The Problem of Induction:
Solved by the Critical Method
David Hume was the first philosopher to discuss the problem of induction. In his *Enquiry Concerning Human Understanding* he divided the objects of human reason into two kinds, relations of ideas and matters of fact. Relations of ideas are those objects of reason which are intuitively or demonstratively certain, like arithmetical propositions. They are discoverable by thought alone. Matters of fact, on the other hand, are not known demonstratively. They are based in experience and come to be known through the relation of cause and effect and not through thought alone. We observe a certain event or circumstance and then observe another event or circumstance seemingly produced from or connected with the first. After observing this sequence many times we come to expect the second event or circumstance to occur every time after the first occurs. In other words, we come to consider the first event as the cause of the second. Because humans make causal inferences of the kind just described, indeed it is one way we learn about the world, Hume considers the ability to draw these inferences as a principle of human nature. He calls this principle habit or custom.

There is, however, a problem concerning this custom. Hume is curious as to "...what is the nature of that evidence which assures us of any real existence and matter of fact..."(2). Though Hume never referred to this problem as such, it has come to be known as the problem of induction. One aspect of the problem of induction is usually taken to be a question of why we are justified in accepting as true or probably true the conclusions reached through inductive inferences.

Hume answers that we have no justification for accepting these conclusions. He argues that the principle of induction is not demon-
...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."(3). He also argues that the principle of induction cannot have experience and matters of fact as its foundation for this would involve the circularity of presupposing the principle of induction to prove that principle. And Hume argues further that if the principle of induction was deducible from relations of ideas then we would always be able to draw inductive inferences from one instance of an event. But we can't. It is these considerations which lead Hume to discard reason and adopt custom or habit as our guiding principle in the forming of general conclusions regarding matters of fact.

Karl Popper is a philosopher who provides a different, non-sceptical solution to the problem of induction. However, before examining his solution, I think a discussion of some traditional and Popper's own epistemological positions will help make his solution clearer. Popper differs from previous empiricists and rationalists in some fundamental ways. In the introduction to Conjectures and Refutations(4) Popper examines and discusses the epistemologies of Bacon and Descartes. He feels that the epistemologies of these two men inspired the birth of modern science and technology. Both epistemologies present a view that man has the ability to discern truth and to acquire knowledge. A basic foundation of this view is that truth is manifest, i.e., once the truth is revealed we have the ability to see it, to distinguish it from falsehood and to know that it is true. This leads to the notion that no one needs to appeal to an authority to find the truth because each man has the ability to discern the truth himself.
It should be noted that "authority" can be understood in several ways. The first way of understanding "authority" is in the sense of 'an authority on subject X', i.e., one who is well versed in subject X. The second way of understanding "authority" is one who has the power to enforce belief. The third way, closely related to the first and second, is one who (that which) is able to show another the truth (disclose the truth), in the sense of an ultimate source. The statement that the view of truth as manifest leads to the view that no authority needs to be appealed to is taking "authority" in the first sense, e.g., Aristotle, or the second sense, e.g., the tradition of the schools or the church, or both senses.

However, both Bacon and Descartes actually do appeal to authority. Bacon appeals to Nature. Briefly, he held that Nature is an open book. If one reads the book with a pure mind, i.e., with a mind untainted with prejudice, he cannot help but discern the absolute truth. Descartes appeals to God. Basically, the foundation of his doctrine is that since God does not deceive us, whatever we clearly and distinctly conceive to be true is true. God is the guarantor of truth. Both Nature and God are here considered as authorities in the third sense of "authority".

Epistemologically, Bacon was chiefly concerned with scientific method as a method of discovery. He thought that the purpose of science was the extension of the dominion of the human race over nature. In order to attain this dominion over nature men must learn the secrets of nature by observing its regularities in a planned and organized manner. Men should smoothe data, interpret the data judiciously and conduct experiments. In other words, men should make inductive inferences from amassed particular observations to general
axioms, tempering the inferences by observations. Bacon does have a place for testing the value of the general axioms, or hypotheses; observations must be deduced from the hypotheses and experiments conducted to confirm these deduced observations. Thus we will learn the truth about nature and extend our dominion over it.

Bacon's scientific method consisted in the construction of the Three Tables of Investigation. The first table is the Table of Affirmation. It consisted in assembling all known instances that agreed in having the same characteristic of a particular phenomenon. For example, if the subject of inquiry was heat, one would assemble and study all known instances of warm 'bodies' such as the sun, flames, blood from a living creature and the like. The second table is the Table of Negation. One would assemble and study all known negative instances. In our example, these instances would consist of things which don't give off heat. The third table is the Table of Comparison. This table consists in an assemblage of instances in which the phenomenon under study is present in varying degrees. Studying these instances would determine whether there was any correlation between the various degrees of the observed phenomenon, such as the way the body temperature of animals increases by exercise or fever.

Once the tables are completed we compare the instances we have amassed. Through this comparison we discover what is always present when a given phenomenon is present, what is always absent when that phenomenon is absent and what varies in correspondence with the variations of that phenomenon. It is in this comparison and interpretation of the amassed data that induction comes into play. The "what" which is always present, absent and varying in accordance with the phenomenon under study is inductively inferred. Also, this "what"
will be true provided the comparison and interpretation was done with an unprejudiced mind.

Descartes was also concerned with determining the truth about nature, but not necessarily so man could have dominion over it. He thought scientific method was deductive as opposed to inductive and consisted in a set of rules for the correct employment of the natural capacities and operations of the mind. He thought the mind had two fundamental operations: intuition and deduction. Intuition is a purely intellectual activity, i.e., it is an intellectual seeing or vision which is so clear and distinct that there is no room for doubt. Deduction consists in all necessary inferences from other facts which are known with certainty.

Descartes' scientific method was composed of two parts termed "analysis" and "synthesis." Analysis was the step by step reduction of complex and obscure propositions to simpler propositions. In synthesis one started with the intuitively perceived first principles or with the simplest propositions and proceeded to deduce hypotheses in an orderly way.

Although Descartes' scientific methodology was deductive, he did hold that experiments and observations can help us decide which hypotheses to accept. Experiments and observations are also needed because of the limitations of the human mind.

Popper claims that besides Nature and God, Bacon and Descartes appealed to two new authorities (6). These new authorities are observation and reason, respectively. (They are authorities in the third sense of "authority" discussed above.) By setting up observation and reason as new authorities which are contained within each person, Bacon and Descartes split man into two parts. Man contains
a higher part, i.e., observation and intellect, which has authority with regard to truth and a lower part, i.e., our ordinary, everyday, non-philosophical selves. It is the lower part that is responsible for error. That is to say, error occurs in Bacon's epistemology when we don't interpret our observations correctly due to the interference of prejudices. For Descartes, error occurs when we are negligent in reasoning or simply refuse to abandon old beliefs which don't accord with our reason.

Popper also writes that one reason Bacon appealed to the authority of the senses and Descartes to the authority of the intellect was that neither man appealed to our critical judgment.(7) This may sound strange to say for it could be argued that both Bacon and Descartes did in fact appeal to critical judgment. Here, "critical judgment" would be equated with their scientific methodology. I think, however, that Popper is using the phrase "critical judgment" in a slightly different sense. Although he is still referring to a scientific method, he is referring strictly to his scientific method, which is considered as a 'critical method'. More will be said about the critical method throughout this paper.

Popper continues by saying that because Bacon and Descartes appealed to new authorities and not to our critical judgment (in Popper's sense) they "...failed to solve the great problem: How can we admit that our knowledge is a human—an all too human—affair, without at the same time implying that it is all individual whim and arbitrariness?"(8). He writes that this problem was solved by the ancient Greeks. The solution consists in realizing that we do in fact err. The idea of error, however, involves another idea, namely, objective truth. Objective truth is a standard which we may strive
for but which we usually fall short of. Even if we were to develop a theory which was actually objectively true we wouldn't know that it was true because we can never know that any objective truth is such. The best our theories can do is get closer and closer to the truth, i.e., each new acceptable theory is a better approximation to the truth. For Popper, we search for truth not by appealing to an authority but rather by persistently searching for our errors.

This last sentence raises a question though: why can't Popper be said to appeal to an authority also? I think he can be said to appeal to an authority, but here "authority" must be understood in a different way than the three ways previously discussed. These three ways can be considered "positive senses", i.e., positive with respect to truth. Popper appeals to an authority which can be considered as negative with respect to truth. This authority is our critical judgment, i.e., the critical method. It is negative with respect to truth in that the critical method is not a search which aims at the attainment of truth but rather aims at finding error. Thus we search for truth by appealing to the authority of our critical judgment; by searching for error. I also think that understanding "authority" in this "negative sense" is to weaken that authority, for now there is nothing in it regarding the attainment of truth. But by this very weakening the "split man" of Bacon and Descartes is unified.

In the proceeding discussion it can be seen that both the empiricist and rationalist traditions held that there was an ultimate source of knowledge. They also held that truth is manifest. What wasn't explicitly mentioned in the proceeding discussion but is important for both traditions is that our knowledge must be justified.
by an appeal to some ultimate source of knowledge. These beliefs lead to the view of science as certain, demonstrable knowledge.

Popper claims that nowadays this view of science is slightly modified, with induction considered as a kind of (weakened) generalization of deduction(9) which doesn’t give us certainty but probability. This probability is considered as a measure of the reasonableness of our beliefs or the reliability of our knowledge(10).

Popper argues that this view of science must be done away with, even if considering purely deductive systems. This is because a deductive system is no longer considered as a system that establishes the truth of its theorems by deducing them from ‘axioms’ whose truth is quite certain, i.e., deduction isn’t used merely for proving conclusions. A deductive system is considered as one that allows critical and rational argumentation, i.e., deduction is used as an instrument of rational criticism. When considering a physical theory, we deduce conclusions for the purpose of criticism. By testing the deduced conclusions we test our hypotheses, there is no intent to establish the conclusions(11).

Popper also writes that someone who holds the inductive view of science (the modified view noted above) conceives evidential statements (like Bacon’s amassed data) as analogous to the quite certain ‘axioms’ which ‘prove’ our theorems. This person also conceives hypotheses as analogous to theorems whose truth is made certain by deduction from the ‘axioms’. Popper’s main objection to this view is that evidential statements are not certain. “Every observation and, to an even higher degree, every observation statement, is itself already an interpretation in the light of our theories.”(12).

It should be fairly clear that Popper rejects most of the tenets
of both empiricism and rationalism, particularly the idea; truth is manifold, there are ultimate sources of knowledge and that our knowledge must be justified by an appeal to those ultimate sources. He is not, however, merely a skeptic for he replaces these tenets with others which form his foundation (though not an absolute foundation) for scientific and philosophical inquiry. He puts his tenets in the form of nine theses(13). (I've only quoted the parts of his theses most relevant to this paper.)

(i) There are no ultimate sources of knowledge. Every source, every suggestion, is welcome; and every source, every suggestion, is open to critical examination...

(ii) The proper epistemological question is not one about sources; rather, we ask whether the assertion made is true—that is to say, whether it agrees with the facts. (That we may operate, without getting involved in antinomies, with the idea of objective truth in the sense of correspondence to the facts, has been shown by the work of Alfred Tarski.) And we try to find this out, as well as we can, by examining or testing the assertion itself; either in a direct way, or by examining or testing its consequences.

(iii) In connection with this examination, all kinds of arguments may be relevant. A typical procedure is to examine whether our theories are consistent with our observations...

(iv) Quantitatively and qualitatively by far the most important source of our knowledge—apart from inborn knowledge—is tradition...

(v) ...every bit of our traditional knowledge (and even our inborn knowledge) is open to critical examination and may be overthrown. Nevertheless, without tradition, knowledge would be impossible.
(vi) Knowledge cannot start from nothing—from a tabula rasa—nor yet from observation. The advance of knowledge consists, mainly, in the modification of earlier knowledge...

(vii) ...there is no criterion of truth at our disposal...But we do possess criteria which, if we are lucky, may allow us to recognize error and falsity. Clarity and distinctness are not criteria of truth, but such things as obscurity or confusion may indicate error. Similarly, coherence cannot establish truth, but incoherence and inconsistency do establish falsehood...

(viii) Neither observation nor reason are authorities...the most important function of observation and reasoning...is to help us in the critical examination of these bold conjectures which are the means by which we probe into the unknown.

(ix) Every solution of a problem raises new unsolved problems; the more so the deeper the original problem and the bolder its solution...

Now the question can be raised whether these nine theses apply to themselves and if so, whether this is a dangerous circularity. I think that these theses do apply to themselves and although this is circular I don't think it is a dangerous circularity. For if the nine theses couldn't be applied to themselves, they would be considered as an absolute foundation, an ultimate source by which to conduct philosophical and scientific inquiry. But this is what Popper is trying to get away from. Also, applying these nine theses to themselves could be considered as just a reaffirmation of them. However, if by assuming that they should be used, i.e., applying them to themselves, results in the conclusion that they should not be used it logically follows that they should not be used.
Since, for Popper, there are no ultimate sources of knowledge, the search for ultimate sources as conceived by the traditional epistemological systems becomes irrelevant. The search for a justification for our knowledge likewise becomes irrelevant. Hence, it is obvious that Popper is not a justificationist. Neither is he a skeptic. His position is, in his own words, one of "critical rationalism"(14).

Critical rationalism doesn't try to answer the question of sources of knowledge and justification by appealing to those sources. This question is replaced by the question "How can we hope to detect and eliminate error?"(15). Popper's answer to this question is "By criticizing the theories and guesses of others and—if we can train ourselves to do so—by criticizing our own theories and guesses"(16).

An idea contained in this answer, and mentioned before, is the idea of criticism; critical examination; the critical method. A critical examination of a theory would consist of an examination of whether the theory in question solves the problem it is supposed to solve and, if so, does it solve more aspects of the problem than previously held theories or new competing theories. A critical examination would also include the question of whether the theory explains what it is supposed to explain or whether it merely shifts the problem. Another aspect of a critical examination is whether the theory is testable and, if so, how well it is testable. Basically, most criticism of a theory is aimed at falsification of that theory. If a theory is falsified by critical examination a different one will be proposed. If this proposed theory stands up to sever critical examination we can adopt it as the preferable one, always ready, though, to reject it if further critical examination falsifies it. This is the way
knowledge grows, always striving for objective truth and hopefully getting nearer and nearer, though we can never know how near we are or even if we have found the truth.

The proceeding paragraph contains many ideas, explicitly and implicitly, which play important roles in the critical method. Briefly, they are explanation, demarcation, testability, experimentation, falsification, corroboration, growth of knowledge and objective truth. I have already discussed objective truth to the extent I think it needs to be explicitly discussed for the purposes of this paper. Some of the other ideas have been alluded to but not discussed in detail. The idea of demarcation (the problem of demarcation) has a close relationship to the problem of induction. The solution to the problem of induction bears a relationship to the other ideas. In fact, all these ideas are linked to each other in such a way that it is difficult to discuss any one idea fully without discussing the others. In what follows I will develop these ideas as they pertain to the critical method and to each other.

Before getting into the meat of Popper's critical method, however, I think it is important to note that he suggests that the aim of science is to find satisfactory explanations of whatever strikes us as being in need of explanation. He has a specific definition of what an explanation is: "...a set of statements one of which describes the state of affairs to be explained (the explicandum) while the others, the explanatory statements, form the explanation in the narrower sense of the word (the explicans of the explicandum)." (17). There are some points concerning both the explicandum and the explicans which should be noted. The explicandum is generally known to be true, or at least assumed to be known to be true. Thus, whenever a scien-
tific explanation is a discovery it will be the explanation of the known by the unknown.

For an explication to be considered satisfactory, it must satisfy some conditions. First, the explicandum must be logically entailed by it. Second, the explicans must not be known to be false; not even after the most critical examination. Third, the explicans must be independently testable; and its satisfactoriness will increase the greater the severity of the independent tests it has survived(19).

Karl Popper considers the central problem of the philosophy of knowledge to be composed of two related problems. The first problem is "How can we adjudicate or evaluate the far-reaching claims of competing theories and beliefs?"(19). He writes that the second problem, i.e., "How can we justify our theories or beliefs?"(20) stems from the first and leads to a third problem, namely, the problem of distinguishing between, or demarcating, rational (scientific) theories and irrational (non-scientific) beliefs(21). The solution to the problem of demarcation is needed for a critical appraisal of scientific theories, or allegedly scientific theories(22). The distinguishing characteristic of a scientific theory, as opposed to a non-scientific theory, is that it is testable, or refutable, or falsifiable(23). An important problem linked with the testability of scientific theories is the problem of their arguability and rationality. Testability can be considered as a certain kind of arguability: arguability by means of empirical arguments, arguments appealing to observation and experiment(24).

The question of whether we can justify our theories and beliefs, besides leading to the problem of demarcation, leads to other questions such as what a justification consists of and whether it is
possible to rationally justify our theories and beliefs. By the word "rationally" Popper means "by giving reasons" for holding as true, or at least probable, these theories and beliefs. He terms these types of reasons "positive reasons". Popper states that there is an unstated assumption which allows the move from the first problem to the second, namely, that we adjudicate among competing theories by determining which of them can be justified by positive reasons and which cannot. He rejects this assumption, asserting that no positive reasons can be given for holding a theory to be true. He also rejects the second problem as irrelevant for the reasons mentioned earlier.

He does, however, formulate a third problem and offers a solution to it. This third problem, though similar to the second, is distinct from it and is the problem of whether one theory is preferable to another—and, if so, why? (25). The word "preferable" is here to be understood as a closer approximation to the truth. He says we have reasons, termed "critical reasons", which are formulated as a result of critical examination, to think that one theory is preferable to another. Critical reasons do not and can never justify a theory. They can, however, be used to defend our preference for one theory over others (26).

Popper claims that this critical approach, i.e., determining whether, and why, one theory is preferable to another leads to a straightforward solution to the problem of induction. He asserts that Hume successfully showed that (i) there are countless (apparent) regularities in nature upon which everybody relies in practice, and many universal laws of nature accepted by scientists, which are of the greatest theoretical importance. (ii) There can be no valid reasoning from singular observation statements to universal laws of nature.
and thus to scientific theories. Popper calls this the principle of the invalidity of induction. (iii) We demand that our adoption and rejection of scientific theories should depend upon the results of observation and experiment, and thus upon singular observation statements. He calls this the principle of empiricism(27).

By accepting (i), above, as given, the problem of induction becomes a logical problem consisting in the clash between (ii) and (iii). By deciding that our knowledge of the laws of nature is obtained from observation, i.e., acceptance of (ii), Hume discarded reason as the basis of our knowledge of laws of nature thereby dissolving the clash, relying instead on habit or custom, as previously discussed, as the basis for our knowledge of nature.

Popper also claims that there is no clash between (ii) and (iii), but not in the same way Hume does, i.e., not by rejecting reason. Instead, Popper introduces another principle which he claims is consistent with (ii) and (iii). This principle is that (iv) we demand that our adoption and our rejection of scientific theories should depend on our critical reasoning (combined with the results of observation and experiment, as demanded by (iii)). He calls this the principle of critical rationalism(28). The word "adoption" as used in this principle is to be understood in the sense of being tentative. According to Popper, our adopted scientific theories always are and always will remain guesses or conjectures or hypotheses. This last statement is the key to Popper's solution of the logical problem of induction.

There are some aspects of experimental observation, as part of our critical reasoning, used in determining whether a theory is adopted or rejected, which are important to distinguish. Experimental ob-
servessions are not capable of inferentially verifying a theory. They are capable of inferentially falsifying a theory, however. I should point out, because this point is sometimes missed(29), that (T ∩ A ∩ B ∩ C) ⊃ Ø
\[ \frac{Ø}{\therefore (T ∩ A ∩ B ∩ C)} \]
where A, B, C are background assumptions with a high degree of corroboration, thereby allowing us to infer Ø. More will be said about this below. Experimental observations can also be used to corroborate a theory to varying degrees.

The degree of corroboration of a theory is the degree to which a theory has stood up to tests. A theory's degree of corroboration does not have anything to do with establishing, or making firm, or verifying a theory as true. Rather, it is used as an aid in evaluating the acceptability of a theory with respect to the tests it has undergone, i.e., it "...permits us to compare rival theories such as Newton's and Einstein's..."(30). Popper also says that he doubts that a numerical evaluation of the degree of corroboration of a theory would be of practical significance.

The main reason(31) that Popper wants to speak of 'degree of corroboration' is to avoid confusion with talk of 'probability of a hypothesis in the light of tests'. The confusion arises because of the different senses in which "probable" and "probability" can be used. One sense of "probability" is the sense suggested above, i.e., probable with respect to a theory's tests. This sense is very similar to the intended meaning of 'degree of corroboration' but has to be distinguished from two other common usages of "probable" and "probability".

One of these other common usages is the 'probability of an event'. It should be noted that the probability of an event has a
characteristic feature, namely, "...the probability of a complex event consisting of the concurrence of several single events will in general be less than, and at most equal to, the probability of any of the component events." (33). Accordingly, increasing logical content of a statement describing an event decreases the probability of that statement. Popper calls this the "rule of content" (33). The logical content of a statement is the class of all statements that follow from the statement describing the event (34). The first sense of "probability", i.e., degree of corroboration, has no corresponding rule of content.

The third sense of "probability" which has to be distinguished is the 'probability of an inference'. This sense of "probability" arises from the idea of science as certain, demonstrable knowledge, as previously discussed. Both the probability of an inference and the probability of an event can be considered as satisfying the probability calculus (35) and degree of corroboration does not (36), i.e., non-satisfaction of the probability calculus is determinative for degree of corroboration.

The proceeding discussion showed what degree of corroboration is not: it is not a probability which satisfies the probability calculus. On the positive side, the degree of corroboration of a theory is an evaluation of the results of the empirical tests it has undergone (37). Because it is an evaluation of test results, the testability of a theory obviously has a close relation to degree of corroboration (38). The empirical content of a theory also plays an important role in the concept of degree of corroboration, for the the greater the empirical content of a theory the greater is that theory's testability. In other words, the greater the empirical
content of a theory the greater the number of tests that can be derived from it. The empirical content of a theory is determined by the class of those observational statements which contradict the theory, i.e., the class of its potential falsifiers(39). This shows that the greater the content the greater the logical improbability (in the sense of the probability calculus) of the theory.

Thus the logically more improbable theory will turn out to be the better tested theory because of its greater testability and greater content(40). The logically more improbable theory will also turn out to be the better corroborated theory, provided it isn't refuted. The severity of the tests also plays a role in determining the degree of corroboration of a theory, for the more severe the tests a theory has passed, the better corroborated it is. The severity of a test is closely related to the probability of failing that test, i.e., the greater the probability of failing a test, the more severe that test is(41).

Perhaps the relationships of scientific explanation, demarcation, corroboration, testability and the solution to the problem of induction will become clearer through a discussion of the growth of scientific knowledge(42). The general problem situation that the scientist finds himself in is the task of getting nearer to the truth. In order to do this, the scientist needs to formulate new theories which explain certain experimental facts. These facts are of three types: facts successfully explained by earlier theories; facts which aren't successfully explained by earlier theories; and facts which falsify earlier theories. Some theoretical difficulties should also be resolved by a new theory. A couple of these theoretical difficulties consist of how to unify two theories or how certain ad hoc hy-
potentia can be dispensed with.

However, Popper states that the logic of the general problem situation of the scientist requires more than an explanation of the facts and a resolving of some theoretical difficulties. He has three requirements for the growth of scientific knowledge and states that the first requirement is that "The new theory should proceed from some simple, new, and powerful, unifying idea about some connection or relation...between hitherto unconnected things...or facts...or new 'theoretical entities'...

Independent testability is the second requirement. For a theory to be independently testable it must have new consequences, preferably of a new kind, and these consequences must be testable. That is to say, it must lead to the prediction of phenomena which haven't been observed yet. A theory must also, obviously, explain all the phenomena it was designed to explain.

These two requirements serve to limit the range of choices among the possible solutions to a given problem. Satisfaction of the second requirement ensures that a new theory will be a step in the right direction. This is ensured because in addition to the explicanda of the previous theory being explained by the new theory, new tests can be developed from the new theory.

The development of new tests from a new theory gives rise to the third requirement, namely, that new and severe tests should be passed by the new theory. It should be noted, however, that this third requirement is different in character from the first two requirements. The third is a requirement of empirical success and can be considered as a 'material requirement'. It can be satisfied, or found to be unsatisfied, only through empirically testing the new
theory. The first two requirements can be considered as 'formal requirements'. Logical analysis of the old and new theories in question can determine whether these first two requirements are satisfied or not.

Besides positing these three requirements, Popper holds that all three are indispensable for knowledge to grow. However, the third requirement is indispensable in a different way than the first two. These first two requirements help us decide whether a new theory is an interesting and promising one, i.e., whether it should be seriously considered for examination by empirical tests. The way in which the third requirement is indispensable is, Popper contends, that scientific progress, the growth of scientific knowledge, would stagnate if the third requirement were not often met. He writes: "New predictions... must not only be produced, but must reasonably often be corroborated by experimental evidence... if scientific progress is to continue."(44). He continues: "... it is only through these temporary successes of our theories that we can be reasonably successful in attributing our refutations to definite portions of the theoretical maze."(45) In other words, only by the corroboration of theories, all of which may, at sometime or other, form the background assumptions, or knowledge, used when testing a new theory can we attribute a refutation of that new theory to that new theory and not to one of the background assumptions. This is not to say that the refutation of a predicted observation derived from a new theory can be definitely attributed to a new theory, but rather the corroboration of these background theories make it reasonable to examine the new theory first in trying to determine where the error is that causes the refutation. There is also another reason why the third
requirement is essential for scientific progress. This is that "We have no reason to regard the new theory as better than the old theory—to believe it in nearer to the truth—until we have derived from the new theory new predictions which were unobtainable from the old theory...and until we have found that these new predictions were successful."(16).

An example of the growth of scientific knowledge can be seen in a brief comparison of Newton's and Einstein's theory of gravitation. Einstein's theory superseded Newton's theory in that the former explains facts at the micro and macro levels of physical events which the latter cannot account for. When considering the effects of gravity on light, Newton's theory predicts that light will not be bent by a gravitational field and Einstein's theory predicts light will be bent. In 1919 an eclipse of the sun provided an opportunity to test this prediction. A certain star of which the calculated position was known was in a location that would permit observation of light bending, if the bending was going to occur. During the eclipse, the star was observed in a slightly different position, the position predicted by Einstein's theory, than the position predicted on the basis of light not bending. That is to say, Einstein's prediction that a gravitational field (here, the sun's) would bend light a certain amount was confirmed thereby corroborating the theory. In this corroboration of Einstein's theory, Newton's theory was refuted (at least partially).

This paper is mainly an exposition of Karl Popper's conception of scientific method. I feel that an exposition of this type is appropriate, and needed, since there are more than a few philosophers who seem to not see how Popper's rejection of induction and subsequent
replacement of induction by critical rationalism forms a less problematic, and seemingly more accurate picture of scientific methodology(47). For the most part starting with Bacon, scientific method was thought to be inductive. Even today many people think that induction plays a prominent role in science. As I think I have shown, Popper explodes the idea that induction is the method of science, replacing induction by the critical method. Critical examination of theories, i.e., the search for error in those theories, for falsification, by means of various argumentation such as logical evaluation and experimental observation is what, for Popper, gives science its rationality(48). One of the key elements of critical rationalism is the realization that all our theories are guesses or conjectures. They are conjectures which attempt to bring us closer to the truth, but as conjectures they are always open to critical examination and refutation, for refutation is the aim of criticism.

I should mention that critical examination is not restricted to science. Critical rationalism allows for the growth of any knowledge, scientific or otherwise. For example, even logic itself has evolved and been improved upon. More adequate logical systems were devised through Frege's and Russell's critical examination of Aristotelian logic.
NOTES


6. Popper, Conjectures, pp. 15-16

7. Popper, Conjectures, p. 19

8. Popper, Conjectures, p. 16


10. Popper, Realism, p. 232

11. Popper, Realism, p. 231

12. Popper, Realism, p. 232

13. Popper, Conjectures, pp. 27-28

14. Popper, Conjectures, p. 26

15. Popper, Conjectures, p. 25

16. Popper, Conjectures, p. 26

17. Popper, Realism, p. 132

18. Popper, Realism, pp. 132-133

19. Popper, Realism, p. 13

20. Popper, Realism, p. 19

21. Popper, Realism, p. 162

22. Popper, Realism, p. 164

23. Popper, Realism, p. 159

24. Popper, Realism, p. 162

25. Popper, Realism, p. 20
26 Popper, Realism, p. 19-20
27 Popper, Realism, pp. 31-32
28 Popper, Realism, p. 32
30 Popper, Realism, p. 321
31 Popper, Realism, p. 222
32 Popper, Realism, p. 224
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34 Popper, Conjectures, p. 395
35 Popper, Realism, p. 226
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42 Popper, Conjectures, pp. 240-243
43 Popper, Conjectures, p. 241
44 Popper, Conjectures, p. 243
45 Popper, Conjectures, p. 243
46 Popper, Conjectures, p. 246
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