

So, Strawson's claim of inductive analyticity is untenable. It is generally accepted that valid deductive rules are necessarily truth-preserving, while inductive rules are not (Harman & Kulkarni, 2005, pp. 1-2). Thus, the deductive method may be said to be analytic but the inductive method does not enjoy such a status.

In sum, Strawson's argument, although popular, is unconvincing. In my view, it is Strawson himself who is confused. He equivocates between the legality and purpose of the law, between reasonableness and reliability, between the strength of evidence and truth, and most importantly between rationality and analyticity. And so, it looks like Strawson has actually moved the goalposts.

4.3.5 BonJour and his 'a Priori' Solution

The last response in this group to be discussed comes from Laurence BonJour. His means of justification is different from conventional approaches in several ways. Firstly, BonJour claims that his method of justification need not turn induction into deduction. Secondly, it does not rely on the uniformity of nature. Finally, it is a priori (BonJour, 1998, pp. 204-205), which is the most important characteristic of this approach.

BonJour begins by claiming that the problem of induction can be solved in two broad ways, namely, the empiricist way and the rationalist way (on a purely a priori basis). Since the empirical way has often been shown to be circular and question-begging, the only choice left to us, apart from resorting to extreme scepticism, is an a priori justification of induction (BonJour, 1998, pp. 200-203). Because the principle of induction transcends direct observation, the problem of induction is a problem of observation-transcendent inference. As such, the problem can best be solved by a priori reasoning, and the prospects for an a priori justification are quite good (BonJour, 1998, pp. 187-188).

BonJour then asks this crucial question: 'What does it mean for a conclusion to follow

rationally, whether certainly or probably, from a set of premises?' His answer to this question leads to his claim of a priori justification. He says that anyone who understands the truth of the premises will be able to grasp the truth of the conclusion either with certainty (in the case of deduction) or with probability (in the case of induction). This understanding or grasping of truths can only be a priori in character. Therefore, any 'rationally justified transition' from the premises to their conclusion must be made on an a priori basis (BonJour, 1998, p. 203).

In the case of induction, what we need is an a priori reason for thinking that the conclusion is *likely* to be true if the premise is true. For example, if m/n of observed A's have been B's, then it is likely that approximately m/n of all A's are B's. However, BonJour is aware that the constant conjunction of A's and B's may be accidental, so there must be a further requirement that the observed proportion of A's that are B's tends to converge to m/n. He claims that this kind of reason is derived a priori because such regularities provide the best explanation for the truth of the premises, and this explanation is known a priori from our reasoning that coincidence is unlikely (BonJour, 1998, pp. 206-208).

BonJour admits that there may be some possible worlds in which there are no 'non-chance' explanations—everything is irregular in such worlds—but he claims that this is unlikely because such worlds 'involve the repeated recurrence of an unlikely situation.' And this is why it is unlikely that the actual world is such a world (BonJour, 1998, pp. 208-209).

BonJour is also aware that his solution is incomplete. For example, how do we extend past regularities into the future? His reply is that regularities, as he formulates them, must be stronger than mere constant conjunctions and must have the propensity to persist, otherwise they will not be the best explanation of the inductive evidence (BonJour, 1998, p. 214).

Another objection anticipated by BonJour is that some inductive evidence may apply only in the area under observation, but not other areas. To this he responds that, if the observed area is small, it is unlikely that, in the long run, our observations will be limited to only one area; if it is a large area, the inductive conclusion is then likely to be true (BonJour,

1998, p. 215).

Criticism. Because the most prominent characteristic of BonJour's approach is its claim of being derived a priori, the main problem to be considered is whether the derivation is purely a priori. There are reasons for thinking that it is not. Firstly, the unlikelihood of sheer chance does not necessarily imply regularity, since there are other explanations; for example, there may be intervening factors which cannot be ruled out a priori. Secondly, it cannot be known a priori that 'irregular' worlds are unlikely and that the actual world is 'regular.' Thirdly, it cannot be known a priori that a convergence to its limit has been reached. Finally, even when regularities are identifiable, their propensity to persist into the future cannot be known a priori. Therefore, as BonJour's claim is not purely a priori, it suffers the same fate as other empirical responses.

Even if BonJour's a priori reason can be established, it will not necessarily result in a justification, for it rests on likelihood of likelihoods; in other words, his argument contains several layers of likelihood as follows:

- Regular worlds are more likely than irregular worlds, so the actual world is more likely to be a regular world.
- Regularity is likely to be the best explanation of a convergence because coincidence is unlikely.
- Regularities are likely to persist.

Suppose that all the above likelihoods are known a priori as BonJour claims, and suppose that, for the sake of argument, we are able to assign a rather high probability figure of 0.8 to each likelihood, the end result will be a probability (likelihood) of only 0.512—calculated from $(0.8)^3$—meaning that several layers of likelihood may result in unlikelihood. Consequently, the prospects for an a priori justification are not as good as BonJour would like them to be.

4.3.6 Criticism of Group 3

After considering all the above claims of justification of induction, it is obvious that there are no inductive propositions whose premises are apparently true and non-question-begging and whose corresponding conclusions show that the particular inductive inferences are rationally justified (Hajek & Hall, 2002, p. 152). As have been shown, attempts to justify induction by means of epistemological theories on a purely a priori basis have resulted in a dead end (Kornblith, 1995, p. 5). And attempts to justify induction by means of empirical reasoning have resulted in either an infinite regress, circularity, or uncertainty.

4.4 Group 4: Induction is not Justifiable

Some philosophers admit that there are no generally accepted ways to justify induction, so they try instead to explain why induction is not justifiable. In this section, I shall discuss the thoughts of three such philosophers, namely, Bertrand Russell, David Hume himself, and Nelson Goodman.

4.4.1 Bertrand Russell

Russell agrees with Hume that we can never use experience to prove the inductive principle without begging the question; therefore, we must either accept the inductive principle, or we cannot have any justification of our expectations about the future. Without induction, there is no reason for expecting the sun to rise tomorrow, or for any other expectations in our daily lives. Russell is of the opinion that the reference to the future in Hume's problem is really not essential. We have the same question when we make inferences to past things which we have not observed, for example, in geology, or in theories concerning the origin of the Solar system (Russell, 1912, pp. 36-38).

Russell claims that all such expectations are only probable; thus it is not necessary to

try to prove that they must be fulfilled, but we should only try to find some reason for the likelihood of their fulfillment. The most we can hope is that the more often things are found together, the more probable they will be found together again. And if they have been found together often enough, the probability will almost reach certainty. But absolute certainty is impossible because things may change unexpectedly, as in the case of the chicken whose neck is wrung by the person who feeds it. Nevertheless, probability is all we should look for (Russell, 1912, pp. 34-36).

Russell cautions that probability is always relative to certain data, which are merely the known cases of constant conjunction. Additional data may change the current probability. For example, a man who had seen many white swans might argue that all swans were white. His argument is not disproved by the fact that some swans are black, because this new knowledge is outside his existing data (Russell, 1912, p. 37).

Therefore, concludes Russell, our inductive principle is not capable of being *disproved* by experience. Nor is it capable of being *proved* by experience. All experiential arguments concerning the future or the unobserved must presuppose the inductive principle (Russell, 1912, p. 38).

4.4.2 Hume's own Solution

According to Hume, what we can observe is a succession of objects and events. One observation cannot tell us the relation of cause and effect because the conjunction of objects may be arbitrary. With more experience, we observe constant conjunction of certain objects and infer the existnece of one object from the appearance of the other. Still, the knowledge of the secret power of objects comes neither from experience nor reasoning. Therefore, there must be a principle that allows us to make such inferences (Hume, 1975, p. 42). Hume says that, 'This principle is Custom or Habit.... After the constant conjunction of two objects—heat and flame, for instance, weight and solidity—we are determined by custom alone to expect the

one from the appearance of the other' (Hume, 1975, p. 43).

Hume claims that his hypothesis can clear the difficulty in explaining why we can draw an inference from a thousand instances but not from one instance alone, whereas reason is incapable of doing this (Hume, 1975, p. 43). He then goes on to conclude that:

> All inferences from experience, therefore, are effects of custom, not of reasoning. Custom, then, is the great guide of human life. It is that principle alone which renders our experience useful to us, and makes us expect, for the future, a similar train of events with those which have appeared in the past. Without the influence of custom, we should be entirely ignorant of every matter of fact beyond what is immediately present to the memory and senses. We should never know how to adjust means to ends, or to employ our natural powers in the production of any effect. There would be an end at once of all action, as well as of the chief part of speculation.... All these operations [of drawing inferences] are a species of natural instincts, which no reasoning or process of the thought and understanding is able either to produce or to prevent. (Hume, 1975, pp. 43-46)

To sum up, Hume's view is that the experience of constant conjunction tends to create a 'habit of the mind' that leads us to infer the conclusion when we encounter the same premise again. This habit is not an objective feature of nature, but a subjective power. To think that there is objectivity in cause and effect, which supports the principle of induction, is an illusion (Vickers, 2006, sect. 2).

However, Hume's strategy is to explain where it cannot be justified and his explanation is an appeal to something non-rational and innate (Howson, 2000, p. 20). Therefore, his solution also suffers the same weakness as several others in the sense that it merely explains how we come to believe that the future will resemble the past but it does not give the foundation or source of authority for such a belief. And it is this source of authority

that Hume seeks in the first place. Having said that, I must hasten to add that Hume's sceptical solution is compatible with his conviction that there is no logical foundation on which the principle of induction can be based, and this means that induction is not justifiable.

4.4.3 The New Riddle of Induction

Nelson Goodman (1906-1998) adds a second problem to Hume's sceptical doubts on induction, saying that there is the problem of differentiating between predicates that are projectible and those that are not. He invented an ingenious way of illustrating this extended problem (Pojman, 1993, p. 459).

Goodman begins by stating that Hume's account of induction based on regularities was imprecise. In fact, some regularities do establish habits while others do not; it follows that predictions based on some regularities are valid while predictions based on other regularities are not (Goodman, 1983, p. 82).

Goodman explains that, when a hypothesis is to be confirmed by an instance, what must be taken into consideration is not only its syntactical form, but also the features of the hypothesis. For example, the hypothesis 'all copper conducts electricity' is a legitimate generalization while the hypothesis 'all men in this room are third sons' is not, even though both are confirmable by particular instances. The difference is that the first hypothesis is a lawlike statement while the second hypothesis is a contingent or accidental generality. Obviously, then, we should search for a way of drawing the distinction between lawlike and accidental statements (Goodman, 1993, pp. 459-460).

But things are not so simple. Here, Goodman gives his inventive illustration. He introduces a new predicate 'grue' which applies to all things observed before time *t* just in case they are green but to other things just in case they are blue. If at time *t*, all observed emeralds have been green, then the prediction that all emeralds subsequently observed will be green and the prediction that they will be grue are both confirmed by evidence. But after time *t*,

if the next observed emerald is grue, it is blue and hence not green. This shows that the same observation may confirm different predictions. Because we lack a criterion for determining lawlikeness, we are in an awkward situation in which anything may confirm anything (Goodman, 1993, p. 460).

Some people may argue that the predicates 'green' and 'blue' are purely qualitative while the predicates 'grue' and 'bleen' ('bleen' applies to emeralds observed before time *t* just in case they are blue and to other emeralds just in case they are green) are not, since the meanings of the latter two predicates refers to a particular time. To this Goodman replies that, if we start with grue-bleen, then green-blue will be explained in terms of grue-bleen and a temporal term; 'green,' for example, applies to emeralds observed before time *t* just in case they are grue, and to other emeralds just in case they are bleen. Qualitativeness is an entirely relative matter. Goodman concludes that we have no good way to distinguish lawlike hypotheses from accidental ones. It is this problem that Goodman calls 'the new riddle of induction' (Goodman, 1993, p. 462).

As a solution, Goodman proposes the rule of entrenchment derived from the use of language (Goodman, 1983, pp. 94-95). But entrenchment, for Goodman, depends on frequency of projection rather than on mere frequency of use, so that new and useful predicates are not excluded merely because of their novelty. Goodman's rule reads as follows: 'A hypothesis is projectible if all conflicting hypotheses are overridden, unprojectible if overridden, and nonprojectible if in conflict with another hypothesis and neither is overridden.' For example, the hypothesis 'all emeralds are grue' is overridden by the hypothesis 'all emeralds are green' because 'green' is well-entrenched while 'grue' is not (Goodman, 1983, p. 101). However, Goodman cautions that there is no way to know whether projections of well entrenched predicates will turn out to be true; we simply have no guarantees (Goodman, 1983, pp. 98-99).

Criticism. Since Goodman's new riddle is an extension to Hume's problem, his points

are quite different. They can be summed up in three issues:

1. Is projectibility of predicates a problem?

2. Is Goodman's description of the problem of projectibility accurate?

3. Does Goodman's rule of entrenchment solve the problem of projectibility?

For the first issue, there are both agreement and disagreement. BonJour (1998, p. 189), for example, does not see that Goodman's new riddle has any important effect on the classical problem of induction. But Hempel (2001, p. 346) agrees with Goodman that the same evidence can be described in different ways and results in logically incompatible generalizations and hypotheses concerning particular past, present, or future cases. So, the problem of projectibility is a real issue. J. L. Pollock (1986, pp. 145-146) explains further that projectibility depends on concepts, not formal relationships. Although there is no general theory of projectibility, we know that induction does not apply equally to all concepts and thus inductive reasoning must be restricted to projectible concepts. Therefore, in my view, projectibility of predicates is an important issue in induction.

For the second issue, many people agree that Goodman's idea is inventive and unique but not accurate. J. Clendinnen (1966, pp. 225-226), for example, comments that the predicate 'grue' involves a complexity that has not been observed up to now in any objects. It is therefore misleading for Goodman to claim that the color 'grue' represents a regularity that has been observed. It may be conceded that the more complex statement *is consistent* with what has been observed, but it cannot be claimed that this statement *describes* an observed regularity. Therefore, Clendinnen concludes, to infer that all emeralds are grue is non-inductive since it assumes that an observed regularity will be replaced by a different pattern at some arbitrary date.

For the third issue, Goodman says that the problem of projectibility of a predicate is determined by its entrenchment in natural language. This is not much different from saying that the projectible predicates are the ones that we use in inductive inferences (Huber, 2007, pp.

19-20). Moreover, Goodman does not explain what the entrenchment of a rule has to do with its probability of success (Friedman, 1975, p. 180).

There is another aspect of projectibilty that Goodman does not discuss. This aspect is concerned with what may be called 'counter-grue' predicates or 'bundled' predicates. Instead of being more complex, a bundled predicate is simpler in the sense that it is more permissive. Consider the color RGB. Something is RGB if it is either red, green, or blue, or a combination of these three colors. Thus, green and blue are RGB, so are grue and bleen. However, this permissiveness comes at the expense of precision: if an object is RGB, it is not clear what specific color it is. My point is that Goodman's projectibility works both ways: As a projectible predicate like 'green' may be turned into an unprojectible predicate like 'grue' by making it more complex or restrictive, so an unprojectible predicate like 'grue' may be turned into a projectible predicate like RGB by making it simpler or more permissive.

In sum, Goodman's new riddle of induction, although interesting, not only fails to solve Hume's problem but also makes it unnecessarily more complicated. Most people already know that some 'regularities' are genuine while others are not. Goodman's new riddle has the effect of saying just that, since his rule of entrenchment has the effect that what can be projected is projectible. In real-life situations, we sometimes mistake accidental constant conjunctions for genuine ones and vice versa, without the influence of artificial predicates like 'grue.'

4.4.4 Criticism of Group 4

There is not much else to say about this group because philosophers in this group agree with the thesis that induction has no logical foundation. But it is worth noting that they still try to explain the origin of our inductive reasoning and its complications. This implies the importance and indispensability of induction.

4.5 Contemporary Debate on Induction

An important issue in the problem of induction is how to distinguish between good inductive inferences and bad ones and to do it fairly precisely (Hajek & Hall, 2002, p. 150). This issue has something to do with our conception of knowledge. More and more contemporary philosophers have come to accept that absolute certainty is unattainable and that knowledge, beliefs, and opinions come in degrees. This change in attitude affects our understanding and treatment of induction. The new understanding is that the force of evidence is better expressed by its effects on our degree of belief, which is in turn expressed in terms of probability. Thus, inductive inferences are now being modeled by some rules that govern changes of probability values in light of new evidence (Hajek & Hall, 2002, p. 149).

In this section, my discussion is divided into two aspects, namely, the contemporary debate on the problem of induction in general and the debate about Hume's view on induction. Of course, the two aspects are related and sometimes even considered to be the same. But we should be careful not to ascribe later developments to Hume and we should take into account the different situations in which Hume's view was formulated and in which contemporary debate is going on.

4.5.1 The Trend of Debate in General

There are many accounts of inductive inference. Nevertheless, according to J. D. Norton's study (2003, p. 2), almost all such accounts are based on just three families of ideas as shown below:

1. Inductive generalization. An instance confirms the generalization.
2. Hypothetical induction. The ability to entail the evidence is a mark of truth.
3. Probabilistic induction. Degrees of belief are governed by a numerical calculus. (Norton, 2003, pp. 2-3)

Inductive generalization. Most people are familiar with the most basic form of induction in this family called 'enumerative induction' or 'induction by simple enumeration.' Quite often, people consider enumerative induction to be representative of induction in general and the actual scientific process has always involved enumerative induction (Norton, 2003, p.4). The contemporary debate about inductive generalization is whether it is justified, given that the concept of absolute certainty is out of fashion, so to speak.

A new conception of inductive generalization has recently been proposed by J. D. Norton. It is called a 'material theory of induction' as opposed to older 'formal theories of induction.' In formal theories, the aim is to reduce all non-deductive inferences to one universal form or pattern, applicable to all cases (Okasha, 2005, pp. 264-266). Norton explains that many philosophers have been misled by the certainty of the deductive inference and try to base induction on the deductive model. In other words, they attempt to find formal theories of induction which act as templates that can be applied universally. Norton's material theory of induction, on the other hand, derives its justification from particular matters of fact. For example, from the particular fact that elements are generally uniform in their physical properties, we are licensed to infer the melting point of bismuth from a few samples. Note that the inference is not deductive because the particular fact is not an absolute truth but a generally accepted fact. The qualification 'generally' retains the inductive quality of the inference (Norton, 2003, p. 17).

Norton concludes that inductive inferences should be based on particular facts, which he calls 'material postulates,' effective in local domains; for example, 'specific facts about elements license inductions in chemistry; specific facts about quantum processes license inductions about radioactive decay.' In short, 'all induction is local' (Norton, 2003, p. 18).

In sum, Norton claims that the locality of inductive inferences solves the problem of inductive universality. Each inductive inference is applicable in its own domain (Norton, 2003, p. 22). But how are those material postulates justified? To this Norton replies that they are

based on further material postulates. He admits that this is a regress but claims that it is not a malicious one because it is the real practice of ordinary science in which justification for one fact is derived from another fact; in the end, all facts may be traced back to experience (Norton, 2003, p. 23). Samir Okasha (2005, p. 267) supports Norton's idea. He says that different inferences are based on different assumptions, so the whole of science cannot be based on a single 'overarching' assumption about nature.

Hypothetical induction. The central principle of this family of induction is that a hypothesis deductively entails the evidence. The current debate concentrates on a major weakness of this principle, which is that any auxiliary hypothesis, no matter how ridiculous it may sound, may be added to a genuine hypothesis without justification. For example, if the hypothesis H entails the evidence E, then the hypothesis H&X has the same ability, even though X has nothing to do with either H or E (Norton, 2003, pp. 6-7). Some philosophers solve this problem by selecting the simpler hypothesis from those that have the same ability of entailment, but this may be problematic, given the difficulty of defining simplicity (Norton, 2003, p. 8).

Another approach to solve the problem of auxiliary hypotheses is called 'abduction' or 'inference to the best explanation.' This account of induction requires the hypothesis not just to entail the evidence but also to explain it. The hypothesis that provides the best explanation is then chosen. But, just as choosing the simplest hypothesis is problematic, so is the notion of best explanation. Although there is a lot of literature on the nature of explanation, there is no consensus regarding the criteria for deciding how the best explanation is to be chosen (Norton, 2003, pp. 8-9).

Probabilistic Induction. The development of the theory of probability, which started in the 17th century, has given rise to several accounts in this family of induction. Although the theory of probability had its origin in the games of chance, people soon realized that probabilistic events had certain characteristics common to their degrees of belief, so the same

calculus might be applied to drawing inductive inferences (Norton, 2003, p. 9).

Many contemporary philosophers pay much attention to the concept of probability and to the nature of drawing probabilistic inferences. Some of them have argued that such probabilistic inferences are not susceptible to Hume's argument against induction (Rosenberg, 2006, p. 77).

One of the important products of the theory of probability is Bayesianism, whose conditional probability is expressed in the form of P(H|E), which is the probability of the hypothesis H given that E is true (Norton, 2003, p. 9). As we have seen, Okasha is a strong advocate of Bayesianism. D. Miller (2007, p. 24) goes so far as to say that, nowadays, the problem of induction is the problem of learning from experience, implying the importance of probability in general and Bayesianism in particular.

A main issue in the contemporary debate is how to deal with events that are non-random or under-determined. A typical question is: Why should simple ignorance be measured by degrees that conform to a calculus devised for games of chance? (Norton, 2003, p. 10). Consider the following example. Suppose we know next to nothing about some proposition A and its negation ~A, so we just have no idea which is correct. For simplicity, we might just assign a probability of 1/2 to each of them. But this is equivalent to saying that both the proposition A and its negation ~A have exactly the same probability of one-half. Apparently, the assigned value goes beyond what is really known (Norton, 2003, p. 11).

A related idea in the contemporary debate on probabilistic inference is the view that universal propositions, taken literally, must have a probability value of zero in any inductive argument (Milton, 1987, pp. 61-62). This is due to the fact that a universal proposition involves a population that is infinite, so that any number of samples taken from such an infinite population must be infinitesimal.

4.5.2 Interpretations of Hume's View

Hume's problem of induction is possibly his most important contribution to contemporary philosophy of science (Hajek & Hall, 2002, p. 149). So the problem is still significant today. Samir Okasha (2001, p. 307) says that Popper's entire theory of knowledge is founded on Hume's argument against induction; that is why Popper tries to show that scientific processes do not involve inductive reasoning. There may be disagreements on Hume's and Popper's arguments but contemporary philosophers of science still give much importance to Hume's problem and continue to investigate it with keen interest.

Many people agree that Hume's writings and arguments are not too difficult to understand. Despite this relative simplicity, however, there are disagreements on how to interpret some of Hume's arguments. The current debate on Hume's argument against induction is a case in point. According to Okasha's analysis (2005, pp. 254-255), there are two rival interpretative camps. The first camp includes David Stove, J.L. Mackie, and others; let us call it the Stove camp. The second camp includes Barry Stroud, Wesley Salmon, and others; let us call it the Stroud camp. The main point of contention is Hume's claim that, 'All our experimental conclusions proceed upon the supposition that the future will be conformable to the past' (Hume, 1975, p. 35). In other words, what is the role that NUT (nature's uniformity theory) plays in Hume's argument? The difference between the two camps may be expressed as follows:

1. Members of the Stove camp hold that, in Hume's view, NUT must be added to the premises of an inductive argument to make it deductively valid. This is the deductivist view, the view that only deductively valid arguments are rational.
2. Members of the Stroud camp hold that, for Hume, the role of NUT is not that of an additional premise, but it is the role of an assumption needed to make inductive inferences probable; without NUT, there is no reason to believe that the conclusion of an inductive inference is warranted. NUT should be understood epistemically, not logically. In this

> sense, Hume has no special interest to defend a deductivist view since he does not think that all reasons must be deductive. (Okasha, 2005, pp. 255-256)

The deductivist view was popular for a while in the early part of the twentieth century. The aim was to make NUT strong enough to provide entailment for inductive generalizations. This attempt is now considered to be unsuccessful. The reasons for its failure are as follows. Firstly, if NUT is strong enough to do the job it is intended to do, then it is obviously false because nature is not always uniform and some generalizations may hold in limited areas or at certain times only. Secondly, NUT is a generalization about the world, and so its justification has to come from induction, which is obviously circular (Pollock, 1986, pp. 15-16). Because of this, the popularity of the deductivist view has waned. This is not surprising. Just as our attitude towards knowledge has changed, so has our attitude towards induction and towards Hume's scepticism.

Popular opinions about Hume's view. At present, there are many popular opinions about Hume's view on the problem of induction. I shall discuss some of them here.

Firstly, it is now widely believed that Hume is an inductive sceptic, not just an inductive fallibilist. An inductive fallibilist's argument merely amounts to the boring (Okasha's term) argument which says, 'Past data never *entail* anything about the future; therefore it is *possible* that the future will turn out differently from how we believe; therefore knowledge of the future is impossible.' This argument is obviously true but totally unthreatening, since we can hold beliefs that are uncertain or even improbable (Okasha, 2001, pp. 308-309). What Hume, as an inductive sceptic, has really shown is that our beliefs about the future are not based on reason, not just that they are uncertain; in his own words, 'Even after the observation of the frequent or constant conjunction of objects, we have no reason to draw any inference concerning any object beyond those of which we have had experience' (Treatise I: iii.xii). So, Hume's argument is much deeper than the fallibilist one.

Secondly, some philosophers think that Hume's description of nature's uniformity is extremely inadequate. Samir Okasha (2001, pp. 308-309) says that it is a serious over-simplification at best. When Hume says that, 'All inferences from experience suppose, as their foundation, that the future will resemble the past' (Hume, 1975, p. 37), he is taken to mean that nature is uniform in every respect. But in reality, we know that not everything in nature is uniform. We extend some regularities into the future, but not others. Okasha's example is: 'All of the Costa Ricans I have ever met are philosophers, but that does not lead me to believe that all Costa Ricans are philosophers, nor that the next Costa Rican I meet will be a philosopher.' Whether this interpretation is correct is still being debated.

Finally, there is a widely held belief that Hume's sceptical argument is irrefutable. Most philosophers have given up the hope of getting a satisfactory solution to Hume's problem (Okasha, 2001, pp. 308-309), but once in a while, someone will come up with a novel idea to refute Hume. Normally, the debate is on how restrictive Hume's argument should be interpreted, and this issue plays a vital role in deciding whether the problem of induction can be solved. Because there is no accepted standard of justification, those who accept that Hume's argument is irrefutable have a different standard from those who deny it.

Despite the differences in interpretation of Hume's arguments, it is generally agreed that Hume holds inductive reasoning to be indispensable, and that science depends on it. It is also widely believed that Hume's arguments greatly inspire contemporary philosophers of science in their attempts to provide foundations for inductive inference (Rosenberg, 2006, p. 77).

4.5.3 Criticism of Contemporary Debate on Induction

No one can deny that a lot of developments have happened since Hume's time. For example, during Hume's time, mathematical theory of probability had a rather narrow scope; its applications were limited to simple games of chance (Howson, 2000, p. 61). Nowadays,

there are various types of probability theories and their applications extend to almost all fields of study and enquiry.

Likewise, the debate on induction has undergone a lot of changes since Hume's time, as can be seen from what has been discussed earlier. Generally speaking, the contemporary debate is concentrated on more refined points that have been previously overlooked. For example, the difference of emphasis between the Stove camp and the Stroud camp, as discussed above, might seem insignificant to earlier philosophers, but it does influence how we should approach the problem and how we should respond to it. This is certainly a step in the right direction.

However, we should be cautious not to overdo it, or to ascribe something to someone to whom it does not belong. Okasha's accusation is a case in point. He underestimates Hume's ability when he says that Hume's description of nature's uniformity is extremely inadequate because nature is not uniform in every respect; this is such a 'boring' argument on the part of Okasha. I venture to affirm that most people, including Hume of course, are aware that nature is not always uniform. It seems strange, in my view, that Hume should be interpreted in such a way as to be ignorant of this simple fact. When Hume speaks of 'the supposition that the future will resemble the past,' what he means is simply that, 'Generalizations holding at one time hold at all times' (Pollock, 1986, pp. 15-16), or 'past regularities will extend into the future under similar circumstances,' and this condition is presupposed in all inductive inferences. What may be inferred from this interpretation is that past *irregularities* will also extend into the future, and this is perfectly compatible with 'the future will resemble the past.' Hume nowhere says that everything in nature is uniform, so Okasha's accusation is obviously misplaced. Furthermore, even if it was true that Hume's description is inadequate, one might ask, 'adequate for what? or for whom?' Surely, Hume's description is adequate for his own purpose, and that is what actually counts. And Surely, Hume could not have provided a description for all purposes, past and future; that would be an impossibility.

On the other side, it seems to me that some philosophers have overestimated Hume's ability. For example, W. C. Salmon (1967, p. 4) claims that, 'It was part of Hume's genius to have recognized that the arguments he applied to simple enumerative induction apply equally to any kind of ampliative or non-demonstrative inference whatever.' Since Hume's arguments are quite narrow in scope, it is a gross overstatement to say that they would be able to deal with something far beyond their scope. I am not saying that they could not; that is a separate issue. What I am saying is that Salmon's claim goes far beyond Hume's intention.

A similar claim to Salmon's has been made by D. Murdoch (2002, p. 199). He says that, 'Hume would have been able to defend his argument against attempts to defuse it by appeal to those conceptions of probability which have been developed since his time.' It should be noted once again that Hume's use of the terms 'probability' and 'probable' is quite different from ours; in Hume's sense, probable reasoning is non-demonstrative and has nothing to do with mathematical probability as we know it today. It is very nice of Murdoch to praise Hume for something the latter did not anticipate, but in my view, the praise is superfluous.

In sum, the contemporary debate on the problem of induction should be going smoothly and progressively if necessary precautions are taken to avoid anachronism and incorrect ascriptions of ideas. Things change, so do concepts and standards by which philosophical ideas are judged. This point should be kept in mind when evaluating arguments of past philosophers, who are not in a position to respond to later accusations or misconceptions.

4.5.4 Concluding Remarks

It should be clear by now that the problem of induction is not a single question but a combination of many different but related questions. The reason for this variety is partly because of the difficulty of finding a satisfactory solution. Earlier formulations of the problem

were too restrictive and have been given up. They are replaced by weaker ones in the hope that what was impossible to justify in the strong case might be possible to prove in a weaker case (Feyerabend, 1964, pp. 349-350). As the questions become weaker and weaker, they lose their attractiveness and are not taken as seriously as their stronger counterparts. If we disregard these weaker cases, we will have no choice but to accept that Hume's argument is irrefutable, and many philosophers have done just that.

P. Lipton (1993, p. 12), for example, says that, 'We do not yet have a satisfying solution to Hume's challenge and the prospects for one are bleak.' W. C. Salmon (1967, p. 4) agrees. He says that, 'Hume's problem has proved astonishingly recalcitrant,' adding that none of the efforts to solve or dissolve the difficulty is widely accepted as a satisfactory answer. Under the circumstances, what should be done to remedy the situation, apart from turning to scepticism? This is one of the main points to be discussed in the next chapter.

Chapter 5

Circumvention of Hume's Argument

As I have argued, Hume's argument is irrefutable because all attempts to justify induction on Hume's terms have failed. But it does not follow that the use of induction is unjustified. Because induction is indispensable, our attention should be paid to the effective use of induction rather than to its justification; this I call the circumvention of Hume's argument. To circumvent something is to go round it (Oxford dict., 1998). Therefore, to circumvent Hume's argument is to find ways to justify our use of induction and to find ways to use it effectively. In this sense, there are innumerable ways to do so.

In this chapter, I shall discuss several problems with attempts to justify induction, offer ways to circumvent Hume's argument, and analyze the logic of inference.

5.1 Problems With Justification of Induction

Sceptical arguments have played an important role in the history of epistemology, resulting in an excessive emphasis on justification and a relative neglect of the less interesting aspect of description (Lipton, 1993, p. 185). Another aspect that has been overlooked is the practical side of induction, especially how to use induction effectively. In my view, the overemphasis on justification has done more harm than good to the study of epistemology as a whole.

Having said that, I should point out that I have nothing against the justification of induction per se. Justification of induction, or of anything else, is generally desirable, and we should seek it whenever possible. But after many futile attempts, it may be time to give up, or at least to put the problem aside, and to look for better alternatives. Moreover, justification is

not an end in itself. According to F. Dretske (1989, pp. 95-96), justification has an instrumental utility; it tends to increase the reliability of our beliefs and influence our actions. So, justification is important. But, under certain circumstances, justification affects neither our willingness to act on what we believe, nor the reliability of our beliefs on which we act. A case in point is our perceptual beliefs. We usually find justification of our perceptual beliefs to be largely irrelevant to what we can see. This is why some philosophers see the problem of induction as an artificial problem or even a pseudo-problem (Pojman, 2001, p. 187). This is quite true if we look at the problem from the practical point of view, since we have to use induction anyway whether it is justifiable or not.

In this section, I shall discuss the various difficulties that arise from attempts to justify induction. These difficulties act as additional reasons why justification of induction is not worth our while.

5.1.1 The Problem of Uniformity

For many philosophers in the past, the problem of the justification of induction would disappear if the uniformity of nature could be established with certainty (Salmon, 1953, pp. 40-41). But nowadays, it is widely accepted that it cannot be done without circularity. For nature is uniform in certain respects but not in others. The future is something like the past, but it is somewhat different as well. If nature is totally uniform, it would mean that everything remains the same from one moment to another and the universe would be a changeless world. In reality, changes do occur, so the future is not exactly like the past. What we need to do is distinguish genuine causal regularities from mere coincidences (Salmon, 1967, p. 42). But this is easier said than done. As pointed out earlier, attempts to establish nature's uniformity usually result in a formulation that is either too strong to be true or else too weak to be useful.

Apart from the problem of projectibility raised by Goodman (discussed in the previous chapter), there is also the problem of complexity. Some regularities of nature might be so

complex, or extremely long, that we are unable to identify them. If that is the case, it is possible that patterns of nature that we have discovered might be part of a much more complex or long-term pattern (Feigl, 1961, pp. 214-216). So, the outcome depends on whether we take short-sections of the course of nature in isolation, or whether we take the course of events over a period sufficiently long to disclose a pattern of regularity (Dewey, 1929, p. 244). Since we never know when a pattern has completed its cycle, this seems to be a futile endeavor in most cases.

Another problem is with the detail or level of sophistication. It is well known that order can emerge from disorder by 'blurring.' In other words, we can get a sort of regularity if we are willing to ignore certain details. Thus the same thing can be a regularity at the macro level and an irregularity at the micro level. Therefore, it might be the case that what we take to be regularities are in fact caused by our ignorance of, or inability to respond to, their details (Rescher, 2000, pp. 62-64). In this sense, regularities seem to be dependent on how we conceive them.

In practice, we should not be overly dependent on the concept of uniformity. What we need is approximation. Under different circumstances, we use different degrees of approximation to serve different purposes, and there is no need to seek a universal principle of uniformity. Even if the principle could be established, it would not be able to do the job it was intended to do; a universal principle of uniformity would not be applicable to all situations.

5.1.2 The Problem of Circularity

Traditionally, philosophers would reject a justification out-of-hand if the argument for it is circular (Brown, 1994, p. 406). That was what Hume did to the justification of induction. However, more and more contemporary philosophers are casting doubts on whether such a practice is rational. Recent literature on the subject points to the obscurity of how circularity is to be defined and, more importantly, whether all circular arguments are unacceptable (Brown,

1994, pp. 406-407).

Although the concept of circularity is an effective tool for philosophers to reject any arguments that contain it, there are reasons to doubt whether the objection is conclusive against the justification of induction. There are cases in which people reject perfectly good arguments and there are those in which we are persuaded by circular arguments. Moreover, it is not enough to say that an argument is circular if its conclusion is included in its premises; otherwise, we may have to count all deductive arguments as circular (Lipton, 1993, pp. 161-163).

What we should do is to treat circularity as audience relative. While the inductive justification of induction may not be convincing for inductive sceptics, yet, it may carry some weight for others because there is nothing wrong with giving arguments for beliefs already held. So, if circularity is relative to audience, the inductive justification of induction is acceptable for non-sceptics on the ground that induction is better than guessing (Lipton, 1993, pp. 164-167).

Some philosophers think that there are different types of circularity. D. Papineau (1992, pp. 14-15), for example, says that we should distinguish between *premise* circularity and *rule* circularity. He defines them as follows:

- An argument is premise-circular if its conclusion is contained among its premises;
- An argument is rule-circular if it reaches the conclusion that a certain rule of inference is reliable by using that selfsame rule of inference. (Papineau, 1992, p. 15)

Papineau's point is that premise circularity is a vice in an argument but rule circularity is not. His reason is that deduction is rule-circular but it is accepted as a legitimate form of inference; so, the fact that induction can only be shown to be reliable in a rule-circular way does not in itself constitute a reason to distrust induction (Papineau, 1992, p. 16).

In my view, Papineau's argument is beside the point, since we are mainly concerned with justification, not trust or distrust. Anyway, his argument at least shows that the concept of

circularity is problematic, and this is another reason why we should not pursue the route of justification.

5.1.3 The Problem of Certainty

Traditionally, many philosophers thought that certainty is a precondition for knowledge, but it was not clear why. There are reasons to believe that the traditional requirement of certainty may be a mistake (Papineau, 1992, pp. 2-3). It is a necessary truth that all empirical statements are contingent. If they had the formal validity, they would not be able to describe anything that happens. If we demand logical necessity for empirical statements, we shall lose their factual contents (Ayer, 1956, p. 41). Inductive uncertainty is not a defect in itself because the quest for knowledge is not a quest for certainty. It would be logically self-contradictory to equate empirical knowledge with certainty (Hempel, 2001, p. 331).

The meaning of the term 'certainty' itself is ambiguous. It may be interpreted in two very different perspectives:

1. As an unattainable ideal, a condition at which a knowledge claim aims but which in the very nature of things it cannot attain—to its own decisive detriment.
2. As an assurance, a promise, a guarantee that everything needful has been done for the ascertainment of the knowledge claim, and this must be construed in socially oriented terms as a real-life resource of the operative dynamics of communication (Rescher, 2003, p. 42).

The first perspective, favored by many traditional philosophers and sceptics, is obviously unrealistic. In real life, it is the second perspective that really works in the actual conception of knowledge. The standards of knowledge set up by sceptics are so unrealistic that they actually separate the sceptics from the concept of knowledge as it should be in everyday life and in most philosophical discussions (Rescher, 2003, pp. 42-44).

Surely, in a way, we should be certain of our knowledge, but the 'certainty' in question need not be absolute certainty in such a way that it is in principle unrealizable. Certainty should be understood in the sense of as certain as can realistically be expected in a situation (Rescher, 2003, p. 40). In our quest for certainty, if we ignore what is uncertain in the processes of nature, we are denying the conditions out of which certainty arises (Dewey, 1929, p. 244).

Even though perfection is unattainable, we may be able to function perfectly well. Our effort is a matter of making the best possible use of the tools we have. We must bear in mind that improvement is realizable and that progress is possible. The hope of realizable progress and of correcting past mistakes is one of the driving forces of scientific discoveries and technological innovations (Rescher, 2000, pp. 48-49). Therefore, what is important for us is not ideal or certain knowledge, but realizable and realistic approximation within our reach.

Apparently, the cost of attaining absolute certainty is so high that it is not worth the effort. Since one of the aims of justifying induction is to get certain knowledge of the future or the unobserved, this is another reason why we should not take that route.

5.1.4 Is Deduction Preferable to Induction?

All other things being equal, deduction is certainly preferable to induction. In reality, however, all other things are not equal, especially when we are dealing with matters of fact. The distinction between what is valid and what is invalid does not apply to matters of fact, since many invalid arguments are perfectly good in the sense that they provide supports for our beliefs (Hajek & Hall, 2002, p. 155).

Deduction results in either totally valid or totally invalid arguments; there is no such thing as degree of validity for deductive arguments (Salmon, 1967, p. 16). This is certainly not applicable to inductive arguments. Since deductive logic is a theory of what follows from what (Harman & Kulkarni, 2005, p. 3) but not so for inductive logic, it does not make sense to

speak of validity in inductive reasoning. In our inductive practice, we have no interest in conditional propositions like 'if nature is uniform, then such and such consequences follow.' This kind of entailment is beside the point. If we do not know that nature is uniform, what follows from nature's uniformity has no value in determining facts of the world (Salmon, 1953, pp. 41-42).

Take Aristotle's famous syllogism as our example:

- Major premise—All men are mortal;
- Minor premise—Socrates is a man;
- Conclusion—Therefore, Socrates is mortal.

If the major premise cannot be established, the conclusion has no bearing on our knowledge of the world. The problem then is how to establish the major premise. In my view, there are two ways to do so, namely, as an assumption and from induction. If the major premise is merely an assumption, then the conclusion has to be an assumption as well. And if the major premise is derived from induction (that is to say, from past observations), the reliability of the conclusion cannot go beyond that of induction. So, deduction is not preferable to induction insofar as a proposition involves matters of fact.

Since many philosophers consider deduction to be their ideal form of inference and try to justify induction in the image of deduction (whether successful or not), the problem with deduction is another reason why aiming at justification of induction is not a good policy.

5.1.5 Is Scepticism a Good Policy?

Some philosophers are sceptics and some others are not, so, it cannot be determined whether scepticism is a good policy in philosophy; it is a matter of personal preference. But in real life, scepticism is definitely not a good policy, as I shall explain below.

An effective weapon of sceptics is the claim that all empirical knowledge is fallible. Since ancient Greece, many philosophers have stressed the unattainability of absolute

knowledge of the world. There is always a possibility of defeating any such knowledge (Rescher, 2003, p. 38). This kind of argument does carry some weight. We simply have no method of inquiry or cognitive process that is completely free of errors of all kinds. The possibility of mistakes can never be eliminated from every human endeavor. Nevertheless, there are a lot of disadvantages in scepticism. N. Rescher (2003, pp. 49-50) says that scepticism is totally counter-productive. Since most sceptics try to avoid mistakes at a considerably high cost in ignorance, they are virtually blocked from any opportunity of getting realizable information about the world.

Human beings are rational animals; they must act in a rational way and their survival depends on those rational actions. The circumstances under which every human being must act do not allow the total suspension of belief. Scepticism is simply not a viable policy. The sceptic misconstrues the purpose of rational inquiry. It is not just to avoid error but to get answers to our questions, to acquire information about the world. A crucial weakness of scepticism is that it guarantees failure from the start. The sceptical policy turns out to be an irrational policy (Rescher, 2003, pp. 53-56).

In sum, the main reason against the sceptical policy on induction is quite straightforward. It is the reason that an inductive sceptic fails to recognize reliable methods when they are available. Scepticism may not be irrational to sceptics, but it is not very good at leading to truth either. If we consider an important aim of epistemology to be the search for methods that lead to truth, then there is an epistemic reason not to be an inductive sceptic (Steel, n.d., p. 30). If scepticism is not a good policy, then resorting to inductive scepticism is not a good way out of the problem of induction.

The justification of induction is plagued with so many problems, and scepticism does not help; what then should we do about the problem of induction? My answer is in one word: circumvention. This will be the focus of the next section.

5.2 Ways of Circumvention

In this section, I shall argue that circumvention is a good way out of the problem of induction. It should be emphasized that my 'way out' is not to be construed as a solution to the problem, but merely an alternative way of dealing with it. My argument will begin with the discussion of the merits of circumvention and will be followed by my proposed ways to do it effectively.

5.2.1 Why Circumvention?

There are several reasons why we should take the route of circumvention in place of the route of justification of induction. Here are some of them:

1. Although Hume's argument is irrefutable, it is not important to our life, especially in its practical aspect that lies outside of philosophical circles. The main aim of induction should be to make accurate predictions, not to justify itself.
2. We are finite beings with limited resources. We need priorities in using our valuable resources wisely. Our goal should be improvement and progress rather than perfection.
3. Since absolute certainty concerning inferences of matters of fact is unattainable, it may be a total waste of time trying to justify induction, especially after repeated failures. Circumvention is attainable because it does not seek absolute certainty.

Themes of circumvention. For my purpose, there are two themes of circumvention to be discussed:

- There are degrees of certainty among uncertainties. In other words, absolute uncertainty is impossible. This means that some events are more likely than others. If we are able to identify what makes an event more likely, or what influences its likelihood, we will be able to make better predictions.
- It is better to know how to use induction effectively than to know why induction should be

used. The reason is that knowing why induction should be used may give us moral support but does not make life better in any other way, whereas knowing how to use induction effectively actually makes life better. Induction may be compared to a tool that already exists. Knowing how it came into existence would be nice but does not affect the products made from it. On the other hand, knowing how to use the tool effectively does affect what is produced from that tool.

The first theme (absolute uncertainty is impossible) can be proved by the concept of probability. Generally speaking, the probability of a future event lies between zero and one. A probability of one denotes absolute certainty, that is, the event is going to happen. A probability of zero also denotes absolute certainty, that is, the event is not going to happen. Anything in between denotes uncertainty but never absolute uncertainty. We know that some events are more certain than others. For example, 'The sun will rise tomorrow' is more certain than 'It will rain tomorrow,' although we cannot justify the claim in a logical way. As for the second theme, we know that induction is useful, whether we can justify it or not. Therefore, our valuable resources should be better used on how to make accurate predictions than on how to justify induction. No further explanation is needed.

What follow are ways of circumvention for making predictions more accurate. They are arranged in three groups as follows:

1. Knowledge-based circumvention.
2. Concept-based circumvention.
3. Method-based circumvention.

5.2.2 Knowledge-Based Circumvention

Knowledge is one of the essential components of modern life. Most people spend a large part of their lives for the acquisition of useful knowledge. Our circumvention will be more effective if knowledge is put to good use.

Background knowledge. It can be said with confidence that very few people are ignorant of everything. So, we seldom make decisions, assertions, or predictions without taking background knowledge into consideration. By 'knowledge,' I mean what one has learned from experience and accepted as true or probably true. Background knowledge plays an important role in human experience since the same experience may result in different expectations of the future in different ways, depending on which background beliefs we hold (Okasha, 2001, p. 318). Thus, background knowledge, experience, and expectations are all interrelated, and they influence each other in an intimate way. For example, when there is a severe earthquake, a scientist may explain that it is due to the movement of the Earth's crust, a village shaman may explain that it is a divine punishment for people's sin, while a Chinese philosopher may explain that it is caused by disequilibrium in nature. Apparently, how we react to new information depends to a great extent on our background knowledge. This means that, in real life, our inductive processes are much more complicated than what Hume explicated. As Samir Okasha (2005, p. 261) says, 'relative to one background theory, a given observation might lead us to make one prediction, but relative to a different background theory it might lead to a different prediction, or to no prediction at all.' With such importance being attached to background knowledge, we should be extremely careful in acquiring our background knowledge so that our predictions will be more accurate. But the problem is how to achieve this end; this issue will be discussed next.

Intelligence and rationality. Knowledge in itself does not mean very much. The importance of knowledge lies in its use. In other words, knowledge is useful when it can be used intelligently and rationally. According to John Dewey (1929, p. 213), intelligence is associated with judgement, the judgement of selecting and arranging effective means to achieve our ends. He explains it in this way:

> A man is intelligent not in virtue of having reason which grasps first and indemonstrable truths about fixed principles, in order to reason deductively from them

> to the particulars which they govern, but in virtue of his capacity to estimate the possibilities of a situation and to act in accordance with his estimate. In the large sense of the term, intelligence is as practical as reason is theoretical. (Dewey, 1929, p. 213)

Acting intelligently means, for Dewey, judging events as indications of other events. In other words, we judge things as signs of other things. This concept is exemplified by scientific knowledge, which enables us to prepare in advance for what is to come. Under certain circumstances, we may even be able to prevent an event from happening, or change its course, to our best benefit (Dewey, 1929, p. 213).

Whether an action is blind or intelligent depends on how we use our knowledge. An intelligent action is directed; so, it is an achievement, not an original endowment. Progress is possible because we are able to transform blind actions into intelligent ones. Basically, actions are controlled by external conditions. With intelligence, we transform them into actions guided by our purposes through our insight into their consequences. Knowledge provides us with a way of giving intelligence to actions that were originally blind (Dewey, 1929, p. 245).

Intelligence is related to rationality. N. Rescher (2003, p. 194) defines a rational person as 'someone who uses intelligence to maximize the probability that matters will eventuate favorably for the promotion of his real interests.' Rationality tells us to choose the best possible alternative available in a situation. That is why when we are asked, 'Why be rational?' we often answer, 'It's the intelligent thing to do' (Rescher, 2003, p. 193). In short, we are rational when we act intelligently.

However, rationality is not to be confused with logical consistency or entailment (if this is the case, then that must be the case), which is purely hypothetical. Rationality is not just a hypothetical issue but it involves also the issue of giving appropriate weight to our background knowledge (Rescher, 2003, p. 52). Since the aim of having beliefs and expectations is to provide information to guide our actions, rational people would rather

employ processes that effectively achieve this goal (Rescher, 2003, p. 177). Therefore, if we use our background knowledge intelligently and rationally, we will be able to make predictions that are more accurate and beneficial to us in achieving our goals.

Classification of Matters. Many philosophers hold that the existence of natural kinds can explain a certain causal structure. This is why natural kinds make inductive knowledge of the world possible and reliable (Kornblith, 1995, p. 7). H. Kornblith (1995, p. 35) defines a natural kind as 'a cluster of properties which, when realized together in the same substance, work to maintain and reinforce each other, even in the face of changes in the environment.' He also says that our ability to recognize differences among objects through their qualities plays an important role in our learning (Kornblith, 1995, p. 62). Knowledge of natural kinds gives us reason to believe that the behavior of natural kinds is more consistent than that of non-natural kinds. So, the problem is how to justify the existence of natural kinds and to explain why they will persist into the future. This is the problem of induction all over again. Since we are not concerned here with the problem of justification, we shall have to assume that there are natural kinds and that they will persist in the foreseeable future.

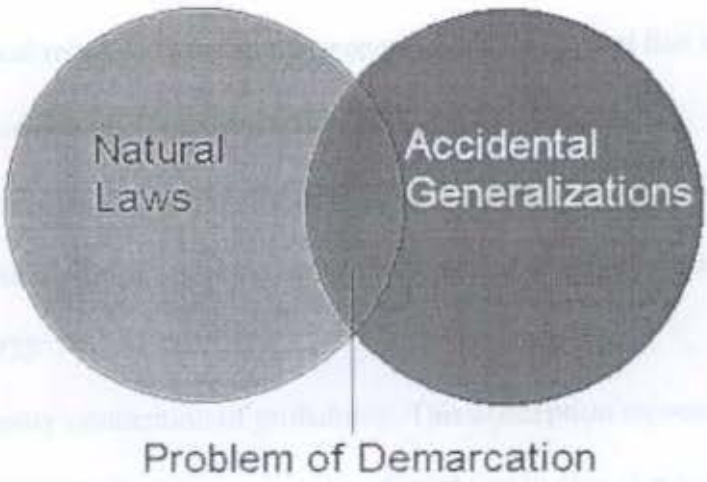
Even so, the concept of natural kinds is insufficient for the purpose of making good predictions, since one natural kind may differ substantially from another. So, instead of employing the concept of natural kinds, I shall resort to a similar concept. This is what I call 'classification of matters.' In my view, all matters may roughly be divided into six groups, according to how they react or respond to stimuli or changes in their environment. They are:

1. Basic elements, such as copper, oxygen.
2. Compound substances, such as water.
3. Complex substances, such as soil, air.
4. Potential living things, such as plant seeds.
5. Non-sentient beings, such as plants.
6. Sentient beings, such as animals, human beings.

The above classification of matters can be used as a guideline for approximating the consistency of behaviors of matters. For example, the reaction of basic elements is always consistent under similar circumstances whereas that of sentient beings may be changed according to their experience. Therefore, the classification will help us to make better predictions. In practice, what is important is not how matters are classified but how to recognize the degrees of consistency or inconsistency of what is under consideration and to make our predictions accordingly.

Other knowledge-based ways of circumvention. There are a lot more ways, based on knowledge, to circumvent Hume's argument against induction. Here, I shall discuss two of them. Firstly, our knowledge of life cycle plays an important role in predicting future events. Many things come and go in cycles; some cycles are short and some are long. Night-and-day is a short cycle while seasons are longer ones. The problem is how to identify them. Russell's chicken, for example, does not know that its being fed daily is part of a larger cycle, until it is too late. We are not in a better position either when it comes to long cycles like the big bang or the existence of the human species. Will the human species disappear from planet Earth and re-emerge? Will there be another big bang, or even a super-big bang? Despite these insoluble questions, there are a lot of cycles of which we are aware. The important point is that, to make good predictions, we should consider cycles or patterns of events rather than single events.

Secondly, our knowledge of natural laws should be helpful to us in making accurate predictions. The major problem with this kind of knowledge is how to distinguish genuine natural laws from accidental generalizations. This is called 'the problem of demarcation.' This problem arises whenever we attempt to draw distinction between two groups of things that share some common features; there will always be indeterminable borderline cases. But on closer examination, we will find that the problem area is relatively small. This may be expressed in the following diagram:



Thus, there are roughly three types of situations to be considered:

1. When natural laws are applicable.
2. When natural laws are not applicable.
3. When it cannot be determined whether natural laws are applicable.

In the first case, knowledge of natural laws is helpful in making predictions more accurate. In the second and third cases, it does not help and we have to use other ways.

5.2.3 Concept-Based Circumvention

Many concepts can be used to circumvent Hume's argument against induction. Some of them may be used directly while others have to be modified before use.

Probability. Probability is a systematic way of making predictions. It is very useful in science and everyday life. Theories of probability have progressed so much since Hume's time that they have become an indispensable tool for making good predictions, provided that we have a good understanding of the theories and apply them correctly.

There are many kinds of probability and many ways to classify them. D. Murdoch, for example, divides probability into 5 kinds:

1. The classical conception of probability. This is concerned mainly with the outcomes of trials in games of chance (Murdoch, 2002, p. 187).

2. The logical conception of probability. This conception represents the relation p(h|e) as a purely logical relation between the propositions h and e, and this relation does not depend on any causal assumption (Murdoch, 2002, pp. 191-192).
3. The frequency conception of probability. This conception represents the probability of an F being G as the limit r of the relative frequency of G's in a sequence of F's (Murdoch, 2002, p. 195).
4. The propensity conception of probability. This conception represents the probability of an event as the strength of the propensity of an object to give rise to that event (Murdoch, 2002, p. 195).
5. The Bayesian conception of probability. On this conception, the function p(h|e) represents a person's degree of belief in h on the assumption that e is true (Murdoch, 2002, p. 196).

No matter how probability is classified, it rests on the assumption that nature is uniform. Some philosophers claim that certain kinds of probability can be used to justify induction, but this claim is untenable because, as discussed in chapter 4, the application of probability is itself inductive. So, probability cannot be used to justify our inductive practices, but it is a very good tool for making good predictions. There are a few things to keep in mind when using probability. Here, I shall discuss two of them:

Firstly, there is a way of betting called 'Dutch book,' which should be avoided. A Dutch book is 'a combination of bets on which a person will suffer a collective loss no matter what happens.' It can be proved mathematically that if one's degrees of belief do not conform to the probability calculus then a Dutch book can be made against that person (Pollock, 1986, pp. 97-99), that is, he or she will always end up with a net loss in every bet.

Secondly, a distinction should be made between definite and indefinite events. The tossing of a coin is an indefinite event because it can go on to infinity, and each toss is independent of what came before it and does not have any effect on what comes after it. On the other hand, definite events are opposite. An example of definite events is drawing balls

from an urn without putting them back. Suppose an urn contains five white balls and five red ones. The more white balls have been drawn, the less likely it will be that the next ball to be drawn is white; the result of each drawing changes the probability of the next. If we mistake definite events for indefinite events, or vice versa, we will get the opposite result and our predictions will be way off the mark.

Rebracketing. Edmund Husserl (1859-1938) is considered by most people as the founder of the philosophical movement known as phenomenology. One of his main ideas is what he called epoché, or 'bracketing.' This is the assertion that, in order to study the structure of consciousness, one would have to distinguish between the act of consciousness and the object-in-itself which transcends consciousness. Knowledge of essences would only be possible by bracketing all assumptions about the existence of an external world (Wikipedia, 2008, Nov.). In other words, Husserl's bracketing is the suspension of empirical subjectivity. But it is doubtful whether such a suspension can be put into practice. In my view, the concept of bracketing will be practicable if it is modified into a multi-step process as follows:

Bracketing → *Unbracketing* → *Rebracketing* . . .

This new process is analogous to the relation between the theoretical and experimental aspects in science and should be useful for making good predictions. Scientific progress is a result of dialogue between theoreticians and experimentalists.[8] N. Rescher's research (2000, p. 38) shows that this kind of interactions is very important. At first, the experimentalists study nature to seek out important phenomena, and the theoreticians use the observational data to construct a hypothesis that is able to solve the problem. Then, the ball returns to the experimentalists' court. The experimentalists use new, more powerful ways to study nature

[8] In case the theoretician and the experimentalist happen to be the same person, the so-called 'dialogue' should be construed as a reflection between the theoretical and experimental aspects.

and get new data, which often fail to fit the old theories resulting in disequilibrium between available theory and the new data. At this stage, the ball re-enters the theoreticians' court. The process will continue until a satisfactory solution has been found.

By the same token, making good predictions is sometimes a multi-step process. Although predictions are based on facts, we also need creativity and imagination in order to find the truth behind those facts because things are not always what they appear to be. Under such circumstances, the concept of rebracketing should come in handy.

Realisticism. A widely held belief is that it is better to be optimistic than to be pessimistic. But in the context of trying to make good predictions, both optimism and pessimism tend to reduce their accuracy. Realisticism is better for the purpose. As the name implies, realisticism is the doctrine of being realistic; its main concept is to try to be neutral, unbiased, and to see things as they are, not as what we want them to be.[9] This I call 'interpretative' realisticism; that is, being realistic in our interpretation of data.

Another type is what I shall call 'situational' realisticism. We should be realistic in accordance with what is available and relevant to a specific situation. It is realistic, and therefore rational, to make the best use of all the relevant information available at the time; but it is unrealistic to require that we should use information that we do not have and cannot obtain (Rescher, 2003, p. 189). To act realistically is to act rationally.[10] Thus defined, we may distinguish between two types of rationality:

1. *Ideal* rationality, with absolutely everything relevant taken into account.
2. *Practicable* rationality, with everything relevant taken into account that we can effectively manage to take account of in the prevailing circumstances. (Rescher, 2003, p. 191)

In everyday life, only practicable rationality is realistic and achievable. The most we

---

[9] Here, I am speaking from the practical point of view, which is totally different from the metaphysical comparison between 'things in themselves' and 'things as they appear to us.'

[10] It is worth noting that there is more than one way to be rational. Although several ways to be rational have been discussed earlier, they do not necessarily imply any contradiction.

can do is to act in accordance with available information that is usually incomplete. We may want to aim at the absolutely best, but we have to settle for the best that is realistically achievable (Rescher, 2003, pp. 191-192). This is true in science as well. Scientific knowledge is certified by reference to relevant empirical data (Hempel, 2001, p. 330). For example, nineteenth-century science is not deficient by its own standards, since it was the best knowledge that could be had at the time.

It is worth noting that, generally speaking, there is nothing wrong with having ambitions, imaginations, or even dreams. But in the context of predictions, realisticism is a good policy.

Properties and values. David Hume argues that objects and their properties (what Hume calls 'secret powers') are distinct or unrelated. He explains it thus:

> It is confessed that the colour, consistence, and other sensible qualities of bread appear not, of themselves, to have any connexion with the secret powers of nourishment and support. For otherwise we could infer these secret powers from the first appearance of these sensible qualities, without the aid of experience. (Hume, 1975, p. 37)

Hume's argument is familiar; the connection between objects and their properties cannot be known a priori, so it cannot be proved to be necessarily true. Nowadays, few people agree with Hume on this point. We know that certain objects have certain properties, although it is conceivable that they do not. For example, we know that copper conducts electricity, although it is conceivable that it does not. Nevertheless, Hume is partially right in the sense that some properties (or values) are ascribed to objects rather than inherent in them, as we shall see.

The difference between properties and values is that properties are either in objects or caused by objects whereas values are ascribed to objects.

As discussed in chapter two, properties or qualities of objects, according to John Locke,

are of two types, namely, primary and secondary. Secondary qualities are further divided into sensible qualities and powers. To this I would like to add values of objects, which depend on the degrees of desirability of qualities or properties of objects. For example, the properties of gold are highly desirable, so we ascribe the value of 'preciousness' to gold.

Some properties are observable while others are not. When we draw inferences concerning the observable, we at least have a way to determine whether they are successful. For inferences to the unobservable, however, it is difficult to know whether we are right; that is why the latter case is more speculative than the former (Lipton, 1993, p. 176).

J. O'Neill (1989, pp. 121-122) has noted that even though the number of particular events and objects in our universe is infinite, there are only a finite number of properties of such events and objects. This means that it is not necessary to examine all objects in a class to learn about their common properties.

Obviously, our understanding of properties and values of objects should be helpful in making our predictions more accurate.

5.2.4 Method-Based Circumvention

Many methods can be used to circumvent Hume's argument. Here I shall discuss some of them, in no particular order.

Mill's method. J. S. Mill (1806-1873) proposes five eliminative methods (or canons) in his work entitled *A System of Logic* (Book III, Chap. 7, pp. 383-417). These methods are suitable for inductively inferring causes from known effects. They should be helpful in making good assertions and predictions. The five methods are as shown below.

First Canon: the Method of Agreement.

> If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon. (Mill, 2008, p. 396)

Second Canon: the Method of Difference.

> If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon. (Mill, 2008, p. 397)

Third Canon: the Joint Method of Agreement & Difference.

> If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon. (Mill, 2008, p. 403)

Fourth Canon: the Method of Residue.

> Subduct from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents. (Mill, 2008, p. 405)

Fifth Canon: the Method of Concomitant Variation.

> Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation. (Mill, 2008, p. 409)

Scientific method. Scientific method provides a means for selecting the best theories available by eliminating those whose observed instances are false, so that the ones that remain tend to have observed instances that are true (Lipton, 1993, p. 169). This is why scientific method is widely accepted as an efficient tool for studying facts about the world.

The strength of scientific method lies in its openness. In scientific experiments,

everything is done in the open. Every step can be observed and repeated by anyone. The process is clearly stated and the conclusion is externally exhibited and reported. Thus, every one can judge for himself or herself whether or not the conclusion reached in this way can be counted as knowledge, or whether there are any errors, deficiencies or oversights that need to be corrected (Dewey, 1929, pp. 288-289). In short, scientific method is almost objective, or less subjective than other methods; although it cannot guarantee truth, it nevertheless provides an acceptable way of aiming at truth.

Despite its strengths, it should be cautioned that scientific method is not the only way of finding truth and that scientific knowledge is not the only valid kind of knowledge. Science is just an intensified form of knowing. It is able to change some doubtful situations into resolved ones, especially those concerning physical matters. It is in addition a powerful tool at our disposal for developing other modes of knowledge (Dewey, 1929, pp. 250-251). But scientific knowledge, like its counterpart in the social sciences, is fallible and may be revised at any time when there is enough evidence for doing so. Thus, the concept of scientism, the excessive belief in the power of scientific knowledge (Oxford Dict., 1998), is impractical and should be avoided.

N. Rescher (2000, pp. 146-147) has made a very interesting analogy between the success of science and a thirsty man who drank white grape juice, mistaking it for lemonade. The man's success in quenching his thirst was not due to his being approximately right, but he was not wrong in ways that mattered for his purpose. Likewise, although there are defects in our scientific knowledge and procedures, such defects simply do not matter for the issues in question. The success of science should not be explained by the actual acquisition of truth, but in terms of an environment that is tolerant to imperfection. Surely, the effectiveness of science necessarily requires some conformity between scientific knowledge and the actual world, but this does not mean perfection; it means only sufficiency to resolve issues at hand.

The history of science shows that science is progressive. Some theories may be false,

but they are nevertheless closer to truth, better predictively and more explanatory than the ones they replaced (Lipton, 1993, p. 73; Weintraub, 1995, p. 468). Over time, we learn more and more about the world than our predecessors did. Therefore, our understanding of science and scientific method, together with our understanding of their strengths and weaknesses, should be very useful in our efforts to make accurate predictions.

Other method-based ways of circumvention. There are many other methods that can be used to circumvent Hume's argument. I shall discuss two of them here. Firstly, I shall discuss the method of explanation. Sometimes, we infer an explanation from the evidence we have gathered, and sometimes, we make an inferential choice between competing explanations. It is obvious that there is a close relationship between our inferential and explanatory behavior, and this is quite an effective way to acquire knowledge about the world (Lipton, 1993, pp. 67-68). Under certain circumstances such as when there is insufficient information or when drawing inferences about unobservables, the method of explanation should be a great help. For example, physicists believe in the existence of unobservable entities like electrons, quarks, gravitational fields and so on because such existence explains the behavior of observable entities quite satisfactorily (Fumerton, 1980, pp. 589-590). Quite often, we have expectations about the future without sufficient data and the method of explanation should be useful in these situations.

Secondly, I shall discuss the method of learning from experience. No one can deny that we ultimately learn from our experience. This is because induction is a self-correcting process. Inductive reasoning itself teaches us how to conduct our inductive business more effectively. Our use of induction is supported by its improved performance. Experience is our guiding light by providing us with feedback from our trials and errors (Rescher, 2000, pp. 19-20). Consider a person who had too much confidence on induction, thinking that it would almost always lead to true predictions. Past performance will convince him or her to revise such an optimistic view. If that person still clings to the old belief, despite past failures, he or she will

be inductively incoherent. Conversely, someone who was too pessimistic about his or her inductive powers would learn from past successes and adjust accordingly his or her attitude towards inductive reasoning (Lipton, 1993, p. 165). Experience not only gives us background knowledge, but also helps us to form habits. Good habits are useful in many aspects of our life, including the enhancement of our predictions.

5.2.5 Factors Affecting the Accuracy of Predictions

When trying to make our predictions as accurate as possible, we should take into consideration certain factors that influence their accuracy. There are a lot of such factors, some of which are more significant than others. What follows is a brief discussion of a few important ones.

Spatio-temporal coverage. When someone says that all copper conducts electricity, how far and how long does the term 'all' cover? Interpreted literally, 'all copper' covers every piece of copper in the universe, including those that existed in the past, those that exist now, and those that will exist in the future until eternity. The question is: Is it necessary to have such a large spatio-temporal coverage? My answer is negative. What really matters is the actual world and a reasonable coverage of time (Papineau, 1992, p. 9). Unless one is concerned with spirituality or divinity, whether our knowledge is true in all possible worlds has no effect. In practice, it is often better to settle for less than full coverage. In such cases, we are entitled to ignore what lies outside the scope under consideration. Most possible circumstances are so unlikely that they are not relevant to the problems at hand (Papineau, 1992, pp. 10-11). So it is prudent to limit spatio-temporal coverage to what is really necessary and this will help to make our predictions more accurate and practical.

A related concept is that of generality versus particularity. How detailed we want our predictions to be? A prediction that a certain number of people will die next year is more general, and therefore more accurate, than to pinpoint who those people are. Another related

concept is that of simplicity versus complexity. For example, predicates such as 'green' are simpler, and more accurate to predict, than predicates such as 'grue.'

Economic rationality. The expression 'economic rationality' is used by N. Rescher (2000, pp. 12-13) to mean cost-effectiveness, which he defines as 'the proper coordination of costs and benefits in the pursuit of our ends.' Why should we be rational economically? Why, indeed. Well, there are at least two reasons in favor of economic rationality:

1. It is a crucial fact that almost all human endeavors are not cost-free. Finding solutions to problems involves costs and risks (Rescher, 2003, p. 49).
2. We are finite beings, with limited resources (time, energy, wealth, and the like) at our disposal (Rescher, 2003, p. 54).

In many situations, the additional costs of acquiring complete information for full knowledge, reliability, or accuracy are not worthwhile, since the extra costs are much higher than the additional benefits to be gained. This is probably the reason why we do not seek complete accuracy or certainty in our everyday activities (Papineau, 1992, p. 8).

Surely, it is possible to try to be as complete and error-free as we possibly could, but that would defy our practical purposes. For example, we could build a car that is as strong as a military tank, with so many safety devices that it will be too expensive to buy, too bulky to control, and too slow to drive. Additional precautions might prevent some mistakes; but for each mistake avoided, we would have to pay a high price in terms of our valuable resources. This is why we should consider the optimal balance between costs and benefits (Rescher, 2003, p. 50).

In sum, economic rationality should not be overlooked. Although it is rational for us to try to get the best results from all the resources, both physical and intellectual, that we have, it is not rational to use more resources than necessary for a given purpose. Likewise, it is not rational to use fewer resources than necessary to achieve a certain end, unless these resources can be used to get even better results for another purpose. Cost-effectiveness is a form of

rationality (Rescher, 2000, pp. 12-13). This is why we do not try to solve all the problems that come to us. And for those problems that we try to solve, we do not seek perfect solutions, but acceptable solutions within the available means. By the same token, we do not seek the most accurate predictions at all costs. What we should look for is the level of accuracy high enough for our purposes, within the limit of our resources. We should be rational, both intellectually and economically.

Types of inductive inference. Normally, induction is treated as one class of inference, but upon closer inspection, it may be divided further into several types. Depending on which type of inductive inference we are making, its accuracy in prediction varies accordingly. For predictive purposes, induction may be divided into four types as shown below:

Type of Induction	**Description and Example**
1. Super-induction	Inferences drawn from several species to their genus: All observed copper expands when heated. All observed aluminium expands when heated. All observed zinc expands when heated. --- Therefore, all metals expand when heated.
2. Iso-induction	Inferences drawn within a single species: All observed copper expands when heated. --- Therefore, all copper expands when heated.
3. Sub-induction	Inferences drawn from a species to its members: All observed copper expands when heated. --- Therefore, all copper wires expand when heated. Therefore, all copper implements expand when heated.

4. Cross-induction	Inferences drawn from one genus or its species to another genus or its species: All observed copper expands when heated. Therefore, all stones expand when heated.

Different types of induction yield different degrees of accuracy. Iso-induction and sub-induction have high degrees of accuracy, super-induction has a medium degree of accuracy, and cross-induction has a low degree of accuracy. Our understanding of the different types of induction should help us to determine the expected accuracy of our predictions.

A related concept is the level of induction. At the macro level, we use inductive method to draw inferences from particular to universals. At the micro level, we draw inferences from particulars to particulars. Apparently, inferences at the micro level are more accurate than those at the macro level.

5.3 The Logic of Scientific Inference

As mentioned a few times, induction is indispensable in everyday life and in science. Hume's conception of induction was applicable, for a time, to both everyday life and science. But so much scientific progress has been made since Hume's time that his conception of induction needs to be reformulated for the field of science.

Scientific induction differs from everyday induction mainly in its forming and testing of hypotheses. In everyday induction, past regularities are expected to extend into the future, but in scientific induction, hypotheses are formed by considering available data from observations, experiments, existing theories, and other background knowledge. These hypotheses are then put to test. Long-tested hypotheses are accepted and become new theories,

laws, or accepted practices. Thus, scientific process is more systematic and precise than everyday inductive process.

The most notable reformulation of scientific induction, in my view, belongs to C. S. Peirce. Other formulations are different only in their emphases on certain points.

In this section, I shall first analyze Peirce's formulation of scientific inference together with its problems, then, I shall propose a simple modification to solve those problems, and finally, I shall discuss the modified description of scientific procedure.

5.3.1 Peirce's Inferential Logic

Traditional philosophers and logicians had divided arguments into two classes: deductive arguments (or necessary inferences) and inductive arguments (or probable inferences). Around the second half of the nineteenth century, C. S. Peirce (1839-1914) proposed that there were two completely distinct forms of probable inferences, which he called inductive inferences and abductive inferences (the latter was also called by Peirce hypotheses and retroductive inferences). Abduction has the distinctive characteristic of conjecture or 'educated guess' about it (Burch, 2008, sect. 3). It is also known today as 'Inference to the Best Explanation.' Its main concept is that inferences are marked by explanatory powers of their corresponding hypotheses; in other words, the hypothesis that is most likely to be correct is one that would best explain the evidence (Lipton, 2006, p. 1).

Peirce defines abduction as 'the process of forming an explanatory hypothesis' (1931, para. 171). He explains further the characteristics of abduction and its relations to other forms of inference as follows:

> Deduction proves that something must be; Induction shows that something actually is operative; Abduction merely suggests that something may be. Its only justification is that from its suggestion deduction can draw a prediction which can be tested by induction, and that, if we are ever to learn anything or to understand phenomena at all,

> it must be by abduction that this is to be brought about. No reason whatsoever can be given for it, as far as I can discover; and it needs no reason, since it merely offers suggestions. (Peirce, 1931, para. 171)

A few paragraphs later, Peirce adds that the ability to make good guesses is an 'insight,' comparable to instincts in both human beings and animals, that enables us to learn facts beyond the reach of senses (1931, para. 173). He concludes that a good abduction must be able to form an explanatory hypothesis that explains the facts and this hypothesis must be capable of experimental verification by induction (1931, para. 197).

So, there are now three forms of inferences, namely, deduction, induction, and abduction. The following examples should help to differentiate between them:

- Deduction: All balls in this urn are red; all balls in this particular random sample are taken from this urn; therefore, all balls in this particular random sample are red.
- Induction: All balls in this particular random sample are red; all balls in this particular random sample are taken from this urn; therefore, all balls in this urn are red (or the next ball taken from this urn will be red).
- Abduction: All balls in this urn are red; all balls in this particular random sample are red; therefore, all balls in this particular random sample are taken from this urn. (Burch, 2008, sect. 3)

Problems with Peirce's inferential logic. From my analysis, there are at least three problems with Peirce's formulation of inferential logic, as shown below:

1. It is self-contradictory to say that a hypothesis yields a deductively valid conclusion (or entailment) and at the same time that the conclusion is a prediction of the hypothesis. Predictions, by definition, are uncertain or contingent whereas entailments must be necessarily valid. In my view, it is incorrect to say that scientists use a hypothesis to predict its consequence; since a hypothesis necessarily entails its consequence, there is no

need for any prediction at all. For example, if the hypothesis is, 'All copper conducts electricity,' there is no need to predict that, 'the next piece of copper to be observed will conduct electricity,' because this is an entailment and therefore a valid conclusion. However, it should be noted that, under certain circumstances, a group of hypotheses may be used to predict a phenomenon, but this implies a new problem in a new situation, and therefore requires a new solution not entailed by the available hypotheses. Since the purpose of abduction is to form hypotheses, there is no role for predictions to play. We can test a hypothesis but not its conclusion (entailment) because the entailment will always hold unless the hypothesis itself is modified or dropped altogether.

2. To claim that the faculty of abduction is an insight or a result of instincts does not carry much weight. If we are allowed to explain a problem away by claiming that it is an insight, or caused by instinct, philosophy would not have come thus far. Doing so would be tantamount to saying that the problem is insoluble.
3. Even though we have put aside the problem of justification of induction, we are still left with the problem of identifying regularities. Abduction seems to take it for granted that there are regularities waiting for us to form hypotheses about them. If this is the case, then hypotheses formed by abduction are nothing better than mere assumptions and their validity is no more than assumed validity.

For the above reasons, Peirce's inferential logic concerning matters of fact, especially scientific facts, is based on very shaky grounds. Is there a way out of those difficulties? I think there is. What follows is my proposed modification, which I hope will at least lessen the severity of the problems mentioned above.

5.3.2 Modification of Peirce's Inferential Logic

Due to the deficiencies in Peirce's conception of inferential logic, I would like to modify it by adding a fourth form of inference, which I shall call 'preduction' or 'inference to

the most accurate prediction.' Just as abduction is separated from induction, so is preduction separated from abduction. The major aim of preduction is to search for regularities, or signs thereof, by means of predictions. The main characteristics of preduction are as follows:

1. Background information, when available, is the fundamental criterion for selecting the most accurate prediction. By background information, I mean information directly relevant to what is being predicted, in contradistinction to background knowledge, which may help us to make judgement or calculate certain values but is not directly related with the matter at hand. For example, in our example of balls in the urn, the number of balls is background information, whereas probability calculi are background knowledge.
2. Preduction applies only to inferences from particulars to particulars. There is no need for generalization or hypotheses. However, this does not mean that hypotheses are not important, only that they are not the aim of the preductive process.
3. The most accurate predictions are selected on a case-by-case basis. There are no general rules applicable to all situations.
4. No presuppositions, such as nature's uniformity, are required at this stage.

The preductive process is quite simple. When there arises a new phenomenon that requires special attention, it will be carefully examined together with any background information available at the time. With the help of background knowledge, the most accurate prediction that can be expected is chosen and tested for regularity. The procedure of predicting and testing has to be done several times until a regularity has been tentatively established. Then, and only then, will the inquiry move to the next step, the forming of a hypothesis or the abductive process. If no signs of regularity can be identified, the problem may be put aside until further background information comes in, or it may be abandoned altogether. Without any signs of regularity, there is no case to be made. So preduction is an important step in the inferential logic concerning matters of fact. But it should be reminded that preduction does not guarantee certainty or success of any prediction or regularity; it should be thought of as a

screening process before further actions can be taken.

It is worth noting that the term 'preduction' has two important connotations. Firstly, it is intimately involved with predictions. Secondly, it is the first step leading to other forms of inference; hence, the prefix 'pre.'

Before going on to discuss the details of preduction, the following points should be brought to special attention:

- In traditional logic, the dichotomy between deduction and induction is taken to be roughly the same as the dichotomy between demonstrative reasoning and non-demonstrative (or probable) reasoning. This habit is still prevalent today, except when there is a need to differentiate between induction and other types of non-demonstrative reasoning. Now, such a need has arisen in our discussion of scientific inference. Henceforth in this chapter, induction will be considered as just one type of non-demonstrative reasoning, unless otherwise stated.
- The term 'probable' may cause misunderstanding because it is commonly used in at least two senses, namely, 'non-demonstrative' and 'likely.' Thus, a probable (non-demonstrative) argument may be improbable (unlikely to be true). From this point onward, the term 'probable' will be used exclusively to mean 'likely,' unless otherwise indicated.
- When discussing samples drawn from a population, an infinite population may have a finite number of members but the number is too large to be enumerated. For example, the number of ravens in this world at any particular time is finite but it is considered infinite in practice. Also, a finite population may be treated as infinite if the number of samples drawn from it is relatively small.

In order to appreciate the force of preduction, it is necessary to discuss the similarities and differences between preduction and other forms of inferences. The following abbreviations will help to facilitate the discussion:

Abbreviation	Meaning
B-info	background information
MAP	the most accurate prediction (that can be expected)

Deduction and preduction. In certain cases, preduction may be similar to deduction, but there are differences, as illustrated by the following example:

Example 1	
Case	All balls randomly drawn from this urn have been red.
B-info	All balls in this urn are known to be red.
MAP	The next ball to be drawn from this urn will be red.

Despite the seeming similarity, there are differences. Firstly, background information for preduction must be known, not assumed. Thus, this case is not applicable to population with indefinite members. For example, 'All ravens are black' is not legitimate background information since it cannot be known. Secondly, preduction is not limited to this kind of deductively valid arguments. This case is just a special case.

Induction and preduction. Inductive inferences are based on observed instances. Thus, they are thought to be independent of background information. If all balls drawn from this urn have been red, then the inductive inference is that all balls in the urn are read. But preductive inferences are dependent on background information. The following three examples will illustrate this point:

Example 2	
Case	All balls randomly drawn from this urn have been red.
B-info	Not available.
MAP	Indeterminable.

The most accurate prediction for example 2 cannot be determined because there are an innumerable number of predictions that are equally likely.

Example 3	
Case	All balls randomly drawn from many urns have been red.
B-info	The population is of the infinite type.
MAP	The next ball to be drawn from this urn will probably be red.

The preductive case in example 3 coincides with induction.

Example 4	
Case	All balls randomly drawn from this urn have been red.
B-info	The population is finite; there were an equal number of red and non-red balls.
MAP	The next ball to be drawn from this urn will probably be non-red.

In example 4, there are more non-red balls remaining in the urn. Hence, it is more likely that the next ball to be drawn will be non-red.

Therefore, with different background information, the most accurate prediction that can be expected will have to change accordingly. Positive instances do not necessarily increase likelihood.

Abduction and preduction. Both abduction and preduction are based on 'educated' guesses. However, the main difference is that abduction seeks the best hypothesis to explain an observation whereas preduction seeks the most accurate prediction available that can be inferred from an observation by taking into account any relevant background information. In short, abduction seeks to establish hypotheses but preduction seeks to establish regularities.

The modified inferential logic may be summarized as follows:

Forms of Inference	Means of Support	Bases of Inference	Strengths of Inference	Subject-Matters	Modes of Inference
1. Deduction	Validation	Entailment	Validity	Necessity	Mechanistic
2. Induction	Vindication	Evidence	Cogency	Uniformity	Enumerative
3. Abduction	Explanatory power	Suggestion	Coherence	Hypotheses	Judgemental
4. Preduction	Predictive power	Background information	Rationality	Likelihood	Common-sensical

5.3.3 Strengths and Weaknesses of Preduction

Nothing is perfect in this imperfect world. Even perfection itself is not perfect since it does not exist. Preduction, like any other philosophical concept, has its own strengths, benefits, and weaknesses, which are discussed below.

Strengths. In my view, the strengths of preduction lie in its abilities to solve the problems in Peirce's inferential logic discussed earlier.

1. Preduction solves the problem of self-contradiction inherent in the abductive process, the problem that a hypothesis entails its conclusion and the conclusion is also a prediction of the hypothesis. Since the role of preduction is to identify possible regularities, it comes before hypothesis formation. Once a hypothesis is formed, predictions play no role.
2. Preduction solves the problem of basing our inference on insight or instincts because it is based on background information and, to a lesser extent, on background knowledge. Although there is the problem of how to justify our background information, it can at least be referred back to experience and observation, and this provides a firmer foundation for drawing inferences than can be said of such psychological concepts as insight or instincts.
3. Preduction solves the problem of identifying regularities, if not completely then at least partially. As many philosophers have noted, not everything in nature is uniform. Preduction provides us with a means to identify possible regularities for further scrutiny.

Benefits. Using preduction has a lot of benefits. Here are some of them:

1. Preduction is relatively unproblematic. It sidesteps the problem of unattainability of strict justification and the problem of presuppositions.
2. It is practical. Its emphasis on getting the most accurate predictions gives us more utilities in everyday life than justification and explanation. In science too it is beneficial as an initial step before moving on to higher and more complex steps. This last point will be further elaborated later.
3. Its criterion of depending on background information is intuitively rational, for virtually no inference is made without background information.
4. It is flexible because it is non-formal, and, therefore, poses few limitations on the types of background information. But this does not mean that 'unnatural' predicates like 'grue' will pass the test; they will probably be screened out when selecting the most accurate predictions. In other words, unprojectible predicates have low predictability values.
5. Preduction has a wide coverage. At one extreme, it may yield a deductively conclusive prediction if background information warrants it. At the other extreme, it may be indeterminable if background information is not sufficient.

Weaknesses. Some of the weaknesses of preduction are:

1. Preduction is subjective in its selection of the most accurate predictions. Different people may select different predictions as their most accurate ones. This weakness may be corrected by a later step in the inferential process.
2. Preduction does not guarantee success. This is a common weakness in all types of non-demonstrative inference.
3. Background information may be wrong, unreliable, or subject to different interpretations, resulting in less accurate predictions.
4. The preductive process may be haphazard especially in complex situations involving a lot of background information.

5. Preduction plays no role in forming hypotheses. This restriction is necessitated by its function. This problem can easily be solved by using preduction in conjunction with other forms of inference.

5.3.4 Possible Objections to Preduction

The following are some objections that may be raised concerning the necessity and appropriateness of preduction:

Firstly, it may be objected that the term 'preduction' is unnecessary because the term 'prediction' is much better and more natural. My response is that the two terms have different meanings and are not interchangeable. A prediction is an expected event, which may be likely or unlikely. Preduction, as proposed here, is a form of inference which results in the most likely prediction available in a particular situation. There is little parallelism between the two terms. The relationship between them is more like that of parent and child, rather than that of siblings.

Secondly, it may be objected that preduction is similar to the material theory of induction, discussed earlier, which claims that induction is warranted by matters of fact, called material postulates, that prevail in local domains. I would like to point out that the term 'local domain' refers to a specific domain of study, not to instances. Moreover, the material theory of induction is a form of generalization (within a limited domain) whereas preduction is a form of inference that does not rely on any generalization.

Thirdly, it may be objected that if preduction is a form of induction then it cannot be used to support the use of induction for reason of circularity, whereas if it is not a form of induction then it is a separate type of inference and therefore irrelevant to Hume's argument. This objection, I must admit, carries some weight, but the problem arises out of the confusion in the use of the term 'induction.' The current use of the term 'induction' may be divided into three senses: 1) non-demonstrative inference; 2) generalization from particulars to universals

(macro-level induction); 3) enumeration from particulars to particulars (micro-level induction). Note that we also have the same problem with abduction, which is sometimes subsumed under induction and at other times treated as a distinct form of inference.

At this point, I would like to show that it does not matter much whether abduction and preduction are subsumed under induction or whether they are distinct forms of inference. Let us consider each case and its consequence.

If abduction and preduction are subsumed under induction, then induction itself can be divided into three elements of inference, namely:

1. Enumerative inference or generalization.
2. Abduction or inference to the best explanation.
3. Preduction or inference to the most accurate prediction.

Each inductive element then should be treated as a step in the whole inductive process. In this sense, induction is a multi-step process in which preduction is the first step. On the other hand, if abduction and preduction are distinct from induction, then there will be three forms of non-demonstrative inference, namely, induction, abduction, and preduction. In this sense, preduction is the first form of inference to be done; after it is done, the next form takes over and so on. All three forms work in conjunction and in sequence to attain a single result.

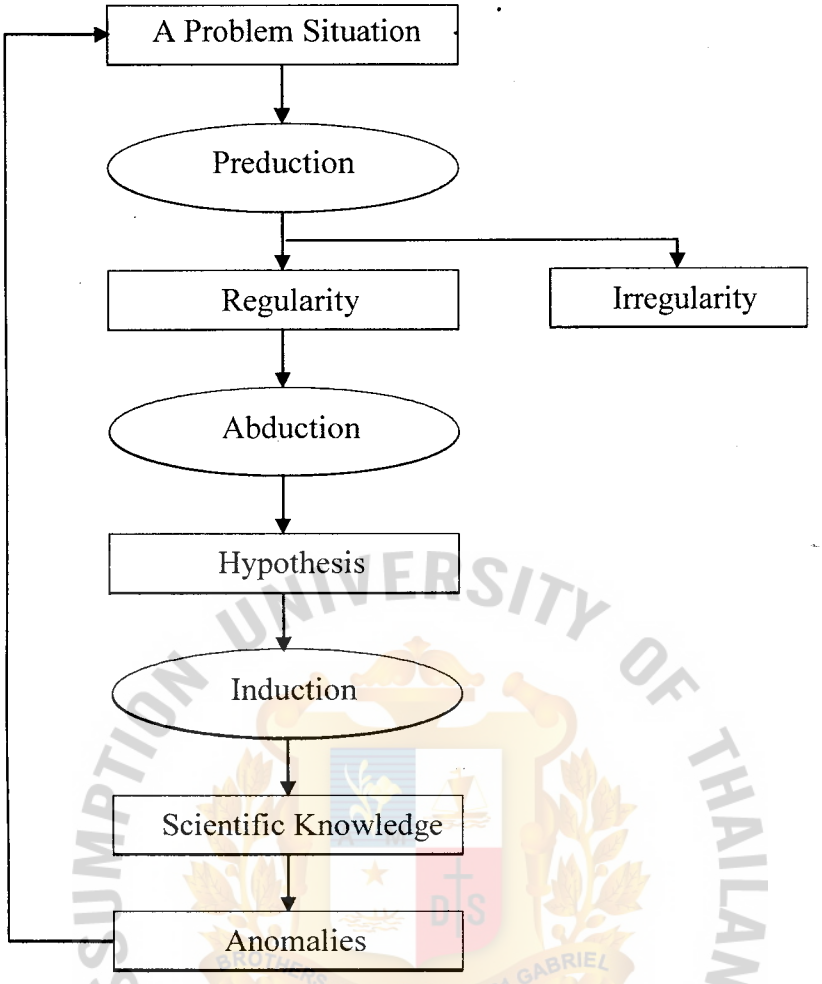
The confusion in the use of the term 'induction' is difficult to overcome because induction is a multi-faceted concept, involving a wide variety of other concepts such as projectibility, uncertainty, uniformity, degree of beliefs. Because of this, induction may mean different things to different people. So, it is not possible to find a single solution to all the problems related to induction. A way out of this difficulty is to consider one aspect of it at a time and see what can be done within that particular aspect. However, since all aspects are interrelated, attempts to solve problems in one aspect may complicate things further in other aspects, resulting in incompatibility or even contradiction. This is another reason why we should not expect a consensus on the problem of induction, much less a single solution.

5.3.5 Scientific Procedure

Let us consider an application of the modified logic of inference. As mentioned earlier, preduction is the first step leading to other forms of inference. In everyday life, preduction begins with a problem situation that calls for a prediction of future events. This prediction is verifiable because it is an instance, not a generalization. The prediction may have to be repeated several times to determine whether the problem involves a possible regularity or irregularity. If the problem involves an irregularity, there is no case to be made and the investigation stops. If, however, the problem involves a regularity, then the investigation may enter the next step if the investigator so wishes. In this sense, preduction is a screening process for regularities or what look like regularities. This is also the starting point of scientific investigation.

Thus, science does not begin with hypotheses, as claimed by some philosophers. If science were to begin with hypotheses or conjectures, scientists would have to spend their whole life testing those conjectures, for there are innumerable conjectures that can be used to explain even the simplest phenomenon. That is why we need an initial screening process like preduction to weed out irregularities.

Only when there is a case to be made, that is, there is a regularity or what looks like a regularity, will scientists go on to the next step, which is the process of abduction or the forming of competing hypotheses and selecting the best one that can explain the phenomenon better than others. The third step, then, is to test the selected hypothesis by means of induction. Since the hypothesis is a generalization, it cannot be verified as true but can only be supported as probably true. The hypothesis may be discarded or modified when new information warrants such an action, in which case the process has to start all over again. Note that induction is used to test a hypothesis, not its conclusion. If the conclusion does not occur in the testing as previously expected, then there is something wrong with the hypothesis, not with the conclusion. The scientific procedure may be expressed in the following diagram:



Of course, the actual scientific procedure is much more complicated than what has been sketched above. Here, I merely hope to make my point that preduction is an important and necessary step before further steps can be taken; it is often overlooked because of its simplicity. Without the hint of regularity, there is no case to be made. And this hint of regularity is a direct result of preduction as outlined earlier. Another point worth noting is that the problem of circularity or infinite regress is not at issue since we are not concerned with justification anymore.

5.3.6 Concluding Remarks

So many things have happened since Hume's time that many people think Hume's view on induction is too limited in scope to be treated as the whole problem of induction.

Nowadays, epistemology, philosophy of science, scientific knowledge, and for that matter all other types of knowledge, are interrelated and even interdependent. It may be a convenient way for the purpose of research to have different models for different mental activities; in reality, they are not separable in the way we want them to be. For example, some modeling work in the artificial intelligence literature has addressed, to some extent, both deductive reasoning and inductive reasoning. Although everyone agrees that there are important differences between induction and deduction, it would be ideal if reasoning models tackled both forms of reasoning instead of each one separately.[11] By the same token, it would be better to study non-demonstrative inference by taking into account the effects of background knowledge, judgements and decision-making processes (Heit, 2007, pp. 27-29).

When we understand how complicated things have become, we shall realize that absolute certainty, absolute accuracy, and other types of absoluteness concerning matters of fact, are idealistic and therefore unattainable. What we should strive for is approximation to truth, not exactness of truth. If we were required to get absolute knowledge before taking an action, we would not be able to do anything at all. Likewise, if induction must be justified before being put into practice, we would not have any reason to use it. But the fact is that we are using it, and, more often than not, with good results. This may be an indication that circumvention is all we need in order to tackle the problem of induction.

Admittedly, my proposed way out of the problem of induction may raise more questions than it could answer. Nevertheless, my aim is to increase the effectiveness of induction, not to solve its problem. In this sense, I hope that it contributes something to the debate on the problem of induction, something that is both positive and constructive.

---

[11] Here, I am speaking in the context of Western Philosophy. Note that certain types of Eastern logic have already included both deduction and induction in their arguments for thousands of years. Vide Warayuth Sriwarakul's (a different spelling of surname here) Comparative Logic (in Thai) in *Thammasat University Journal,* Vol. 20(2) May-Aug 1994, pp. 114-134.

Chapter 6

Conclusion

The problem of induction is relatively new, compared with the longevity of induction itself. Be that as it may, it has aroused a lot of interest among philosophers and logicians alike. Many people believe that the problem was first raised by David Hume, in the eighteenth century, who wanted to know the philosophical justification behind the uniformity of nature. However, the history of induction has shown that the problem is much older than most people think. Anyway, it cannot be denied that Hume was the first philosopher who sensationalized it, so much so that the problem of induction has become synonymous with Hume's problem.

Most ancient and traditional philosophers, including Hume, held that true knowledge must be absolutely certain. Anything less than absolute certainty was not worthy to be called knowledge. The most famous quest for certainty seems to be that of Descartes, a rationalist, who found it in his *cogito,* but it looks like the cogito is the only certainty Descartes was able to find; his other claims of certainty were not convincing. Later on, the emphasis of knowledge acquisition gradually shifted to empiricism, but it did not help much either. Even a mixture of rationalism and empiricism could not solve the problem of certainty of knowledge. And the same is true for the problem of induction. Today, it is widely accepted that absolute certainty, especially when it is concerned with matters of fact, is unattainable, and we have no choice but to deal with the difficulty of uncertainty.

Hume's argument against induction is rather simple. He argues that the principle of induction (not his own terminology) is founded on neither reasonings concerning matters of fact nor reasonings concerning relations of ideas. Therefore, there is no foundation on which the principle of induction can be based. In short, the principle of induction is not justifiable philosophically. However, despite the simplicity and clarity of Hume's argument, there

appears to be no consensus as to what the problem actually is and how exactly it should be solved. The confusion, or lack of agreement, is due partly to the nature of induction, such as its complexity, multi-facetedness, and so on.

Even so, many philosophers and logicians have attempted to tackle the problem, resulting in many creative ways to solve or dissolve it. But it is commonly agreed that no approach has been widely accepted as a viable solution. Many people also believe that a full-fledged solution will not be found anytime soon. The fact that so many people have tried and failed to solve the problem of induction over the past two-and-a-half centuries shows that the problem is not trivial (Rhoda, 2003, p. 2).

Nevertheless, the fact that the problem of induction seems to be insoluble does not mean that our inductive practice should be abandoned altogether. There are two major perspectives from which induction could be viewed. This dichotomy can be expressed in what I call the 'spoon' of induction, to which we shall immediately turn.

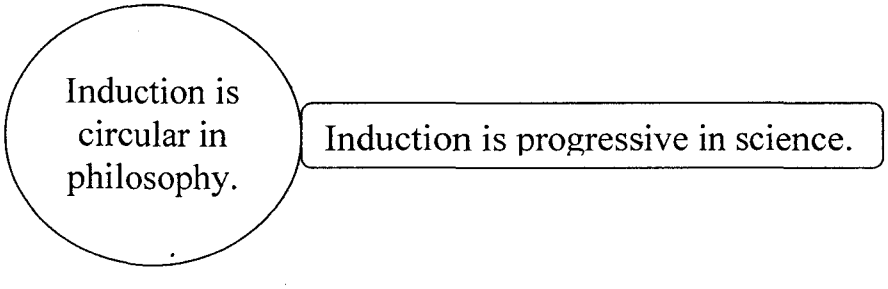
The spoon of induction. Hume is well aware that we can look at induction from two different perspectives, namely, from the philosophical perspective and from the non-philosophical one. Hume has a split personality, so to speak. He raises the problem of induction not as a denial of induction, but out of his own curiosity as a philosopher. Here is how Hume explains it:

> And though none but a fool or madman will ever pretend to dispute the authority of experience, or to reject that great guide of human life, it may surely be allowed a philosopher to have so much curiosity at least as to examine the principle of human nature, which gives this mighty authority to experience, and makes us draw advantage from that similarity which nature has placed among different objects. From causes which appear similar we expect similar effects. This is the sum of all our experimental conclusions (Hume, 1975, p. 36).... My practice, you say, refutes my doubts. But you mistake the purport of my question. As an agent, I am quite satisfied in the point; but

> as a philosopher, who has some share of curiosity, I will not say scepticism, I want to learn the foundation of this inference. No reading, no enquiry has yet been able to remove my difficulty, or give me satisfaction in a matter of such importance (Hume, 1975, p. 38).

From the above quotes, it is obvious that Hume does not try to persuade us to believe that scientific knowledge, which depends on induction to a great extent, is unreliable. Hume's argument is not a rejection of induction. According to Hume, we need to practice induction, but the practice itself is not justifiable (Lipton, 1993, pp. 10-11). We are unable to find any sound reasoning for acquiring knowledge of the unobserved from experience alone. But we may be justified, in terms of its truth value, in relying on induction from the practical point of view (Howson, 2000, p. 2). Apparently, Hume's doubts are limited in scope since they are not part of everyday life or part of the ordinary pursuits of science. We would have a better understanding of the problem if we could make the distinction between ordinary empirical doubts and philosophical doubts (Feigl, 1961, p. 212).

The two perspectives mentioned above may be conceptualized in the spoon of induction, as illustrated with this diagram:



Next, I shall explain why induction is circular in philosophy but not so in science. Recall that, in chapter one, I quoted an aphorism which says that, 'Induction is the glory of science and the scandal of philosophy.' This should not be the case if we understand the different aims of the two disciplines:

- The aim of philosophy is to seek truth. To find truth, philosophers have to go far beyond perception and experience. It is their aim to understand thought operations and not merely to apply them instinctively. They want 'to look through the superstructure and to discover the supporting structure' (Reichenbach, 1993, p. 454). So, it is not unusual for them to try to justify induction, despite repeated failures. Induction can hardly be called a scandal merely because it is insoluble. In fact, most philosophical problems are insoluble.
- The aim of science is to study and understand nature. Induction is just a tool. The success of science is not due solely to induction, so induction can hardly be called the glory of science.

Philosophical theories are neutral to particular matters of fact, so they are not tested by observation, and philosophical questions cannot be settled by experiment (Ayer, 1956, p. 7). Science leads us to knowledge but philosophy leads us to wisdom. Science deals with the actual world but philosophy deals with all possible worlds. The progressiveness of science lies in its applications (Rescher, 2003, p. 226) but the depth of philosophy lies in contemplation and reflection. Induction mystifies philosophy in theory but demystifies science in practice. Induction serves different purposes in these two important disciplines. There is no conflict, no glory, and no scandal. The said aphorism may sound interesting and forcible, but it does not reflect the actual situation.

Therefore, induction is circular in philosophy because philosophers try to justify it and they cannot do it without assuming that past experience is an indication of future events. Scientists, on the other hand, are not interested in justifying induction. They have other things in mind: To acquire knowledge about the world. That is why induction is not circular but progressive in science. But it should not be construed that induction is really not circular in science, only that the circularity in justifying induction is not what is at issue in scientific inquiries.

Someone might ask the question whether we should be philosophers or scientists. In

my view, there is no harm in being both, just like Hume; but it should be cautioned not to mix the two disciplines in a haphazard fashion. As philosophers, we should try to find truth, knowing very well that truth is elusive and that we may fail time after time. As scientists, we should try to acquire knowledge about the world, knowing very well that such knowledge is fallible and subject to revision but still much more valuable than ignorance. As philosophers of science, we study science in a philosophical way, knowing very well that we should not apply philosophical methods to our study of science and vice versa.

This brings us to the final conclusion that there is no last word in induction. Induction, although philosophically unjustifiable, is nevertheless highly beneficial to us if we know how to use it effectively. Long live induction, whatever it is.

References

Primary Sources

Descartes, R. (1993). Meditations on first philosophy. In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part II, chap. 1, pp. 28-30; part V, chap. 1, pp. 193-205). Belmont, CA: Wadsworth Inc.

Hume, D. (1975). *Enquiries concerning human understanding and concerning the principles of morals* [3rd ed.]. Reprinted from 1777 ed., P.H. Nidditch (Ed.). New York: Oxford University Press.

Hume, D. (2003). *A treatise of human nature.* Project Gutenberg Etext. Retrieved May 2008, from http://www.gutenberg.org/wiki/Main_Page.

Locke, J. (2004). *An essay concerning human understanding.* Project Gutenberg Etext. Retrieved May 2008, from http://www.gutenberg.org/wiki/Main_Page.

Secondary Sources

Books:

Ayer, A. J. (1956). *The problem of knowledge.* Reprinted 1966. Middlesex, England: Penguin Books Ltd.

BonJour, L. (1998). *In defense of pure reason.* Cambridge, U. K.: Cambridge University Press.

Dewey, J. (1929). *The quest for certainty* [1960 ed.]. 5th impression. New York: Capricorn Books.

Dretske, F. (1989). The need to know. In M. Clay & K. Lehrer (Eds), *Knowledge & scepticism* (chap. 5, pp. 89-100). London: Westview Press Inc.

Gillies, D. (1993). *Philosophy of science in the twentieth century: Four central themes.* Oxford, U. K.: Blackwell Publishers.

Gillies, D. (2000). *Philosophical theories of probability.* London: Routledge.

Goodman, N. (1983). *Fact, fiction, and forecast* [4th ed.].Cambridge, MA: Harvard University Press.

Goodman, N. (1993). The new riddle of induction. In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part VIII, chap. 6, pp. 459-462). Belmont, CA: Wadsworth Inc.

Hempel, C. G. (2001). *The philosophy of Carl G. Hempel: Studies in science, explanation, and rationality.* J. H. Fetzer (Ed.). New York: Oxford University Press Inc.

Howson, C. (2000). *Hume's problem: Induction and the justification of belief.* New York: Oxford University Press Inc.

Kant, I. (1997). *Prolegomena to any future metaphysics.* G. Hatfield (Ed.). Cambridge, U.K.: Cambridge University Press.

Kornblith, H. (1995). *Inductive inference and its natural ground: An essay in naturalistic epistemology.* Cambridge, MA: The MIT Press.

Lipton, P. (1993). *Inference to the best explanation.* London: Routledge.

Millican, P. (2002). Hume's sceptical doubts concerning induction. In *Reading Hume on human understanding,* (chap. 4, pp. 107-173). New York: Oxford University Press Inc.

Noonan, H. W. (1999). *Hume on knowledge.* London: Routledge.

Owen, D. (1999). *Hume's reason.* New York: Oxford University Press Inc.

Pojman, L. P. (1993). *The theory of knowledge: Classical and contemporary readings.* Belmont, CA: Wadsworth Inc.

Pojman, L. P. (2001). *What can we know?: An introduction to the theory of knowledge.* Canada: Wadsworth, a division of Thomson Learning Inc.

Pollock, J. L. (1984). Reliability and justified belief. In Paul K. Moser (Ed., 1986), *Empirical knowledge* (chap. 8, pp. 193-202). New Jersey: Rowman & Littlefield.

Pollock, J. L. (1986). *Contemporary theories of knowledge.* New Jersey: Rowman & Littlefield.

Popper, K. R. (1959). *The logic of scientific discovery* [Reprinted 2000]. London: Routledge.

Popper, K. R. (1979). *Objective knowledge: An evolutionary approach* [Revised ed.]. New York: Oxford University Press Inc.

Popper, K. R. (1989). *Conjectures and refutations.* [5th ed., reprinted 2000]. London: Routledge.

Quine, W. V. (1969). Epistemology naturalized. In Paul K. Moser (Ed.), *Empirical knowledge* (1986, chap. 10, pp. 214-228). New Jersey: Rowman & Littlefield.

Quine, W. V. (1993). Epistemology naturalized, & Two dogmas of empiricism. In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part VI, chap. 3, pp. 320-328; part VII, chap. 4, pp. 395-407). Belmont, CA: Wadsworth Inc.

Reichenbach, H. (1993). The pragmatic justification of induction. In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part VIII, chap. 4, pp. 450-454). Belmont, CA: Wadsworth Inc.

Rescher, N. (2000). *Nature and understanding: The metaphysics and method of science.* New York: Oxford University Press Inc.

Rescher, N. (2003). *Epistemology: An introduction to the theory of knowledge.* Albany, NY: State University of New York Press.

Russell, B. (1912). *The problems of philosophy* [2nd ed. 1998, Reissue 2001]. With Introduction by J. Skorupski. Oxford, U. K.: Oxford University Press.

Salmon, W. C. (1967). *The foundations of scientific inference.* Pittsburgh, PA: University of Pittsburgh Press.

Sosa, E. (1980). The raft and the pyramid. In Paul K. Moser (Ed.), *Empirical knowledge* (1986, chap. 6, pp. 145-170). New Jersey: Rowman & Littlefield.

Strawson, P. F. (1993). Dissolving the problem of induction. In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part VIII, chap. 5, pp. 455-459). Belmont, CA: Wadsworth Inc.

Stroud, B. (1977). *Hume.* Reprinted 2000. New York: Routledge.

Thomson, G. (2001). *On Leibniz.* Belmont, CA: Wadsworth, a division of Thomson Learning, Inc.

Will, F. L. (1993). Will the future be like the past? In L. P. Pojman (Ed.), *The theory of knowledge: Classical and contemporary readings* (part VIII, chap. 3, pp. 442-449). Belmont, CA: Wadsworth Inc.

CDROM:

Bealer, G. (1998). Analyticity. *Routledge encyclopedia of philosophy* [CDROM]. Version 1.0. London: Routledge.

Chappell, V. (Ed.). (2006). Locke's theory of ideas. In *The Cambridge companion to Locke* [CDROM] (chap. 2, pp. 26-55). Cambridge, U.K.: Cambridge University Press.

Hajek, A., & Hall, N. (2002). Induction and probability [Electronic version]. In P. Machamer & M. Silberstein (Eds.), *The Blackwell guide to the philosophy of science* [CDROM] (chap. 8, pp. 149-172). Malden, MA: Blackwell Publishers Inc.

Honderich, T. (Ed.). (1995). *The Oxford companion to philosophy* [CDROM]. New York: Oxford university Press Inc.

Kaplan, M. (1998). Induction, epistemic issues in. *Routledge encyclopedia of philosophy.* Version 1.0 [CDROM]. London: Routledge.

Lipton, P. (2006). Abduction. In Sarkar S. & Pfeifer J. (Eds), *The philosophy of science: An encyclopedia* [CDROM]. New York: Routledge.

Maher, P. (1998). Inductive inference. *Routledge encyclopedia of philosophy*[CDROM]. Version 1.0. London: Routledge.

Norton, D. F. (Ed.). (1993). *The Cambridge companion to Hume.* [CDROM]. Transferred to digital printing 2005. Cambridge, U.K.: Cambridge University Press.

Oxford talking dictionary [CDROM]. (1998). Oxford, U.K.: Oxford University Press & Learning Company Properties Inc.

Rosenberg, A. (2006). Hume and the philosophy of science [Electronic version]. *Cambridge companions* [CDROM], pp. 64-89. Cambridge University Press.

Internet sources:

Anderson, J. N. (2000). *Secular responses to the problem of induction.* Retrieved March 2007, from http://www.proginosko.com/docs/induction.html.

Burch, R. (2008). Charles Sanders Peirce. *The Stanford encyclopedia of philosophy* [Fall 2008 ed.], E. N. Zalta (Ed.). Retrieved September 2008, from http://plato.stanford.edu/archives/fall2008/entries/peirce/.

Gordon, O. E. (2006). *More on logic.* University of Utah. Retrieved March 2007, from http://www.psych.utah.edu/gordon/Classes/Psy4905Docs/PsychHistory/Cards/Logic.html.

Harman, G., & Kulkarni, S. R. (2005). *The problem of induction.* Princeton University. Retrieved May 2008, from www.princeton.edu/~harman/Papers/REC-Rev.pdf

Heit, E. (2007). Models of inductive reasoning. To appear in R. Sun (Ed.), *Cambridge handbook of computational psychology.* Cambridge University Press. Retrieved May 2008, from www.faculty.ucmerced.edu/eheit/computational.pdf.

Heit, E. (n.d.). What is induction and why study it? Excerpt from A. Feeney & E. Heit (Eds.), *Inductive reasoning: Experimental, developmental, and computational approaches.* Retrieved May 2008, from assets.cambridge.org/97805218/56485/excerpt/9780521856485_excerpt.pdf.

Huber, F. (2007). *Confirmation and induction.* California Institute of Technology. Retrieved May 2008, from www.hss.caltech.edu/~franz.

Kant, I. (2003). *The Critique of Pure Reason.* Project Gutenberg Etext. Retrieved April 2009, from http://www.gutenberg.org/dirs/etext03/cprrn10.txt

Leibniz, G. W. (2005). *New essays on human understanding.* [Electronic version, last amended Apr. 2008]. Copyright J. Bennett. Retrieved March 2009, from http://www.earlymoderntexts.com/pdf/leibne.pdf.

McCormick, M. (2006). Immanuel Kant (1724-1804) Metaphysics. *The Internet Encyclopedia of Philosophy.* Retrieved March 2009, from

http://www.iep.utm.edu/k/kantmeta.htm#H2.

Mill, J. S. (2008). *A system of logic, ratiocinative and inductive* [Vol. 1 of 2]. Project Gutenberg Etext. Retrieved November 2008, from http://www.gutenberg.org/files/26495/26495-h/26495-h.html#toc67.

Millican, P. (1996). *Hume, induction, and probability.* PhD dissertation, University of Leeds, England. Retrieved August 2008, from http://www.davidhume.org/millican.htm.

Morris, W. E. (2001). David Hume. *The Stanford encyclopedia of philosophy* [Spring 2001 ed.], E. N. Zalta (Ed.). Retrieved March 2007, from http://plato.stanford.edu/archives/spr2001/entries/hume/.

Norton, J. D. (2003). *A little survey of induction.* University of Pittsburgh. Retrieved May 2008, from pitt.edu/~jdnorton/teaching/1702_jnrsnr_seminar/docs/Little_survey.pdf.

Okasha, S. (2005, Mar.). *Does Hume's argument against induction rest on a quantifier-shift fallacy?* Retrieved March 2008, from www.bris.ac.uk/philosophy/department/staff/so/humequantifiershift

Owen, D. (2004). *Hume and the irrelevance of warrant.* University of Arizona. Retrieved May 2008, from web.arizona.edu/~phil/faculty/extra/dowen/warrant.pdf.

Palmquist, S. (2001). *Kant on Euclid: Geometry in perspective.* Retrieved March 2009, from http://www.hkbu.edu.hk/~ppp/srp/arts/KEGP.html.

Payne, W. R. (2003). *The problem of induction.* Retrieved March 2007, from http://www.bcc.ctc.edu/ArtsHum/materials/phil/Payne/spring03/160HumeproblemSp03.htm.

Peirce, C. S. (1931). *The collected papers of Charles Sanders Peirce, vol. V: Pragmatism and pramaticism.* Retrieved Nov. 2008, from http://www.textlog.de/peirce_pragmatism.html.

Rhoda, A. R. (2003). *The problem of induction: An epistemological and methodological response.* PhD dissertation, Department of Philosophy, Fordham University, New York. Retrieved August 2008, from www.alanrhoda.net/papers/ARhodaDissertation.pdf

Sayre-McCord, G. (2006). *Hume on practical morality and inert reason.* [Electronic version]. (Working draft: May 29, 2006) University of North Carolina at Chapel Hill. Retrieved March 2009, from www.unc.edu/~gsmunc/Papers/Hume on Practical Morality.pdf

Schmitter, A. M. (2008). 17th and 18th century theories of emotions. *The Stanford Encyclopedia of Philosophy* [Fall 2008 Edition], Edward N. Zalta (Ed.). Retrieved March 2009, from <http://plato.stanford.edu/archives/fall2008/entries/emotions-17th18th/>.

Steel, D. (n.d.). *Inductive rules, background knowledge, and scepticism.* Department of Philosophy, Michigan State University. Retrieved May 2008, from www.msu.edu/user/steel/Inductive_Rules.pdf.

Vickers, J. (2006). The problem of induction. *The Stanford encyclopedia of philosophy* [Winter 2006 ed.], E. N. Zalta (Ed.). Retrieved March 2007, from http://plato.stanford.edu/archives/win2006/entries/induction-problem/.

Wikipedia. (2008, Nov.). *Edmund Husserl.* Retrieved Nov. 2008, from http://en.wikipedia.org/w/index.php?title=Edmund_Husserl&oldid=249744225

Journals:

Brown, H. I. (1994). Circular justification [JSTOR]. *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, 1994*(1), 406-414.

Clendinnen, J. (1965, Jul.-Oct.). Katz on the vindication of induction [JSTOR]. *Philosophy of Science, 32*(3/4), 370-376.

Clendinnen, J. (1966, Sep.). Induction and objectivity [JSTOR]. *Philosophy of Science, 33*(3), 215-229.

Dubs, H. H. (1935, May). The paradox of certainty [JSTOR]. *The Philosophical Review, 44*(3), 254-266.

Feigl, H. (1961, Apr.). On the vindication of induction [JSTOR]. *Philosophy of Science, 28*(2), 212-216.

Feyerabend, P. K. (1964, Jun.). A note on the problem of induction [JSTOR]. *The Journal of Philosophy, 61*(12), 349-353.

Friedman, K. S. (1975, Apr.). Another shot at the canons of induction [JSTOR]. *Mind, New Series, 84*(334), 177-191.

Friedman, M. (2002, Jun.). Kant, Kuhn, and the rationality of science [Electronic version]. *Philosophy of Science, 69,* 171-190.

Fumerton, R. A. (1980, Dec.). Induction and reasoning to the best explanation [JSTOR]. *Philosophy of Science, 47*(4), 589-600.

Heit, E. (2000). Properties of inductive reasoning [Electronic version]. *Psychonomic Bulletin & Review, 7*(4), 569-592.

Lange, M. (2002, Apr.). Okasha on inductive scepticism [JSTOR]. *The Philosophical Quarterly, 52*(207), 226-232.

McLendon, H. J. (1952, Feb.). Has Russell answered Hume? [JSTOR]. *The Journal of Philosophy, 49*(5), pp. 145-159.

Miller, D. (2007). The objectives of science [Electronic version]. *Philosophia Scientiae, 11*(1), 21-43.

Milton, J. R. (1987, Mar.). Induction before Hume [JSTOR]. *The British Journal for the Philosophy of Science, 38*(1), 49-74.

Murdoch, D. (2002, Apr.). Induction, Hume, and probability [JSTOR]. *The Journal of Philosophy, 99*(4), 185-199.

O'Neill, J. (1989, Mar.). Two problems of induction [JSTOR]. *The British Journal for the Philosophy of Science, 40*(1), 121-125.

Okasha, S. (2001, Jul.). What did Hume really show about induction? [JSTOR]. *The Philosophical Quarterly, 51*(204), 307-327.

Papineau, D. (1992, Jan.). Reliabilism, induction and scepticism [JSTOR]. *The Philosophical Quarterly, 42*(166), 1-20.

Salmon, W. C. (1953, Sep.). The uniformity of nature [JSTOR]. *Philosophy and Phenomenological Research, 14*(1), 39-48.

Salmon, W. C. (1981, Jun.). Rational prediction [JSTOR]. *The British Journal for the Philosophy of Science, 32*(2), 115-125.

Smith, N. K. (1915, May). Kant's relation to Hume and to Leibnitz [JSTOR]. *The Philosophical Review, 24*(3), pp. 288-296.

Weintraub, R. (1995, Oct.). What was Hume's contribution to the problem of induction? [JSTOR]. *The Philosophical Quarterly, 45*(181), 460-470.

Curriculum Vitae

As of June 2009

Name	Suchai Komalittipong, Mr.	
Date & Place of Birth	25th February, 1950; Bangkok	
Occupation	Merchant (retired)	
Nationality	Thai (of Chinese Descent)	
Education		
Vocational School:	• Assumption Commercial College (A.C.C.)	1969
Bachelor's Degrees:	• Bachelor of Business Administration (General Management), First-class Honors, Sukhothai Thammathirat Open University (STOU)	1998
	• Bachelor of Economics (Business Economics), STOU	1999
	• Bachelor of Business Administration (Marketing), STOU	2000
	• Bachelor of Public Administration, STOU	2002
	• Bachelor of Arts (Information Science), First-class Honors, STOU	2004
	• Bachelor of Technology (Business Information Technology), Second-class Honors, STOU	2007
Master's Degree:	• Master of Arts in Business and Managerial Economics (international program), Faculty of Economics, Chulalongkorn University	2003
Language Proficiency	Thai, English, Chinese (Mandarin)	
TOEFL Score	277 CBT (equivalent to 649 PBT)	2004