THE SCIENTIFIC STATUS OF NATURAL SELECTION AS AN EXPLANATION OF EVOLUTION

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Date 27/8/98

ONKWARE, KENNEDY

This Thesis has been submitted with my approval as University Supervisor

Date 27/8/98

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ABSTRACT

This work is aimed at showing that although natural selection does not satisfy the strict criteria for scientific explanation according to the so-called covering law theory, it meets some broader criteria for scientific explanation latent in the history of the actual practice of both natural and social sciences explicitly propounded in the methodological pragmatism of Charles Sanders Peirce. To the extent that it meets such criteria, I argue that to the same extent, natural selection is a scientific theory. Scientific inquiry was carried on long before logical positivism was born. While we acknowledge positive contribution to the economy and logical rigour on the part of the covering-law model, the functional comprehensiveness of scientific inquiry latent (even if not explicitly stated) in Peircean pragmatism cannot be over-looked.

The study explores the requirements of the covering-law theory which demands that, for any theory to qualify as scientific, it must invoke a 'general law' in addition to its premises being known to be true. These two requirements natural selection fails to meet. Consequently, it fails to qualify as scientific according to this criterion.
The covering-law theory presupposes the correspondence theory of truth. This theory does not either methodologically or epistemologically reflect the history of the actual practice of science which is exemplified in the Peircean scientific methodology. Within this methodology, natural selection is scientific. The necessary conditions stipulated by the covering-law theory are, in consequence, merely contributory and not sufficient for scientific explanation.

Scientific progress is accumulative. Therefore, I recommend that, first, one needs to re-examine one's ontological presuppositions before one rejects alternative approaches to scientific inquiry. Secondly, organic evolution Darwinism should not be confused with social Darwinism whose inferences are illegitimately drawn from organic Darwinism leading to untenable conclusions and satisfying no plausible criterion of scientific explanations.
1.0 BACKGROUND TO THE STUDY

The aim of Science is not only to discover and describe events and phenomena in the world but also, and more importantly, to explain scientifically these events and phenomena as they occur. Nagel (1961, p.4) observes:

Science seeks to discover and to formulate in the general terms the conditions under which events of various sorts occur, the statements of such determining conditions being the explanations of corresponding happenings.

From Nagel’s observation two aspects of science can be discerned, namely, that, first, classification of it’s knowledge that leads to description, and secondly, explanation of factors that leads to understanding. A third aspect of science involves prediction and retrodiction. Prediction leads to control. According to Hempel and Oppenheim (1948, p. 18), prediction and retrodiction in science share identical logical structure. To analyse an event which has occurred in the past is to explain that event. If the event has not occurred but is supposed to occur in the future, then the scientist is predicting. Retrodiction then becomes the reconstruction of an explanation of a past event to recollect an earlier one. This view is also held by Cannavo (1974, pp. 113-114).
Hempel (1959, p.12) echoes Nagel when he remarks, "it (science) seeks not only to describe the phenomenon in the world of our experience, but also to explain or understand their occurrences: it is concerned not just with the "what?", "when?" and "where?" but definitely and often predominantly, with the "why?" of the phenomenon it investigates". This is because, as noted earlier, explanation of facts leads to understanding. As Scriven observes, by scientific explanation is meant,

A topically unified communication, the content of which imparts understanding of some scientific phenomena. And by understanding is meant, roughly, organised knowledge, that is, knowledge of the relations between various facts and or laws (1962, p. 102).

Bromberger (1966) and Nagel (1961) hold that scientific explanations are answers to "why?" questions. But "why?" here is ambiguous and calls for clarification. It either means, "for what reason or purpose. For example, Why did you come late to school today? or when it is used in front of a verb to suggest that something is unacceptable or unnecessary as in this sentence: why get upset just because you got a bad mark? We use "why" in the first sense.

It follows that a scientific explanation is meant to make us understand clearly, not only facts, which belong to description, but also laws that cause the phenomena. For example, a house-wife seeks to know "why" a metallic
spoon gets hot (i.e., when cooking) while a wooden spoon does not. She could understand it if she knew that all metals are good conductors of heat and that metallic spoon is made of some metal, e.g., copper, which is a good conductor of heat, unlike wood which is a poor conductor of heat.

From the above examples, it follows that the purpose of an explanation is to give an account of facts or phenomenon so that they become intelligible to a mind seeking to understand. That is exactly what Charles Darwin (1859) tried to do when he propounded the theory of natural selection. Charles Darwin (1859) and Alfred Russell Wallace (1864) working independently arrived at similar conclusions that existing organisms originate out of those existing before them. Because of Darwin's accumulation of evidence together with his publication of *Origin of Species by means of Natural Selection* first published in 1859, the above view has been referred to as Darwinism. This theory can be subsumed under four basic ideas:

1. **Heredity**
Organisms tend to produce their like. This is a clear fact from human experience and observation, and it seems to operate throughout the animate things (Darwin, 1859; pp. 26, 48, 81). For example man produces man, cow produces cows.
2. Variations
While an animal tends to produce an offspring like itself, no two animals are exactly alike. There are always individual variations in structure and function. These variations, according to Darwin, may occur because of organic causes or through mere chance (Ibid., pp. 48, 81).

3. A struggle for existence
Because of the scarcity of food or space for all living creatures, there is fierce competition for life, or a struggle for existence (Ibid., pp. 70-71, 73-9).

4. Survival of the fittest
Those offspring with the most favourable variations, that is, those best adapted to the conditions under which they must live, are the ones that survive. The rest go down in the struggle and do not propagate their kind. Those selected and preserved by nature will bring forth offspring, again with chance variations or modifications. Eventually these changes will rise to new species (Ibid., pp. 81, 84, 95).

The entire process described above is known as "natural selection", in order to mark its relation to man's power of selection (Ibid., p. 67). By nature Darwin meant a physical power causing all phenomena of the material world, making some organisms "fit to survive" while "eliminating the weak ones". This is opposed to, for
example, political power (which may be legitimate or otherwise) and intellectual power as when we say "knowledge is power" by which we mean the ability to discern things and give rational judgements.

Since it was propounded, the theory of natural selection has been at the centre of controversy. Philosophers like Dow (1962), Rescher (1970), Whithers (1971) and Dobzhansky (1977) consider the theory of natural selection to be scientific. Consider these two quotations from Rescher and Dobzhansky, respectively. "... prior to Darwin, the theory of evolution was merely a hypothesis, but it gained acceptance when Darwin advanced a scientific explanation in the name of natural selection ..." (pp. 14-15). "... Charles Darwin did solve the riddle of the uniqueness of organisms adapting to the environment when he advanced the theory of natural selection as a scientific explanation of evolution" (p. 17). To Rescher (1970), we can reply that the acceptance of evolution is one thing and natural selection being scientific is another, while to Dobzhansky (1977) we could reply that the mere fact that Darwin has solved a riddle on how organisms adapt to their environment does not qualify his theory to be a scientific explanation. Many philosophers/people have "solved" riddles but their "solutions" may not qualify as scientific explanations. Consider the following example. If a grandmother seated by a mango tree was hit by one falling mango, we could not accept her explanation as
scientific if she said that the mango had been made to fall on her by a neighbour who she claims is a witch and who incidentally, sat on the same spot a few hours earlier.

Other philosophers like Popper (1976, p. 110), Taylor (1983, p. 13) and Faria (1988, p. XVIII) have questioned the scientific status of natural selection as an explanation of evolution. Popper for example says that Darwinism is not a testable theory.

The above controversy can be attributed to the question of what constitutes scientific knowledge which is still an open one. Science has been applied to all systematic studies, i.e., organised knowledge which includes maths and theology. This is a view which seems to have been established in England in the 19th century. For some time, "scientific" and "demonstrative" were held as synonymous terms. At the beginning of that century, physicists and chemists were still allied philosophers (Encyclopedia Britanica, 1973; p. 18). "The latin word "scientia" meant nothing more definite than "Knowledge", but modern usage covers mainly empirical kinds of knowledge" (Ibid., p. 6).

Science is by nature always developing. It is not a static body of knowledge. It is a search that never ends and is never satisfied (lest it turned out to be a "tradition").
Science has thus been equated with "research" and has come to connote a process and not a static body of doctrine. The "raw materials" of science is the outer world, i.e., phenomena, by which is meant "things that appear", the "appearances". "These can only appear in the senses that we possess, although they may be defective and science seeks ever to correct, aid, and extend our senses by technological devices. Science also ascends phenomena as when it uses abstractions, usually of a mathematical kind" (Ibid., p. 7).

What distinguishes natural science from other branches of knowledge, e.g., metaphysics, is its method. Scientific knowledge lays no claim to infallibility, and in this respect it differs most strikingly from other methods. This too, explains its progressive nature. From the scientific method we can identify two aspects of science, namely formal science and empirical science. The former embraces the sciences of mathematics and formal logic. The latter which is also known as natural sciences embraces all the sciences called "physical" and "social", e.g., chemistry, physics, economics, sociology. Formal science asserts nothing about natural phenomena; it is independent of experience and none of its proofs rest on how facts actually stand. The term "empirical" means "relating to experience"; each empirical science deals with some aspect of what can be experimentally known and attempts to formulate laws about it. It tests its
theories by observing with special techniques that it employs a set of facts which are accumulated by the method of induction.

In his analysis of matter, Aristotle gave two accounts of induction which had great influence on subsequent thought. In Prior Analytics, ii, 23, Aristotle talks of induction as a kind of syllogism in which we reach universal conclusion from an exhaustive survey of the cases it covers. In Posterior Analytics i, 1 and 18, he talks of induction as the establishment of a universal truth by consideration of an instance or instances which reveal to thought the necessity of the connection. The two have been called summative and intuitive induction, respectively; "none of which is identified with ampliative science, by which universal propositions are established in empirical sciences" (Ibid., p. 18), a view to which Bacon, Hume and Mill seem to subscribe. Mill for instance spoke of employing a number of different methods, both modelled on Bacon's induction. He talked of "a method of agreement, in which the cause of a phenomenon is revealed by consideration that it is the only circumstances in which positive instances agree; and a method of difference, in which the cause is revealed by the consideration that it is the only circumstance in which a positive and a negative instance differ. The former was used in observational sciences while the latter was used in the experimental sciences" (Ibid., p. 19).
Mill’s methods do not cover the whole range of scientific activity and the reduction of the business of discovery to rules is itself misleading. It is very difficult to find a formula which will adequately characterise all scientific activity. Some scientists are concerned with the making of inductive generalisations from experience. Others dwell on deductive systems where generalisations may be derived from hypotheses that cannot themselves be tested directly because they deal with unobservable entities e.g., electromagnetic waves. What can be said is that the pursuit of science is the search for knowledge and understanding through the formulations of the laws of nature. The laws of nature should thus be emphasized in our conception of science.

It is important to note that generalisations from experience is an indispensable feature of science. This has its roots in the 17th century naturalists who emphasized on generalisations through induction. "A generalisation which has been confirmed by experience only after it has been deduced from a theory is not invalidated by the discovery of a flaw in the theory, though it may perhaps lose something in reliability when it is no longer linked with other generalisations through the theory" (Ibid., p. 20). In this sense falsification (Popper, 1973) as criterion for scientific explanations is watered down. Since, as noted earlier, science endeavours to discover natural laws through which it explains phenomena,
the covering law theory (Hempel and Oppenheim, 1948) comes out strong. This entails the discovery of a law under which an event can be subsumed hence explaining the event. "Science explains via laws" (Wilson, 1985; p. 2). Hence some philosophers of Science believe that the covering law theory is an adequate deductive criterion for scientific explanations since it emphasizes laws of nature. As we shall show later, such philosophers as Charles Sanders Peirce do not subscribe to this view. Although it is not infallible, the covering law theory is useful as a means of explanation in the physical sciences where laws of nature can easily be found. It would be economical and comprehensive and hence desirable to have a unitary concept of explanation valid for all branches of science. But this desirability does not guarantee its own satisfiability.

Gauged against the covering-law theory, the theory of natural selection cannot be scientific since it does not meet the necessary conditions that the covering law theory demands for an explanation to be scientific (Hempel and Oppenheim, 1948; Salmon, 1984; Giere, 1988).

Copi and Cohen (1990, p. 377) have observed that "a necessary condition for the occurrence of a specified event is a circumstance in whose absence the event cannot occur". In other words, a necessary condition is that condition without which that event cannot occur. It is as
they say in Latin, a *conditio sine qua non*. For example, oxygen is a necessary condition for combustion to occur. Without oxygen, combustion cannot occur.

A necessary condition should be distinguished from a sufficient condition which is "a circumstance in whose presence the event must occur" ([Ibid.], p. 377). In other words, it is that with which an event occurs. For example, boarding a plane is in itself sufficient for you to reach Garissa. But boarding a plane is not a necessary condition for reaching Garissa because you can reach Garissa by road or on foot. For an explanation to be scientific according to the covering-law theory, it must satisfy the following necessary conditions:

1. Explanation of individual events.
   The explanation must contain a number of singular statements, which assert that certain events have occurred at indicated times and places ([Nagel, 1961; p. 30]). If one is riding a bicycle and one of the tyres goes flat, he may initiate a search for a puncture with the assumption that flat tyres are caused by punctures.

2. Subsumption under general laws
   An explanation is marked "scientific" if it has attained (1) above and, more importantly, when it invokes tested and confirmed laws ([Ibid., p. 33]). Subsumption under laws here means to place the item to be explained within a
framework of generalisations that state how things must operate within a certain range of phenomena, e.g., our example of the housewife on page 2. We place the behaviour of the metallic spoon under the universal law that "All metals are good conductors of heat".

3. Requirement of spatio-temporal universality
The explanation must not be limited in time and space. It should be able to apply to events in other places and times. It should be open-ended, i.e., it should have an infinite range both in time and space (Hospers, 1967; pp. 240-247). There is no time and place at which the explanation should not hold true, e.g., the explanation/law that "All metals are good conductors of heat" does not refer to any time or space, it is infinite.

4. Epistemic requirements
We assume that every statement which may appear as a premise in an explanation is either true or false. An explanation is dismissed as "inadequate" if any of the premises was known to be false. Truth is therefore of paramount importance to scientific explanation. Several theories of truth have been put forward, i.e., the "correspondence" theory of truth, the "coherence" theory of truth, and the "pragmatic" theories of truth. The "correspondence" theory of truth is the theory that the covering law model of scientific explanation presupposes. According to this theory, truth consists in the agreement
of our thought with reality. In this sense, the explanatory premises must be compatible with established empirical facts. According to A. J. Ayer (1936), an empirical statement shall not be counted as meaningful unless some observation is relevant to its truth or falsity. The criterion of verifiability evaluates truth in the correspondence theory. By verification we mean a process of finding out, coming to know, that it is true. It is used by the logical positivists in the more inclusive sense of "coming to know whether the statement is true" (Pap, 1962; p. 16). This is opposed to falsifiability principle, where a philosopher is out to find some anomalies in a theory so as to prove it false. One instance of an anomaly falsifies the theory. This view is held by Popper (1963).

The requirement of epistemic evidence is important in scientific explanations since it helps identify pseudo-explanations. The above mentioned necessary conditions for scientific explanations constitute the covering-law theory. The covering-law model represents explanation as a matter of finding a law that covers, in the sense of entailing the phenomenon to be explained. From this three points follow: First, the model insists on invoking of general laws. Second, there are events or phenomena to be explained, and, third, due to the fact that it invokes general laws, the explanation becomes infinite in time and space. Since explanations are judged as adequate or not
depending on the truth of their premises, the premises have to be true.

Consider this schema of a covering-law theory (Hempel and Oppenheim, 1948; p. 5).

\[ \text{The explanans} \]

\[ C_1, \ldots, C_k \]

Logical/Inductive or deductive

\[ L_1, \ldots, L_k \]

\[ E \]

The above schema consists of two sets of premises (the \textit{explanans}) and the conclusion (the \textit{explanandum}) which is arrived at either deductively or inductively. The \textit{explanans} consists of:

1) A set of singular statements describing relevant initial conditions, \( C_1, \ldots, C_k \) and

2) A set of general laws, \( L_1, \ldots, L_k \). \( E \) is the conclusion drawn from these premises. The \( L_1, \ldots, L_k \) could be universal or statistical laws of nature. The \( C_1, \ldots, C_k \) are singular statements stating that the event to be explained did really occur. Consider the example that copper expands on heating. If a piece of metal is heated and it expands, and it is known to be copper, all these cases will make up our \( C_1, \ldots, C_k \); and then the explanation will be to discover a law of nature explaining the
phenomenon, hence "All copper expands when heated" which will be our $L_1$.

From the above schema, we note that first, any explanation should invoke general laws, secondly, the individual events should be clearly stated or explained, and since general laws are infinite in time and space, the explanation should be universalizable. The acceptance of the whole explanation depends on the truth of the premises. So, from the above schema, we conclude that the necessary conditions for scientific explanation are constituted in it. Laying natural selection in the above schema, it does not meet the necessary conditions as stipulated in the covering law theory. These conditions are:

1. **Subsumption under general laws.** According to the covering-law theory, to explain an event or phenomena, it must be shown to have occurred in accordance with some general regularity of nature. This is what is called subsuming the event or phenomena under a general law. Natural selection does not invoke any such law(s). For example, there is no universal law which states that only the fittest survive while the weak are eliminated, a claim Darwin makes in the *Origin of species by means of natural selection* (1859).
2. Epistemic requirement.
It is required of any scientific explanation that its premises be true and well confirmed. Natural selection does not satisfy this requirement. As for truth, some of its premises are, clearly false, e.g., that there is a struggle in life in which only the weak ones are eliminated and only the fittest survive. As for confirmation, natural selection can not be confirmed. Generally, the theory of natural selection becomes meaningless when you take the correspondence theory of truth as our criterion for truth.

3. Generality
Scientific explanation must not be limited in time and space. We should then expect that natural selection is in progress, selecting those fit to live and eliminating those that are unfit to live. But this is not the case in daily life. For how then can we account for institutions for the disabled? Are we not safeguarding/protecting the endangered species, hence showing that natural selection does not work? Natural selection fails to meet this necessary condition for it to qualify as a scientific explanation of evolution. Because of the problems latent in the covering law theory, and due to the fact that scientific knowledge is progressive by nature, the covering law theory needs to be supplemented with the Peircean pragmatic scientific methodology according to which natural selection is, basically, scientific.
1.1 STATEMENT OF THE PROBLEM

Although natural selection does not satisfy the requirements of the so-called covering-law paradigm, the study attempts to show that natural selection meets the requirements of a broader scientific paradigm, namely, the Peircean pragmatism. The study aims at showing that according to the assumptions underpinning Peircean pragmatism, natural selection is scientific in a broader sense of science.

1.2 OBJECTIVES OF THE STUDY

This study is aimed at achieving the following objectives:

(a) To show that the theory of natural selection does not meet the conditions necessary for scientific explanations as stipulated by the covering law theory and according to that criterion, therefore, the assumption that it is a scientific explanation is untenable. In this respect we show that:

i) natural selection does not invoke any universal law and consequently it is not spatio-temporarily universal.

ii) natural selection is based on false premises since it can not be confirmed. It is therefore inadequate as a scientific explanation.
(b) To argue that natural selection is scientific in the Peircean sense. That is, it satisfies some of the salient norms of the Peircean pragmatic scientific methodology.

1.3 PREMISES OF THE STUDY

Two negative hypotheses:

First, the theory of natural selection does not invoke any general law(s).

Second, the Darwinian laws cannot be confirmed and hence they are pseudo-laws, i.e., they satisfy neither the criterion of verifiability (i.e., conformability) nor falsifiability.

One positive hypothesis: Scientific explanation involves inductive process of discovery. That is, all Scientific explanations are at best tentative.

1.4 JUSTIFICATION OF THE STUDY

First, philosophers such as Dow (1962), Rescher (1970) and Whithers (1971) have claimed that natural selection theory is a scientific explanation. We know that science has earned itself a lot of respect because its knowledge is supposed to be (nearly) exact.
Second, man seems to be taking control over nature. By nature is meant everything except the observer who is making observations. A proper understanding of how nature works, that is, its laws would be of practical use to man. By knowing how nature works, man would be able to predict future events and hence take precautions of disastrous ones (events) e.g., lightening.

Third, man by nature is an inquisitive being. According to Aristotle, natural bodies which include animals display a different way of acting which should be understood in terms of a tendency to change in a specific way according to their nature; e.g., it is in the nature of man to seek knowledge, nature of a dog to bark, nature of stone to fall when unsupported. Aristotle's analysis of the "natures" of animals is questionable as experience has shown that animals not only act from the tendency within them but also they act from the influence of their environment, a fact which Darwin noted in his analysis of nature. Darwin living at the dawn of the Industrial revolution, understood everything in terms of competition. For example, countries were regarded as superpowers according to their ability to industrialize and acquire colonies. We can then justifiably say that Darwin was considerably influenced by the prevailing political attitude in Europe and Britain in particular to his theory of biological evolution. This study is justified by our attempt to inquire into the scientific status of natural
selection given methodological and epistemological development of science and philosophy in the twentieth century.

1.5 METHODOLOGY

The research will rely heavily on secondary/library sources. It will consist of a critical survey of written works on the theory of natural selection and explanation in science. The study will also involve three methods, that is, the descriptive, critical, and evaluative methods.

Descriptive

The study will first present distinctly the theory of natural selection by stating its characteristics. By descriptive we mean a factually grounded or informative analysis. This is opposed to the normative, prescriptive or emotive approach, which entails making judgement. The descriptive approach is for portrayal purposes.

Critical

This method involves an analysis of the theory of natural selection concerning its scientific status. The study will point out inconsistencies of the theory of natural selection when studied as a scientific explanation. The study will also point out the strengths of natural selection as a putative scientific theory. Hence the
critical method will be both negative and positive. It is the depth of analysis which matter.

**Evaluative**

This will consist of examination and judgement of the theory of natural selection concerning its quality and significance as a scientific theory of evolution. We will assess, appraise or rate the status of natural selection as a scientific explanation and its relevance to human endeavour. This will be employed in Chapter V of the study.

**1.6 THEORETICAL FRAMEWORK**

**A - The Covering-Law Model**

This study will be guided first by the covering-law model. The history of science shows that the covering law theory is a relatively well-known epoch in scientific inquiry especially in the pure sciences into which the biological sciences are classified. We therefore use it to guide our study. The covering-law model is the model that represents explanation as a matter of finding a law that covers, in the sense of entailing, the phenomenon to be explained. It is divided into two: The deductive-nomological model and the probabilistic model. Hempel and Oppenheim (1948) hold that scientific explanations are either of the deductive-nomological model or probabilistic model. One which does not fall under the two is either an incomplete
explanation or it is a pseudo-explanation.

As far as the covering law model is concerned, for any explanation to be scientific, there are necessary conditions which it has to meet. First, the explanation must contain a number of singular statements, which assert that certain events have occurred at indicated times and places. Second, an explanation is marked "scientific", if in addition and more importantly, it invokes tested and confirmed laws of nature.

Examples of laws of nature are:

1. Water expands when it freezes.
2. Copper always expands on heating.
3. All metals conduct electricity.
4. All iron rusts when exposed to air.

These laws of nature are opposed to accidental generalisations such as:

1. All coins in my pockets (now) are made of copper.
2. All the screws in Mr. Smith's tool-box are Russian-made.

"These laws of nature support counter-factual inferences" (Pap, 1962; p. 289). But statements can be manufactured which satisfy these conditions (of laws of nature) but which would ordinarily not be called laws of nature. This
is what has been called the "problem of counter-factuals" - the problem of making explicit the logical structure of such statements and of analysing the grounds upon which their truth or falsity may be decided.

Consider this example of a counter-factual conditional:

"If Kimathi could have been alive in 1978, he would have been the president of Kenya now".

Which can be formulated as:

"For any X, if X is A then X is B".

The problem of counter-factuals has been argued for by Goodman (1984), Stalmaker (1968), Lewis (1979), Jackson (1979), Edgington (1986) and Dudman (1991).

The third necessary condition for a scientific explanation is its generality. It should not be limited in time and space. Consider the example that "All metals conduct electricity." It has no limits in terms of space and time. What it simply says is that all metals conduct electricity-infinitely in time and space.

B- Epistemic Status of Scientific Theories
The premises of scientific explanations must be known to be true. This is what has been called the epistemic requirement by which we judge the adequacy of scientific
explanation. Three theories of truth have been advanced, namely, the "correspondence" theory, the "coherence" theory and the "pragmatic" theories of truth.

In the "correspondence" theory, facts confirm a statement as true. They confute a statement when false. An explanatory premise of any explanation is accepted as true if it is compatible with established empirical facts. This is the "scientific" approach of truth according to such logical positivists as Ayer (1936). Science starts from observations which have to be empirical. To Ayer other theories of truth are meaningless since an empirical statement can only be counted as meaningful if some observation has been made.

Aquinas distinguished between *Adequatio rei et intellectus*, i.e., agreement between thing and thought and *Adequatio intellectus et rei*, i.e., agreement between thought and thing. The distinction is between formal science and empirical science, respectively. Formal science embraces the sciences of mathematics and formal logic while empirical science embraces all the sciences called "physical" and "social", e.g., chemistry, physics, economics, sociology. Formal science asserts nothing about natural phenomena, it is independent of experience and none of its proofs rests on how facts actually stand. The correspondence theory presupposes Aquinas' theory in *Adequatio intellectus et rei*. 
In the "coherence" theory of truth, a statement is true if it is consistent with other statements within a given body of knowledge or theory. It is false if it is inconsistent. A shortcoming of this theory is that we may have a consistency of falsehoods. Here, truth is tested by the criterion of logical consistency of ideas unlike in the "correspondence" theory where the criterion of verifiability evaluates truth. The Coherence theory of truth finds its home in speculative metaphysical systems such as Hegelian and Bradleyan idealism.

The "pragmatic" theory of truth has several versions. One brand holds that truth is what is "useful" (Schiller). But a problem arises on the meaning of the term "useful". Another holds that truth is what "works", the meaning of the term "works" being problematic. Yet another version holds that truth is the successful solution of a problem (C.S Peirce). We will show that natural selection meets the requirements of the Peircean pragmatic scientific methodology. The type of scientific explanation one adopts depend very much on the type of theory of truth that is presupposed.

Scriven (1962), Gallie (1955) and Dray (1958), have argued, that the covering-law analysis is not adequate for certain types of explanations to be found in other branches of science. For example, teleological explanations and functional explanations in the biological and social
sciences are held not to conform to the covering-law models. The Peircean pragmatism, for instance, and pragmatism in general, is a functional explanation and to argue that they are not scientific because they do not conform to the covering law model is mistaken. The Peircean pragmatism stipulates its own scientific criteria.

Let us now state the criticisms levelled against the covering law theory by the above critics.

Scriven (1962) has criticised the models because of the role they assign to laws and theories in scientific explanations. He argues that:-

1. The models mistakenly include in the explanation itself some of the grounds (the laws) for the explanation while they correctly do not include in the explanation itself the rest of the grounds for the explanation.

2. Since there are cases where laws are not needed even as grounds (the laws) for the explanation, the models are mistaken in their presupposition that each explanation presupposes the existence of a scientific law.
3. Even when laws are used as grounds for an explanation, they are not, as the models require, necessarily true. He says that most laws are known to be inaccurate.

Gallie (1955) claims that there is a special method of explanation used in the historical sciences, which does not fit the covering-law models, i.e., the genetic explanations in which the *explanans* describe a necessary, but not a sufficient, condition for the occurrence of the event described in the *explanandum*. Consequently, the *explanans* do not entail nor do they necessarily offer high inductive support for the *explanandum*. He thinks this is a legitimate mode of explanation that does not fit either of the covering-law models. A covering-law theorist could reply that the existence of a condition necessary for an event does not itself explain the occurrence of that event.

Dray (1958) argues that historians explain the actions in question by showing that they were the rational things for the agent to do in his circumstances. Consequently, the covering-law models do not cover this mode of historical explanation. But it can be objected that the agent in question may be an "irrational" individual. Are his actions in this case explainable on the grounds that they were the rational thing to do? Dray must answer this question before his mode of explanation can be accepted as
A covering-law theorist may try to fit the above example to the covering-law patterns and second, if there are any explanations that resist such reduction, to exclude them as pseudo-explanations.

1.7 LITERATURE REVIEW

The Literature review will be centred on four themes. First, we deal with definitions of key concepts, namely, "natural selection", "science", "scientific explanations" and "the covering-law theory" and alternative scientific explanation model, i.e., the "Peircean scientific methodology". This is for clarification purposes. Second, we focus on scholars who hold without justification the view that natural selection is a scientific explanation. Third, we review the covering law theorists who hold that natural selection is not a scientific explanation. Lastly, we review writers who hold that natural selection, to the extent that it is biological, has some scientific basis, but to the extent that it is construed as ethno-sociological, it has no scientific basis.

Darwin (1859) advanced the theory of natural selection by which he meant the natural elimination or sifting out of those individual who are not so peculiarly fitted to the
environment as to survive in the struggle for existence. This kind of analysis raises some pertinent issues. First, it is doubtful whether it is a universal law of nature for only the strong to survive and the weak to die in the struggle for life. Second, it is also doubtful whether this is the way species are formed, i.e., by the "universal law of struggle for survival." Gauging it by the covering-law theory, it is doubtful whether this analysis of nature is scientific.

Nagel (1961) observes that the desire for explanations which are systematic and controllable by factual evidence generate science. He adds that this is the organisation and classification of knowledge on the basis of explanatory principles that is the distinctive goal of science. He holds that the "sciences seek to discover and to formulate in general terms the conditions under which events of various sorts occur, the statements of such determining conditions being the explanations of the corresponding happenings." We have taken this as the working definition of science for covering law theorists.

Dow (1962) considers the theory of natural selection to be a scientific explanation of evolution. He says that it is a prolonged argument by masses of evidence on how species have originated. He considers it a scientific explanation due to the fact that Darwin made vast observations; "interwoven with a prolonged argument for his theory of
natural selection as a scientific explanation of how that evolution has taken place." This kind of claim raises two important issues. First, that the theory of natural selection is scientific due to the fact that it is based on "vast observation" and second, that since it is "interwoven with a prolonged argument" it is therefore a scientific explanation. Two observations can be made from the above two issues, one for each, respectively. First, although it is one of the facets of science, observation alone cannot qualify a theory to be scientific. Second, the claim that natural selection is a scientific explanation because it is an argument is misplaced. We have arguments which are not scientific explanations. Gauged by the covering law theory, Dow's assessment of natural selection as a scientific explanation fails.

Rescher's (1970) assertions that prior to Darwin, the theory of evolution was merely a hypothesis, but that it gained acceptance when Darwin advanced a scientific explanation in the name of natural selection, leaves much to be desired. The acceptance of evolution is one thing and natural selection being a scientific explanation is another. Rescher should give more evidence for his claims that the theory of natural selection is a scientific explanation of evolution.

Whithers (1971) asserts that the theory of natural selection is a scientific explanation of evolution but
does not make effort to qualify his statements. Maybe the reason why he does not qualify his statements is that his book is a historical account of the theory of evolution.

Dobzhansky (1977) says that Charles Darwin solved the riddle of the uniqueness of organisms adapting to the environment when he advanced the theory of natural selection as a scientific explanation of evolution. But the question is whether "adaptation" and "origin" of species is one thing. Furthermore, the mere fact that Darwin has solved a riddle on how organisms adapt to their environment does not qualify his theory to be a scientific explanation.

The scientific status of natural selection has been questioned by many philosophers. Popper (1976) considers "Darwinism as a metaphysical research programme." According to him, Darwinism is not a testable theory. For this reason, it is not scientific. Our study will test it using the covering-law theory and see if it qualifies as a scientific explanation.

Taylor (1983) points out that Darwinism is unable to predict events in evolution. For purposes of our study, explanation and prediction are logically symmetrical. But Taylor does not give us the logical structure of prediction. Our study will endeavour to show the logical structure of explanation and prediction.
Faria (1988) says that natural selection explains a small part of what occurs in nature leaving out a large portion. He says that it should be replaced with an adequate theory if a complete and comprehensive account of evolution is to be written. He replaces it with another theory he calls "auto-evolution" the theory that evolution starts from matter. Without laws of nature (general regularities) a theory does not offer any scientific explanation.

Hempel & Oppenheim (1948) advanced the view that all scientific explanations are either of the deductive nomological or probabilistic model. This is what has been called the covering-law theory, the view that under general laws, that is, by showing it occurred in accordance with those laws, by virtue of the realisation of certain antecedent condition an event or phenomenon is explained scientifically. By laws is meant the way nature works, i.e., its uniformities. Certain cases of scientific explanation involve "subsumption" of the event or phenomenon under a set of laws some of which are statistical in nature. One observation can be made. All scientific explanations must invoke some general law. We are using the covering-law theory to judge whether natural selection is a scientific explanation or not.

Salmon (1984) says that we secure scientific understanding by providing scientific explanations. Our topic of study is justified under such a view. He continues to say that
science provides knowledge of what has happened in the past, what will happen in the future and what is happening now in regions that we are not observing at the present moment. He adds that many philosophers and scientists believe that this is the primary goal of scientific activity. One thing can be pointed out. Salmon does not give us the structure of scientific explanations. Our study will endeavour to show this structure.

Wilson (1985) defends the covering law theory by saying that it provides knowledge that permits prediction and control. That is why explanation and prediction share the same form. Wilson says that to explain is to deduce from general laws. A law of nature is said to be explained when another law(s) is pointed out, of which it would be deduced. We are subjecting natural selection under such a view and investigate if it meets the conditions necessary for scientific explanations.

Giere (1988) says that a scientific explanation is "a deductive argument in which a statement describing the event to be explained is deduced from a true general law together with appropriate initial conditions". One point to note is that we have other scientific explanations which are not deductive. So he should have mentioned something to do with induction.
Gasper (1990) says that a satisfactory explanation of an event should provide us with understanding of what has been explained. He says that an event of a certain kind is explained by citing a general law(s) that relates events of that kind to events or conditions of some other kind. This is the covering-law theory. It is important to note that the study will investigate whether invoking a general law by itself is enough to count an explanation as scientific.

Scriven (1962), in his article "Explanations, prediction and laws", criticises the covering law models because of the role they assign to laws and theories in scientific explanations. His argument is that the models mistakenly include in the explanation itself some of the laws while they correctly do not include in the explanation itself the rest of the grounds for the explanation. Scriven also points out that the covering law theorists are mistaken in their presupposition that every explanation presupposes the existence of a scientific law. He argues that even when laws are used as grounds for an explanation, they are not necessarily true. He concludes that the covering law theory is inadequate as a criterion for scientific explanations.

Gallie (1955), in his article "Explanation in History and the Genetic Sciences" argues that the covering law theory does not cover events in history, e.g., the occurrence of
a war, e.g., The First World War. The covering law theorists cannot invoke any universal law for its occurrence. However, they could reply that the inability to discover that law does not mean the non-existence of the said law.

Dray (1958) in his article "Historical Understanding as Rethinking" echoes Gallie when he argues that historians explain human actions by showing that they were the rational things for the agent to do in his circumstances. But we can object Dray's argument by questioning the boundaries of his usage of the concept of "rationality". It is clear from human experience that not all human actions are "rational". Some are "irrational".

Central to the criticisms levelled against the covering law theorists is that their criterion does not apply to all explanations particularly the functional and teleological explanations in the social and biological sciences. Pragmatism, a teleological explanation by nature, was offered to cater for the shortcomings of the covering law theory. Its founders argue that theories are meaningful if they are of practical importance to the beholder. Copleston (1966) has given us the history of pragmatism, tracing it to Peirce as the originator. The term "pragmatism" is associated chiefly with the name of William James because "for James' style as lecturer and writer and his obvious concern with general problems of
interest to reflective minds quickly brought him before the public eye and kept him there, whereas during his lifetime Peirce was little known or appreciated as a philosopher. But both James and Dewey recognized their indebtedness to Peirce" (Ibid., p. 304). On the whole, pragmatism was offered as a reaction to European rationalism; it was offered as a method of reflection having for its purpose to render ideas clear. It was offered as a guiding principle of analysis. It was offered, as Nagel remarks, "to bring an end disputes which no observation of facts would settle because they involve terms which no observation of facts would settle because they involved terms with no definite meaning" (Epstein, 1966; p. 813).

Nagel (1967) in his article "Two General Remarks on the Peircean Version of Pragmatism" in The Process of Philosophy (1967) claims that pragmatic maxim was intended as a guiding principle of analysis which was offered to philosophers in order to bring to an end disputes which no observation of facts could settle because they involved terms with no definite meaning. Natural Selection is such a term which does not have a definite meaning. Therefore, it would be important to examine its practical benefits as per the requirement of the Peircean pragmatic scientific methodology.
Peirce (1905) in his article "Issues of Pragmaticism" did not approve of the way in which James was developing the theory of pragmatism and changed the name of his own theory from pragmatism to pragmaticism. In this article, Peirce formulates his theory thus: "In order to ascertain the meaning of an intellectual conception one should consider what practical consequences might conceivably result by necessity from the truth of that conception; and the sum of these consequences will constitute the entire meaning of the conception". In other words, an idea is unimportant if it does not have any consequences to us.

In another article "How to make our ideas clear" Peirce (1934) has given us a different criterion for scientific explanations apart from the one proposed by the covering law theorists. Peirce's argument is that even with the discovery of a "covering law" if it is of no practical benefit to the beholder the law is useless. His scientific methodology begins when there is some problem to be solved or a difficulty to be overcome in life. The person concerned with the difficulty then analyses the situation very carefully and collects all the facts bearing on the problem to be solved. The third step involves proposing a tentative solution to the problem. The tentative solution is then tested to gauge its success. Generally, Peirce's conception of Science is "Success in inquiry". When natural selection is viewed from the Peircean conception of Science, it is, at least minimally, a scientific
James (1907) holds that pragmatism is a method only. It is a method of settling metaphysical disputes. He argues that an idea is made true by events. True ideas are those that we can assimilate, validate, corroborate and verify. If truths are made true by verification or validation, it follows that unverified truths are potentially true. He holds that true ideas are those that "work". The "workableness" which ideas must have, in order to be true, means particular workings, physical or intellectual, actual or possible. On the whole, he argues that pragmatism has "no doctrines save its method" (Ibid., p. 54). Although it does not present any scientific method, James' view of pragmatism presents clearly to us the philosophy of pragmatism.

In another article "Does Consciousness Exist?" James (1912) holds that the pragmatist view is that it has a definite content, and that everything in it is experienceable. Its whole nature can be told in positive terms. He restates his definition of workableness. His argument is that ideas are important to us as long as they present themselves to us in concrete experience.

In "The Place of Affectional Facts in a World of Pure Experience" James (1912) argues that "thoughts and things are absolutely homogeneous as to their material and their
opposition is only one of relation and of function”. His argument is that ideas present themselves to us in experience. Experience leads us to act. Generally, James’ argument is that ideas and things in experience are important so far as they lead us to act. His is a philosophy of action whereby what "works" is true.

Bode (1905) in his article "Pure Experience and the External World" reacts to James’ theory of pure experience by arguing that James’ theory does not make provision for the knowing of objective experience. Bode asks "how can we become aware of its existence, without introducing an element essentially alien to pure experience?" He argues that as much as we can pretend to objective experience, we cannot do without the subjective experience. If the subjective world is admitted, we can never argue to the existence of an objective external world. So he concludes that James’ theory of "pure experience", i.e., pragmatic workableness does not give us a guideline to universal actions. It is, however, questionable whether universal actions are not themselves subjectively performed. Furthermore, James does not argue that they should be universally performed. His point is that these actions should be considered true if they work. We can then argue that Bode has not raised a genuine criticism to James’ pragmatic workableness.
Schiller's (1907) philosophy centres around man who he considers the measure of all things in experience. He argues that a pragmatist believes that the validity of any logical procedure is shown by its successful working. But it works only in concrete contexts. Truths are valuations, i.e., to assert a proposition is true is to say that it possesses practical value by fulfilling a certain purpose. "Truth is the useful, efficient, workable, to which our practical experience leads to restrict our truth-valuations" (Ibid., p. 59). The false, on the contrary, is the useless, what does not work. "Useful" means useful for a particular purpose, which is determined by the general context of a statement. To recognize a truth, is to recognize it as useful. Like James, Schiller's pragmatism does not stipulate any scientific methodology as does that of Peirce.

Dewey (1916) in his article "The Control of Ideas by Facts" argues that the mere accumulation of "realities" without judging the significance they have in particular needs and possibilities of a situation, is useless and irrelevant. He holds that "facts may be regarded as existing qualitatively and in certain spatial and temporal relations; when there is knowledge another relation is added, that of one thing meaning or signifying another. Water exists, for example, as water, in a certain place, in a certain temporal sequence. But it may signify the quenching of thirst, and this signification - relation
constitutes knowledge" (Ibid., p. 767). At the centre of Dewey’s pragmatism is the view that knowledge should be interpreted in terms of the problems that now confront us. His philosophy interprets ideas as "instruments" which we use to solve day-to-day life situations which may confront us.

Sheppard (1958) claims that the date 1/7/1858 marked a turning point in biological thought. On this date, the Darwin-Wallace lecture was delivered before the Linnean society of London. He claims that natural selection is scientific since, to use his own words, "it is the backbone of the biological sciences". But Sheppard does not tell us what makes natural selection scientific in spite of it being the backbone of the biological sciences. Reid (1962) has argued that although natural selection falls in the class of biological sciences, it is not scientific since it manifests the ethno-socio-political systems prevailing in Europe during Darwin’s time. He rejects natural selection as scientific on that ground. We can question his rejection by saying it is void of evidence.
The idea of natural selection was first introduced by both Charles Darwin in 1859 and by Alfred Russell Wallace in 1864. They worked independently and arrived at the conclusion that existing organisms originate out of those existing before them. According to the evolutionist Birkett, (1979), this statement is the first recorded hypothesis of the occurrence of organic evolution. Because of Darwin's accumulation of relevant evidence, together with his publication of the *Origin of species by means of natural selection* in 1859, the above-mentioned view has been referred to as Darwinism.

The term 'Darwinism' is ambiguous in the following senses. In the narrow sense, it refers to a theory of organic evolution proposed by Charles Darwin in his work, *Origin of Species by means of natural selection* (1859) and in the works of such other scientists as Huxley (1974), Spencer (1947) and Dobzhansky (1973). In the broader sense, it refers to a complex of doctrines in science, theology and philosophy amongst other disciplines that were historically stimulated and supported by Darwin's theory of evolution. Throughout this study, natural selection will be used in the narrow sense of Darwinism. This is because our study is limited to the ideas which were
developed by Darwin and other scientists of that period. We are concerned with organic evolution Darwinism and not in the complex doctrines which were historically stimulated and supported by organic evolution, commonly referred to as neo-Darwinism.

We should note, however, that although Charles Darwin was the first scientist to introduce explicitly into biological context the idea of natural selection, the idea is found latent in the works of earlier writers. As Anthony Flew (1967) observes, Darwin had intellectual ancestors among them the ancient Greek philosopher, Lucretius. As early as the first century B.C., Lucretius, in his poem *On the nature of things* edited by Hutchins in 1952, tried to explain how nature has divided things and given unto some more advantages over others. This, however, does not mean that Darwin's discovery was not important. What Darwin did was to make explicit use of the principle of induction from which he drew inferences in his attempt to establish the theory of evolution and to discover the means by which it operated. We use 'induction' in the Skyrmeian sense (1966) in which he defines inductive reasoning as a logical argument in which it is improbable that the conclusion is false while the premises are true and it is not deductively valid. The degree of inductive strength depends on how improbable it is that the conclusion is false while the premises are true. This is contrasted with deductive reasoning in
which the link between the premises and the conclusion is so strong that it cannot be broken. The strength of the claim about the link between the premises and the conclusion of the argument is what differentiates the two arguments. This is opposed to the old distinction that deductive reasoning proceeds from the general to the particular while inductive reasoning proceeds from the specific to the general. This is because logical arguments can be advanced, both deductive and inductive, which proceed from general to general and specific to specific in addition to the above distinction into which both fit (Skyrms, 1966; pp. 13-14).

Before we show how Darwin engaged in inductive reasoning, we will first present his theory, i.e., natural selection, by explicating the major terms used in it.

After amassing a lot of data (during the His Majesty Service Beagle Voyage, a naval ship to South America during the period 1831-1836, Darwin, 1859; p.7), Darwin summed up his findings in the principle of 'natural selection' which he says acts from generation to generation and which may be divided into four tenets for easy comprehension and then dealt with singularly as:
2.1 Heredity

This is the idea that living things have the ability to pass on their own qualities from parent to child in the cells of the body as exemplified in this sentence: "some diseases are present by heredity." That organisms tend to produce their like is a clear fact of human experience and it can be seen to operate throughout animate things (Titus, 1964). By "tendency" Darwin meant some characteristics or behaviours. For example, if an organism showed or exhibited them it was likely to survive in the struggle for life (Darwin, 1859; p. 104). Suppose A and B are agents and C is an action, then A and B would be said to have a tendency to C if they have the characteristics or behaviours to do C. For instance, if an eye E blinks at t1 or t2, before it blinks, it would be said to "tend" to blink if and only if it exhibits characteristics or behaviour so that if it is allowed to "blink" it would result to blinking at time t1 or t2. Darwin gives the case of trees. They tend to compete for light (Ibid., p. 74), i.e., when trees are grown together, they have a behaviour of competing for light. This tendency seems to operate throughout animate life. That is why cows are known to produce cows, sheep, sheep and goats goats. Such stories as, "Once upon a time, a woman gave birth to three dogs ..." can be dismissed as myths which lack scientific substance because, first, they do not fit in the science of genetics and second, they are
not empirically testable.

Darwin writes "... like tends to produce likes ... a fundamental belief: doubts have been thrown on this principle only by theoretical writers" (Ibid., p. 26). This is empirically verifiable through human experience as it can be seen to operate throughout animate life, e.g., sheep produce sheep and goats goats. The "theoretical writers" Darwin had in mind were the church teachers and writers of the Bible, especially the book of Genesis, which claims that the world and all that is in it was out of a special creation by God. How true or false this is, it cannot be empirically tested.

2.2 Variations

Darwin observed that although organisms tend to produce their like, no two organisms are exactly alike. He gives the example of domesticated pigeons which he says exhibit differences when examined closely (Ibid., p. 44). There are always individual variations in structure and function. Take a case of twins. They may appear alike but close examination will reveal that their functioning and structure exhibits differences. We may call the above a "division of labour" by nature. The differences both in structure and functioning are not without merit. That is why performances in human endeavour are diverse.
Once these variations occur, they are accumulated and then inherited. He reasoned that small variations that occur between members of a species may sometimes benefit one individual more than the other. A huge body may benefit a weight-lifter while a slim one may benefit an athlete. The question of "fitness", then, becomes relative to one's situation.

2.3 Struggle for existence

Darwin described natural selection as a consequence of the "struggle for life" or "existence". He argued that if it is true that species have that tendency to increase at a geometrical ratio, then it would hold true that a single species would populate the whole universe. Quantities are said to be in geometric progression when successive terms have a common ratio \( r \). Consider these numbers: 1, 3, 9, 27, 81, e.t.c. They increase at the ratio of three such that the next one will be \( 81 \times 3 \) (as per definition). Or consider these ones: 1, 2, 4, 8, 16, 32; the common ratio here is 2, such that the next number will be 64. Consider Darwin's usage of geometric progression in this quotation "... that if an annual plant produced only two seeds - and there is no plant so unproductive as this - and their seedlings next year produced two, and so on, then in twenty years there would be a million plants" (Ibid., p. 69). The ratio of increase here is 2, such that from the parent (1) we would proceed thus: 1, 2, 4, 8, ...n. The
geometrical progression is distinguished from the arithmetical one where we have a series of numbers arranged in increasing (or decreasing) order. The difference between each number and the next being always equal, thus: 1, 2, 3, 4, ..., n the difference is 1; or 1, 7, 13, 19, 25, the difference being 6 (Fred, 1969; p. 54, Berenson, 1979; pp. 556-558).

Despite this geometrical progression, it can be observed that species have tended to remain stable. Then the question is how the above has been brought about and Darwin points out that the answer lies in the struggle for existence. There would follow a competition over the limited resources that may be available. He says that the amount of food for each species gives the extreme limit to which each can increase. He adds that frequently it is not the obtaining of food, but the serving as prey to other animals, which determine the average number of a species.

What Darwin is saying is that the numbers of a species increase with the increase in the amount of food available. This analysis of nature is questionable as human experience would observe that a species which serves as food for the other is always in larger numbers. That is why the birds are not able to wipe out corn; that is why the insects are not able to wipe out grass. If this is granted, then we observe that Darwin was raising
nothing new but an observation of how the ecological system is maintained. There must be the "eater" and the "eaten", and always the "eaten" is in large numbers.

Darwin seems to be aware of the above point when he writes, "... lighten any check, mitigate the destruction ever so little, and the numbers of the species will almost instantaneously increase to any amount ..." (Ibid., p. 71). If Darwin's assertion is accepted as true, then it seems to mean that the present constancy in numbers of the species are maintained by some "checks". Darwin adds that when a species, owing to highly favourable circumstances increases, epidemics seem to be the checking factor. But if epidemics seem to be the "checking factor", the "struggle" would have no role in maintaining the numbers of a species, not unless one argued that even in these epidemics, the organisms would still struggle for survival.

Darwin extended the "struggle for existence" to cover reproduction, in what he calls "sexual selection". This depends on members of the opposite sex struggling to control the other sex. The result is not death to the unsuccessful competitor, but few or no offspring. The most vigorous will leave most progeny.

It may be pertinent to ask whether this is a true representation of life. It is left to human experience to
work out whether life is always a struggle. This view seems to be in contradiction with cosmogenesis, a view advanced by Chardin in his works (1959a, b, 1961) who says that the world comes into being through love and interaction, the two components of life. Bergson (1901) holds a similar view to Chardin's. He says that evolution is creative, not always blind and destructive as is presented by Darwin. During Darwin's time, competition was prominent, unlike our time when cooperation is prevailing as is witnessed from such unions as The European Union, Ecomog and the East African Cooperation.

Darwin summarizes the struggle for existence in these words: "Owing to this struggle, variations, however slight, and from whatever cause proceeding, if they be in any degree profitable to the individuals of a species, in their infinitely complex relations to their physical conditions of life, will tend to the preservation of such individuals, and will generally be inherited by the offspring" (Ibid., p. 67). Darwin, however, does not give any evidence as to why variations should be profitable and others not. Upon which basis does he draw such a conclusion, "... will tend to the preservation of such individuals ...?" It appears that there is no connection between the premise and the conclusion.
2.4 Survival of the fittest

Darwin argues that since there is a struggle for existence (e.g., trees competing for light, the tallest will absorb enough of it) among individuals, and since these individuals are not all alike, some of the variations among them will be advantageous in the struggle, others will be unfavourable. By "advantageous" Darwin meant qualities or characteristics exhibited by an individual such that in any competition, these qualities or characteristics would give this organism a superior state over the others (Ibid., p. 68). Consider this example. Suppose in an election one candidate is richer than the rest, he has done some rigging of votes and has barred his opponents from campaigning, we would then say that this candidate is in an advantageous position. Darwin remarks:

If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals that have any advantage, however slight, over others would have the best chance of surviving and of procreating their kind? On the other hand, we may feel sure that any variation in the least injurious would be rigidly destroyed (Ibid., p. 81).

From the above quotation, three points can be noted. First, that there are "advantageous" variations. Second, that there is destruction of the "least injurious variations" and third, that the above two variations must occur. Questions may be asked as to what "selects" the "advantageous" from the "injurious" variations. This
presupposes that the organisms are conscious of the distinction. If this is the case, and "remembering that many more individuals are born than can possibly survive", does it not follow that every individual organism would retain as many "advantageous" variations as possible in order to survive in the struggle for life? If the foregoing is granted, doesn't it also follow that "none" is likely to be eliminated in the "struggle for life", not unless by epidemics?

From the above quotation also, it is clear that Darwin takes it for granted that everybody knows that "advantageous" variations would profit the organism and that it has the "best chances of surviving and of procreating their kind". This is subjectivity assumed to be objective. What is "obvious" to Darwin may not be obvious to others. From human experience, it has proved that an "advantageous" variation, e.g., a huge body for a weight-lifter, has always proved injurious in other respects, e.g., in athletics. The question which then arises is how "advantageous" is the "advantageous" variation. The best answer seems to be that it is relative to the situation of the organism.

Having explicated natural selection, we now show that Darwin's reasoning is inductive, a claim we made earlier.
Consider what Darwin has said, (Ibid., p. 124):

If under changing conditions of life organic beings present in individual differences in almost every part of this structure and this cannot be disputed, if there be, owing to their geometrical rate of increase, a severe struggle for life at some age, season, or year, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of life, causing and infinite diversity in structure, constitution and habits, to be advantageous to them, it would be a most extraordinary fact if no variation has occurred useful to each being's own welfare, in the same manner as so many variations have occurred useful to man. But if variations useful to any organic being ever do occur, assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation, or the survival of the fittest, I have called Natural selection.

To understand this passage, we will first identify the claim, i.e., the conclusion of the argument Darwin is advancing. Then we will show the premises by which he attempts to establish his claim.

Darwin's central argument is to prove that only the "fittest" organisms are likely to survive in the struggle for life. He gives his conclusion thus: "... assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized". By "thus
characterized" Darwin means that organisms exhibiting the tendency to struggle for life and which have advantageous variations for themselves in this struggle. In short, Darwin is saying that only organisms which exhibit in their behaviour a strong tendency to struggle for survival will in fact be likely to survive and leave progeny similarly characterized.

From Darwin's conclusion, one observation can be made. Darwin does not say that these organisms must survive and leave progeny if they exhibited a tendency to struggle. He only puts it as a matter of probability that they have the "best chances of being preserved in the struggle for life" and of leaving progeny. Put in another way, we would reconstruct Darwin's conclusion to be: the probability that organisms which exhibit a tendency to struggle for survival to survive and leave progeny is high compared to that of those which do not exhibit any tendency to struggle for life. Put more shortly, he intends this to be his conclusion: The probability that organisms which exhibit in their behaviour a strong tendency to struggle for life and leave progeny similarly characterized is high.

Having got hold of Darwin's conclusion, we must now untangle the argument by which he tries to establish it. We shall give a first reading of the Darwinian passage, then we shall reconstruct his argument.
A first reading of Darwin's argument would go thus: Under natural conditions, all organisms would be involved in a struggle for survival, since many more are born than can be sustained. He reasoned that the small variations that occur between members of a species must sometimes benefit one individual more than another. In nature, the survivors are "selected" since they are better fitted than their competitors to their way of life because of the characteristics they possess. The best adapted organisms survive and produce offspring which inherit their adaptations. In the course of time, favourable variations accumulate so that the whole nature of the species changes.

From the foregoing "first reading" of Darwin's argument, we gather that living organisms have the potential to increase at a geometrical rate but the numbers have tended to remain constant, the constancy is brought by the struggle for sustenance. We also gather that organisms vary in terms of "advantageous" variations. Thus the best live to breed. This argument can be schematized as follows:

1. Living organisms have the potential to increase at a geometrical rate.
2. The numbers of a species tend to remain constant nevertheless.
3. Therefore, there must be competition or "a struggle for existence" between organisms for those finite resource that they all need.

4. Since organisms vary in terms of small variations that occur between members of a species. Some variations benefit one individual more than another.

5. Therefore in the competition, only the "fittest" or best-adapted organisms are likely to survive and leave progeny similarly characterized.

Let us now show how each premise is related or leads to the conclusion. We will take each singularly.

Premise 1: Darwin arrived at this premise when he observed a natural phenomenon that there is a tendency of organisms to increase because offspring in the early stages of existence are always more numerous than their parents. This is true regardless of the reproductive system one chooses to examine (Ibid., p. 74). He gives the case of the fly which deposits hundreds of eggs, which, if all hatched, we would have an equal number of flies from the same eggs.

Premise 2: is closely related to premise 1 and is arrived at from another observation of a tendency of organisms to remain constant. Despite geometrical increase of organisms, their numbers have tended to remain constant. The fly, for instance, would populate the whole earth
within a short period if it hatched all its eggs and if the offspring continued at that rate; but that has not been the case.

From the two premises, Darwin had to look for an explanation to harmonize the two observations. If more young are produced yet the numbers have tended to remain constant, there must be some secret weapon for life.

Premise 3: In trying to look for the secret weapon, Darwin inferred that there must be a struggle for existence, i.e., if more young are produced than can survive, then there must be competition for survival (Ibid., p. 75). If the offspring are many during this early stages of life, and if the numbers of any species have tended to be constant, what it means is that some must die and some survive. For species to come to die or survive, Darwin concluded that there must be a struggle or competition for life. This competition implies that there are victors and failures. Thus in the competition for life, some organisms would emerge victorious and others not. But who are the victorious?

Premise 4: This is arrived at from premise 3 in this way. In the competition for life in premise 3, some were victorious and others not. How this is the case, Darwin observed another tendency in nature that individual organisms exhibit differences, both in their structure and
differences as explicated earlier (2.1.2). This is true regardless of the species one chooses for examination.

From premise 3 and premise 4, Darwin inferred premise 5, survival of the fittest. If organisms have to struggle for existence, and if these individuals are not all alike, then some of the variations among them will be advantageous in the struggle for existence. The organisms with advantageous variations he calls "fittest" or best adapted and which would probably live and leave progeny.

These set of premises are so related that if they are true, they probably imply the conclusion. If any organism exhibits such characteristics, i.e., it is best adapted to its conditions of life, it is likely to survive and leave progeny. Darwin does not say that they must survive and thereby leave progeny but he puts it as a matter of probability that these organisms have the "best chances of surviving" and of leaving progeny thus characterized.

We may have an organism better adapted in the struggle for life and yet it fails to leave progeny, e.g., many men who have succeeded to obtain wives have failed to leave their progeny. Darwin was aware of this fact and that is why he gives it as a matter of probability, i.e., such an organism is "likely to survive and leave progeny". This makes Darwin's argument strongly inductive, i.e., it is improbable that the conclusion is false and the premises
are true. Thus, Darwin’s argument is a case of a strong inductive argument because the probability that the conclusion is true given that its premises are true is high, i.e., the evidential link between the premises and the conclusion is strong.

The above discussion is the idea of natural selection which, Darwin in the last paragraph of the *Origin of Species by means of natural selection* (1859) says is "... a grandeur ... view of life ... having been breathed into a few forms or into one, and that ... from so simple a beginning and endless forms most beautiful and wonderful have been and are being evolved" (Ibid., p. 463). This analysis raises some questions. How "grandeur" is this view of life? Darwin talks as if he means that we are waiting for "better life" to come, because he argues that there is always perfection with time. As to who or which generation would consider itself "inferior" and expect a "better one" is questionable. It is also doubtful whether he is prescribing it as a general outlook of life. Darwin’s analysis would generally be regarded as thoroughly immoral, e.g., hard-heartedness is more likely to make survival on the battlefield than is feeling for human suffering. So, however "grandeur" Darwin’s analysis of nature is, it cannot be recommended as a general view of life.
It may be concluded by saying that what is called Darwinism is nothing but an anthropomorphic view of nature, i.e., it is nature humanized and doing as man does. Darwin’s analysis of nature presupposes that nature is knowledgeable. But natural selection is nothing than an application by Darwin of the prevailing socio-political situation into nature. Darwin (1929) in his Autobiography records that Chemistry and Physics never interested him. So when he was faced with the problem of the origin of species, he did not turn to these disciplines for explanation. Instead, he used the sociological doctrines that dominated his country to explain how species have originated. It should be noted that this was during the time of Queen victoria, when England was becoming a main industrial and colonial power, the notion of struggle was very dominant. During this time the “fallacy” of Eurocentricism was dominant. The “fallacy” is two-fold. First, that the Europeans are “superior” and second, that Africans and other races are “inferior”; that the latter are below the European in human evolution. The result was that Darwin’s interpretation of evolution was based on population relations, i.e., how the “superior” relates with the “inferior”, e.g., how the European relates to the African, i.e., by colonising the latter. Some Africans collaborated and others resisted. Maybe this was a show of “struggle for survival” but it should be remarked that even the collaborators “survived” which gives rise to doubts whether Darwin’s analysis is a true representation
of the real life situation.

The structure of Darwin's entire argument could be schematized as follows:

a) Present day organisms have descended from those existing before them.

b) Through breeding, new varieties of organisms are continually being produced.

c) Living organisms tend to increase at a geometrical rate.

d) Not all offspring can possibly survive or live to leave progeny.

e) A struggle for life ensues over the meagre earth's resources.

f) Since no two organisms are exactly alike, some will have favourable variations in the struggle for life.

g) Therefore, only individuals with advantageous variations will be preserved in the struggle for life and are likely to leave progeny.

h) The offspring are likely to be better in form. As more offspring are produced, the better they would become. Therefore, natural selection perfects organisms with time.
CHAPTER THREE

THE STATUS OF UNIVERSAL LAWS IN SCIENTIFIC EXPLANATIONS

3.0 Introduction

According to the covering-law theory, if a proposed explanation is to be sound, its constituents have to satisfy certain conditions of adequacy, which may be divided into logical and empirical conditions (Hempel & Oppenheim, 1948).

In this chapter, we will examine the logical conditions of adequacy for scientific explanations. The empirical conditions will be examined in the next chapter. The logical conditions require the discovery of universal law(s) behind an occurrence to mark any proposed explanation for that occurrence scientific (Ibid., p. 10). When faced with the problem of how species originated, Charles Darwin in his work, The Origin of Species by means of natural selection (1859), offered natural selection as an explanation of how species originated. Using the logical conditions of adequacy for scientific explanations, we will show that natural selection does not invoke any universal law(s) and hence show that it is not scientific, according to this criterion.
This chapter is divided into two sections: Section I concerns itself with clarification of the term "universal laws". Because the term "universal laws" has no technical definition in any discipline, there is need to explicate it by showing its logical structure with the express aim of distinguishing statements which can qualify for the title "universal laws" from those which cannot qualify for the title "universal laws".

Section II concerns itself with relating "universal laws" to natural selection so as to point out the failure of natural selection to invoke any universal law, a necessary condition for covering law scientific explanations according to which natural selection is not scientific.

Let us observe that Darwin concludes his chapter on "Instincts" by this sentence: "Finally, it may not be a logical deduction, but to my imagination it is far more satisfactory to look at such instincts ... as small consequences of one general law leading to the advancement of all organic beings, namely, multiply, vary, let the strongest live and the weakest die" (Darwin, 1859; p. 216). Elsewhere, he says that natural selection works solely by and for the good of each being all corporeal and mental endowments will tend to progress towards perfection (Ibid., p. 241). It is clear that this assertion purports to prove some sort of "universal law" by which species originate and develop. Darwin also claims that we can rely on this "general law" to predict a "perfect future"
for species. It is the concern of section II to show that biological Darwinism cannot be considered a scientific explanation since it does not invoke any "universal law(s)". Therefore it cannot be used to affirm the above claim.

We will first examine what a "universal law" is and subsequently show its logical structure.

3.1 Universal Laws

The term "universal law" has no technical definition in any discipline and so its usage is commonly not precise. According to R.S. Walters' essay "Laws of science and Lawlike statements" in The Encyclopedia of Philosophy vol. 3 & 4 (1967, p. 410), while a large number of statements of a diverse kind are recognized as laws, many other statements are not lawlike, and others, are matters of dispute; the dispute being centred on two distinct perspectives, namely, whether the statement has strong enough scientific support to justify its being accepted as a law by a scientific community (Kuhn, 1972, Lakatos, 1978, Laudan, 1977) and whether it is lawlike. The first question, though related to the second, is for members of the scientific community to settle. It is to be noted that the term "law" is used by scientists with no consistent meaning and it is not one of the technical terms defined by any science: once a statement has been
accepted in a science, it does not matter whether it is called a law, a principle, or a theory. What counts is its function within the science itself (Encyclopedia of philosophy vol. 3 & 4, 1967; p. 410).

Philosophers of science are generally in agreement that "a minimum necessary condition of any scientific statement proposed as lawlike is that it be a universal generalization" (Ibid., p. 411). To say that a statement is a "universal generalization" is to say that it applies to all members of a given class without exception. However, not all universal generalizations are considered lawlike. There is one fundamental condition that any universal generalization must satisfy for it to be regarded lawlike. If it is to be regarded lawlike, a universal generalization, apart from being true, must make claims about all members of a class at all places and times; a requirement which gives lawlike statements their spatio-temporal universality (Ibid., pp. 41-413, Nagel, 1961, Hospers, 1976).

Here are some statements that are used in the sense we discussed above. These examples have been drawn from A.F. Chalmers' work (1980, p. 36).

1. All iron rusts when exposed to air.
2. All metals conduct electricity.
3. All poison kills.
The above statements make references to all members of their class at all places and times. The above examples can be contrasted with:

1. All trees in Mr. Mwangi's farm are orange-trees.
2. All soldiers in France during the Napoleonic era were tall.

The above two examples make references to some given place and time, respectively. They have been referred to as "space-like" and "time-like", respectively (Pap, 1962, Cannavo, 1974). Space-like statements make reference to some place while time-like statements make reference to some given time; hence the above two statements do not meet the requirement of spatio-temporal universality to qualify for the title lawlike.

Universal statements which are lawlike are used as a basis for prediction because their applicability holds at all places and times. In the next section, we will show that Darwin's "biological law" is not lawlike and cannot be relied upon to explain and predict occurrences of events in nature.
3.2 Relation between Universal Laws and Natural Selection

In this section, we relate universal laws to natural selection with the express aim of showing that natural selection does not invoke any universal law. This section concerns itself with showing that the biological Darwinian law of how species originate and develop does not exhibit the characteristics of lawlike statements. We first state Darwin's claim and then proceed to point out the failure of the biological Darwinian law to meet the requirements of lawlike statements.

Consider this quotation (Darwin, 1859; p. 260):

Finally, it may not be a logical deduction, but to my imagination it is far more satisfactory to look at such instincts as the young cuckoo ejecting its foster brothers - ants making slaves, - the larvae of ichneumonidae feeding within the live bodies of caterpillars, - not as specially endowed or created instincts, but as small consequences of one general law leading to the advancement of all organic beings - namely, multiply, vary, let the strongest live and the weakest die.

Elsewhere, Darwin writes:

As all the living forms of life are the lineal descendants of those which lived long before the cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection
works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection (Ibid., p. 462).

When the two passages are read alongside each other, it becomes clear that Darwin is offering natural selection as a "universal law" for the progressive development of species. Darwin's claim in the first passage is that there is "one general law" (in philosophy of science, "general law", "universal law" and "law of nature" are used synonymously, Nagel, 1961; p. 49) which is responsible for multiplication, variation and selection of the fittest organisms to live and the weakest to die. He further claims that due to this "one general law", the more perfect organic forms will replace the less perfect organic forms in the lineal descent of organic forms. Finally, he claims that this "one general law" which is responsible for the development of species and which helps the more perfect organic forms to replace the less perfect organic forms is to be relied upon to predict a "perfect future for species".

From the above passages, it is clear that Darwin's claim is that presently existing organisms have replaced previous ones because they are "better" organisms. Without questions then, Darwin is saying that presently existing organic beings will be replaced by "better" organic beings to come. It is, however, doubtful as to which presently existing species would consider itself
inferior in its form and live in anticipation of a superior one to succeed it.

From the first passage, it is not clear what "may not be a logical deduction". But close examination reveals that Darwin's claim is that the "one general law", although not granted by the premises, seems to his imagination a more satisfactory inference from such instincts as "ants making slaves". One observation, however, can be made. Darwin's purported "one general law" is an attempt to explain the tendencies of organisms to behave the way they do as is exemplified by the case he gives of ants making slaves. Thus, we can say that Darwin is trying to prove a law of tendency. Anthony Flew (1967) remarks that to assert a law of tendency is to say that something always has occurred and always will occur so long as this tendency will be in operation. In the previous chapter, we gave the example of an eye $E$ tending to blink at time $t_1$ or $t_2$. We would say that the blinking by eye $E$ attains the status of a law of tendency if eye $E$ has blinked at time $t_1$ or $t_2$ and it would blink in a future time $t_1$ or $t_2$, so long as that tendency of blinking would be in operation. In the case of ants making slaves, Darwin is saying that ants have always made slaves and on the basis of the "one general law" which helps the more perfect organic forms to replace the less perfect organic forms, ants will make slaves in the future, and that these ants will be more "perfect" than the present ones.
Another observation which may be gathered from the first passage is that the biological Darwinian law divides organisms into two classes: the strongest which live to multiply; and the weakest which die and hence never leave progeny. The term "strongest" implies that there is a struggle for life, a fact which Darwin gives in his theory of natural selection.

Darwin's central argument in natural selection, then, is that there is a universal law for organisms which exhibit in their behaviour a strong tendency to struggle for survival to be at an advantaged position to survive. Put more precisely, Darwin's claim is that only organisms which exhibit in their behaviour a strong tendency or disposition or propensity to struggle are likely to survive.

Darwin advanced his argument on the following premises.

1) Organic beings have a natural tendency to behave in a certain way.
2) Generations have succeeded each other successfully, i.e., the ordinary succession by generation has never once been broken.
3) We can predict the future of species as implied in premise two above.
4) Natural selection works solely by and for the good of each being.
5) Organisms tend to progress towards perfection.

In premise one, Darwin observes that in nature, organisms tend to behave in a certain way. He gives the example of ants making slaves, the young cuckoo ejecting its foster-brothers. This behaviour of organisms arise out of "one general law". Darwin claims that these behaviours do not come out of special creation but due to this "one general law" leading to the advancement of all organic beings. Put more shortly, Darwin says that the tendency of organisms to behave the way they do is for their own good and it leads to the advancement of the concerned organisms.

In premise two, Darwin observes that the tendencies in nature have remained the same. Ants have always made slaves, young cuckoos have always ejected foster-brothers and parents have always left progeny with similar characteristics.

From premise 2, Darwin concluded that it is possible to predict the future of species because the ordinary succession by generation has never once been broken, e.g., ants have always produced offspring which make slaves of one another. Darwin sees no reason why the future cannot be like the past. He therefore concluded that even in future species would behave as they have always done.
In premise four, Darwin says that natural selection works for the good of each being. In natural selection, variations which are advantageous to the organism are accumulated and then passed to the offspring. In this case an organism with useful variations will be more likely to succeed in the struggle for life. If in natural selection useful variations are stored then the behaviour of organisms is a result of the above accumulation of variations. And if such behaviour has been brought about by natural selection and bearing in mind that natural selection always works for the good of each being, then the accumulation is for the good of the organisms.

In premise five, Darwin argues that if organisms have accumulated useful variations due to natural selection, and that they have a long past which has never been interrupted by anything then the accumulated variations might have perfected with time. This led him to conclude that future organisms would be more perfect than the presently existing organisms which, in turn, are more perfect than the previously existing ones. Darwin, thus, concluded that organisms have tended to progress towards perfection.

Having shown that the biological Darwinian law is a law of tendency of how organisms behave, let us show why it is not lawlike. Our argument in this section is that the "one general law" of tendency which Darwin has
purportedly proved does not have the characteristics of a universal law and consequently, Darwin or any other person for that matter, does not have any firm basis for calling natural selection a scientific explanation.

In section 3.1, we stated that for any statement to qualify for the title "universal law", it should not be applicable only to individual objects, particular places and times. To mention individual objects in a statement necessarily means the non-satisfaction of the requirement of spatio-temporal universality of universal laws. This is so because of two reasons: (1) Individual objects are temporally determined; either belonging to a given time point or a connected time stretch. (2) Individual objects must always have a definite space point or spatial area to which they correspond if they refer to a given time (Pap, 1962). In short, any "law" which is expressed using individual objects must be spatio-temporarily limited.

Close examination of the biological Darwinian law reveals that it makes references to individual objects which, going by the above definition of a universal law, are spatio-temporally limited. Darwin talks of two kinds of organisms; some which are "fit" for survival and some which are 'unfit' and hence are eliminated. The "fit" and the "unfit" organisms are "fit" and "unfit" according to how successful or unsuccessful they have been able to
adapt to their physical conditions of life. One observation can be made. The physical conditions differ from one area to another and are singularly experienced by organisms. Hence the Darwinian law is not applicable to all places but particular places where each organism experiences its "physical conditions of life". Those organisms which are successful in adapting to their "physical conditions of life" leave progeny "which are periodically born". "Periodically born" here refers to a given time-stretch and hence is not temporarily universal.

That biological Darwinian law is not spatio-temporally universal can be explicated in the following argument:

1) The biological Darwinian law divides organisms into the "fit" and the "unfit" organisms.
2) According to this law, organisms are "fit" or "unfit" according to how successful, respectively, they have been in the competition for life and according to their physical conditions of life.
3) If in life there is a competition, there has to be a place or time corresponding to the competition.
4) Therefore, the "fit" organisms and the "unfit" organisms are "fit" or "unfit" in the competition for life at some place and time corresponding to the competition.
5) If organisms are "fit" or "unfit" according to their physical conditions of life, then each organism experiences its physical conditions subjectively. Physical conditions furthermore, differ from one place to another and from time to time.

6) It is to be supposed then that there must be a place and time which corresponds to the organisms' experiences of physical conditions of life subjectively.

7) If the "fit" and "unfit" organisms are "fit" or "unfit" according to their success in the competition for life and according to their physical conditions of life, then the biological Darwinian law refers to some places and times.

8) If then the biological Darwinian law refers to some places and times, then it does not meet the requirement of applicability to all places and all times for it to be spatio-temporally universal.

9) The above is true because a universal law must meet the requirement of spatio-temporal universality.

10) Therefore, if the biological Darwinian law does not meet the requirement of spatio-temporal universality, then it is not a universal law.

11) Consequently, if the biological Darwinian law is not a universal law, Darwin or any other person does not have the justification for calling natural selection a scientific explanation for it does not meet the requirements of the Covering-law theory.
CHAPTER FOUR

EPISTEMIC CONDITIONS FOR SCIENTIFIC EXPLANATIONS

4.0 Introduction

This chapter concerns itself with examination of the epistemic conditions for scientific explanations and then proceeds to point out the failure of natural selection to meet these epistemic conditions. According to Jaegwon Kim in his article 'Explanation in Science' in The Encyclopedia of Philosophy Vol. 3 & 4 (1967, pp. 159-163), an argument conforming to the logical requirements of scientific explanations (discussed in the preceding chapter) qualifies as a potentially explanatory argument, but not necessarily as an explanation. The satisfaction of epistemic conditions is essential: the essentiality being, to eliminate any arbitrarily formulated explanations which meet the logical conditions but whose premises are false. The term 'epistemic' is derived from the Greek word 'episteme', which means relating to knowledge. The premises of any proposed scientific explanation, therefore, according to the covering law theory, must be known to be true.

Aristotle in his Posterior Analytics, Book I (1910, p. 214) is of the opinion that the premises of a proposed explanation must be known to be true. The guarantee of
truth is, however, difficult to attain. In chapter I, we discussed the three theories of truth which have been described, namely, the correspondence theory of truth, the coherence theory of truth, and the pragmatic theory of truth. To evaluate the truth conditions of a putative scientific statement, that is, to determine the truth or falsity of a given statement, the correspondence theory of truth is used. The correspondence theory of truth requires that for any proposed scientific statement, it must be capable of being verified or falsified. Thus, two criteria have been advanced by different schools of thought. The logical positivists advance the principle of verification while the Popperians advance the principle of falsification. In this chapter, we will show, by use of examples, that natural selection is meaningless (going by the principle of verification) and false (going by the definition of the principle of falsification).

This chapter will be divided into three sections. Section I will be concerned with the explication of the logical structure of the principle of verification according to which natural selection fails to meet the requirements of scientific explanations.

Section II will concern itself with the explication of the logical structure of the principle of falsification according to which natural selection is unsound, that is, it is based upon false premises.
The logical positivists' views, put briefly, are that philosophy does not produce propositions which are true or false; it merely clarifies the meaning of statements, showing some to be scientific, some to be mathematical and some to be nonsensical. In drawing the above distinction, the logical positivists distinguished between 'analytic' and 'synthetic' propositions from which they drew the criterion for determining when a proposition is scientifi=c. The logical positivists' views, put briefly, are that philosophy does not produce propositions which are true or false; it merely clarifies the meaning of statements, showing some to be scientific, some to be mathematical and some to be nonsensical. In drawing the above distinction, the logical positivists distinguished between 'analytic' and 'synthetic' propositions from which they drew the criterion for determining when a proposition is scientific.
proposition is cognitively meaningful). According to Ayer, a sentence will be factually significant to a given person if and only if he knows how to verify the proposition which it purports to express, i.e., if he knows what observations would lead him under certain conditions to accept the proposition as being true, or reject it as being false.

Put more shortly, the verification principle can be stated as:

"Every genuine proposition must be either analytic or empirically verifiable" (Wheatley, 1970; p. 48).

One problem which arises with the verification principle lies in the logical status of the principle itself. For the statement "Every genuine proposition must be either analytic or empirically verifiable" appears to be neither analytic nor empirically verifiable, in which case it is self-defeating and the principle is literally meaningless and incapable of truth or falsity (Wheatley, 1970, Shand, 1993).

It is then a clear indication that the principle of verification as a criterion of truth is not infallible (and that is why the guarantee of truth is difficult to attain) and there is need for a sure criterion to be developed which would be used as a test of truth (as we
shall see in the next section, the principle of falsification is itself not infallible). However, when used as a criterion of truth, the principle of verification clearly points out that natural selection is meaningless.

Consider this quotation from Darwin (1859, pp. 68-71).

As struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every Being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence, as more individuals are produced than can possibly survive, there must be a struggle for existence, either one individual with another of the same species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. Although some or less rapidly in numbers, all cannot do so, for the world would not hold them.

There is no exception to the rule that every organic being naturally increases at so high a rate that, if not destroyed, the earth would soon be covered by the progeny of a single pair. Even slow-breeding man has doubled in twenty-five years, and at this rate, in less than a thousand years there would literally not be standing-room for his progeny. Linnaeus has calculated that if an annual plant produced only two seeds - and there is no plant so unproductive as this - and their seedlings next year produced two, and so on, then in twenty years there would be a million plants. The elephant is reckoned the slowest breeder of all known animals, and I have taken some pains to establish its probable minimum rate of natural increase; it will be safest to assume that it begins breeding when thirty years old, bringing forth six young in the interval, and surviving till one hundred years old; if this be so after a period of 740 to 750 years there would be nearly nineteen million elephants alive, descended from the first....

In looking at Nature, it is most necessary to keep the foregoing considerations always in mind - never forget that every single organic being around us may be said to
be striving to the utmost to increase in numbers; that each lives by a struggle at some period of its life; that heavy destruction inevitably falls either on the young or old, during each generation or at relevant intervals. Lighten any check, mitigate the destruction ever so little, and the numbers of the species will almost instantaneously increase to any amount.

In the above passage, Darwin takes up the idea of Malthus (the idea that as the population increases, the food decreases) and then points out the consequences of the "geometrical ratio of increase" of living things, leading to a "struggle for existence". Geometrical progression (G.P) is where successive terms have a common ratio \((r)\); e.g.,

\[1, 2, 4, 8, 16, 32, \ldots n.\]  
The common ratio here is 2, such that the next number can be shown to be 64. Or, consider these numbers: \[1, 3, 9, 27, 81 \ldots n.\]  
The common ratio is 3, such that the next number can be shown to be \(81 \times 3\).

After showing the consequences of geometrical progression of organic beings, Darwin states his central point in the first paragraph of the above passage thus: "Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life".

From the foregoing passage, Darwin does not say that "more individuals are being produced" nor is he claiming that
there is a "struggle for existence". Darwin puts it conditionally that if more individuals were produced than can possibly survive, then there would follow a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the conditions of life.

Darwin's central argument in the above passage, then is: If more individuals are produced than can possibly survive then a struggle for existence between these individuals or their physical conditions of life follow. Put more shortly, Darwin wants to show that natural selection works through struggle for existence between individuals or their physical conditions of life. Darwin's conclusion, then, amounts to this: Natural selection works through struggle for existence.

Let us untangle the argument by which Darwin tries to establish his central argument. To do this, we will first give a first-reading of the passage and then show the premises by which Darwin arrived at his central argument. Here, we will show that Darwin uses strong inductive argument.

A first-reading of the above passage would go thus: a struggle for existence follows if organisms increase at a geometrical rate. Some of the species produce offspring through seeds and others through eggs. Some of these
seeds and eggs must be destroyed or else the world would be populated by these species which produce through eggs and seeds. He gives other examples: the cases of man and the elephant. He then concludes that if more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with individuals of distinct species or with the physical conditions of life. A struggle for existence must ensue because the food resources would be meagre and cannot support all the offspring. Those organisms which struggle would be likely to survive. 'Food', then, acts as a check to the tremendous increase of species. If we 'lighten' any check, mitigate the destruction ever so little, ... the number of the species will almost ... increase to any amount.

Close examination of the above passage reveals that Darwin's argument is based on two premises, namely:

a) Organisms tend to increase at a geometrical rate and not all offspring can possibly survive.

b) Food resources are meagre and cannot be increased artificially.

Therefore, there is a struggle for existence between individuals.
The two premises are related such that if true, they probably imply the conclusion. From the first premise, it is true that if organisms tend to increase at a geometrical rate, it follows that a single species would populate the whole world within a short period. But Darwin observed that, in nature, not all the offspring tend to survive. Some are destroyed. He, then, concluded that there must be some 'check' to population increase in nature. One of these 'checks' is food. Darwin claims that food resources are meagre and that they cannot be increased artificially. It then follows that probably if organisms tend to increase at a geometrical rate and if not all can possibly survive, then the offspring would have to struggle for their subsistence.

Darwin's passage is a case of a strong inductive argument, i.e., if organisms increase at a geometrical rate and given that not all can possibly survive and given that they must subsist on some food, which is meagre and cannot be increased artificially, then the probability that these organisms will struggle for food and with their physical conditions of life is high.

In this section, we have stated our point that natural selection is meaningless according to the principle of verification; according to this criterion, all propositions which aim to express genuine knowledge about the world pass the test of being empirically verifiable.
before they can be admitted to be significant. What observations would be described which would be relevant in determining the truth or falsity of natural selection to call it significant? A clear indication is that there are none of these observations. Drawing examples from artificial selection by animal breeders in England is not enough to make Darwin conclude that there must be 'natural selection'. The occurrence of 'artificial selection' is not indicative of there being 'natural selection'. Since there are no observations which could be described which would be relevant in determining the truth or falsity of natural selection, then, according to the principle of verification, natural selection is meaningless.

That natural selection is meaningless according to the principle of verification can be explicated in the following argument:

1) According to Darwin, natural selection works through struggle for existence.

2) According to the principle of verification, statements are either:
   a) Synthetic (making some claim about reality),
   or,
   b) analytic (true in virtue of their logical form),
   or,
   c) meaningless.
3) It is the contention of the logical positivists that every significant proposition must be either analytic or synthetic, but none can be both.

4) If natural selection as (1) is a significant proposition, it must be either analytic or synthetic, but not both.

5) Natural selection is not analytic because its truth cannot be established by reading and understanding the words which make up the proposition.

6) If it is not analytic, then natural selection is synthetic for it to be significant.

7) For it to be synthetic, natural selection would require some sort of empirical investigation for its confirmation.

8) There are no observations which would be relevant in determining the truth or falsity of natural selection.

9) Therefore, natural selection is not synthetic.

10) Since natural selection is neither analytic nor synthetic to be significant, then it is meaningless according to the principle of verification.

It is important to note, at this stage, that to say that natural selection is meaningless according to the principle of verification is not in itself enough to call natural selection unscientific. The principle of verification is not sufficient, though necessary, for the
epistemic status of scientific explanations. The principle of verification is rooted in the *Tractatus* Wittgenstein (1922) whose views can be roughly outlined as follows. The meaning of a word is the object for which it stands; the meaning of a word is the object for which the object refers (Wittgenstein, 1922; par. 2.021). The world is made up of objects (Ibid., par. 2.021) and the relations between objects form facts (Ibid., par. 1-2.01). Propositions describe the facts by describing how the objects stand in relation to each other (Ibid., par. 2.0231). From the first nine paragraphs of the *Tractatus* it is clear that what makes propositions true or false are facts. To speak of truth is to speak of a correspondence of proposition with fact (Ibid., par. 4.01).

Wittgenstein does not say in so many words that a true proposition is one which corresponds with the facts, but he does say that a proposition is a picture of reality (Ibid., par. 4.01), that a picture either agrees or disagrees with reality (Ibid., par. 2.21), and that truth consists in the agreement of its 'sense' with reality (Ibid., par. 2.222). The above claims clearly presuppose the correspondence theory of truth.

The above account seems obviously inadequate. If the meaning of names is their objects, then names referring to objects that cease to exist, or never did exist (such as 'natural selection'), become, or are, meaningless. This
means that any proposition containing such names will also be meaningless. In attempting to make its point, it would seem that the propositions of the *Tractatus Logico-Philosophicus* (1922) itself are self-stultifying. The above flaw led Wittgenstein to change his philosophical stance in a later work *The Philosophical Investigations* (1953). The views of the *Investigations* could be understood if one saw it against the background of the *Tractatus*. In the *Investigations*, Wittgenstein rejects the idea that the meaning of words is their reference to objects (Wittgenstein, 1953; par.1) and, instead, holds the idea that 'the philosophical concept of meaning has its place in a primitive idea of the way language functions' (Ibid., par.2). At the centre of the *Investigations* is the argument that the meaning of a word is its usage in particular contexts or practices. Consider this quotation from the *Investigations* (par.43).

For a large class of cases - though not for all - in which we employ the word 'meaning' it can be defined thus: The meaning of a word is its use in the language.

Central to the above quotation is the claim that the meaning of a word is the 'use' into which it is put, e.g., 'when a child learns this language, it has to learn...its use' (Ibid., par.9). To put a language into use is to put a language into functions, in Wittgenstein's own words, 'language games' (Ibid., par.23).
In holding that the meaning of an expression is its use, Wittgenstein meant the special circumstances in which it is spoken or written. Wittgenstein concludes that the above is a rule of practice and therefore one cannot follow a rule 'privately' (Ibid., par.202). That the meaning of an expression is its usage in a particular context presupposes the pragmatic paradigm. According to the pragmatic theories of truth, the meaning of a term consists in its being used in determinate and overt ways, i.e., in given 'language games'. Equally, as we shall explicate later, the concept 'natural selection' is meaningful in the Peircean pragmatic game.

In the next section, we will examine another necessary, but not sufficient criterion for the epistemic status of scientific explanations.

4.2 Natural Selection and the Principle of Falsification

According to Popper (1973), theories are speculative and tentative conjectures or guesses freely created by the human intellect in an attempt to overcome problems encountered by previous theories and to give adequate account of the behaviour of some aspect of the world or universe. Once proposed, a theory should be vigorously tested by observation and experiment. Those that fail to stand up to observational and experimental tests must be eliminated and replaced by further speculative
conjectures.

Consider this example drawn for Chalmers (1980, p. 36).

"If we are given the statement, 'A raven which was not black, was observed at place x at time t', then it logically follows from this that 'All ravens are black' is false", i.e.,

Premise: A raven, which was not black, was observed at place x at time t.
Conclusion: Not all ravens are black.

From the above example, it is important to note that the discovery of one contra-example to a given universal statement is enough to falsify the whole theory. But it is important to note that the falsificationists may be ruled out by the lack of a perfectly secure observational base on which they depend. Observations may be erroneous (Shand, 1993).

Despite its shortcomings (observational errors), the principle of falsification when used to judge the scientific status of natural selection reveals that natural selection is based on false premises because counter-examples can be observed which contradict the theory. The discovery of one contra-example, according to the falsificationists, is enough to regard a theory as false.
Consider this quotation from Darwin (1859, p. 68):

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms, for in this case there can be no artificial increase of food, and no prudential restraint from marriage.

Darwin’s central argument in the above passage is that if the numbers of any given species increase, then there follows a struggle for life. He states his conclusion thus: ‘Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the physical conditions of life’. Put more shortly, Darwin claims that any increase in the numbers of any species leads to a struggle for existence because there is no artificial increase in food production and there is no prudential restraint from marriage.
Darwin bases his argument on two premises. First, that species would always increase. Second, that food supply is always constant. Therefore, there must follow a struggle for existence between the individuals or with their conditions of life.

From premise 1, if it is true that species always increase, and that, as Darwin claims, if there is no prudential restraint to marriage, then, for all these individuals to feed on the food, which cannot be increased artificially, there must follow a struggle over the food. It is clear that if the numbers of a species exceed that of the supply of food, there will tend to follow a struggle for this meagre food. The probability that a struggle for existence would follow given large numbers of a species and no artificial increase of food is high. Darwin's argument, then, is a strong case of an inductive reasoning.

In this section, we state our claim that natural selection can be falsified going by the principle of falsification. The discovery of one contra-example renders the whole theory false.

Consider this example:

The population of man has increased so much since Darwin wrote his Origin of species by means of natural selection.
If food supply cannot be artificially increased, according to Darwin, then man must be struggling against one another. Human experience reveals that presently existing humankind lives much more by cooperation than by competition. What this means is that Darwin's analysis of nature is false. His claim that "can be no artificial increase of food, and no prudential restraint to marriage" is also false. During this era, agriculturalists have tended to advance the production of food stuffs (there are cases of plants and animals which are artificially made to mature much faster and hence increase the food supply). Presently, also, the numbers of the offspring can be easily reduced because not every marriage produces offspring. The use of family-planning devices contradicts Darwin's assertions. Therefore, going by the principle of falsification, natural selection is false.

That natural selection can be falsified is explicated in this argument.

1) Darwin claims that there follows a struggle for existence between individuals because there can be no artificial increase of food and no prudential restraint to marriage.

2) According to the principle of falsification, the discovery of one contra-example to the above assertion would render Darwin's claim false.
3) With the advancement of technology, man has managed to increase his food supply and has managed to contain the population increase through family-planning devices.

4) Premise (3) is a contra-example to premise (1) above.

5) Therefore, going by the principle of falsification, natural selection is false.

To claim that natural selection does not meet the epistemic conditions of scientific explanations on the basis of the above two criteria would be a mistake. This is because, as we saw with each criterion, each has its own shortcomings. But this does not mean that we cannot use them to judge the epistemic status of natural selection. We should continue using them as criteria for evaluating the epistemic status of proposed scientific explanations until an infallible criterion is developed.

Because of the lack of a sufficient criterion to evaluate the epistemic status of putative scientific explanations, Paul Feyerabend (1991) has suggested a criterion of knowledge he calls "epistemological anarchy". According to this criterion, each person or community is supposed to hold to what they believe is 'true' regardless of what the others believe. What this criterion leads to is epistemological subjectivism which contradicts the objective nature of scientific knowledge and hence,
Feyerabend's criterion of 'epistemological anarchy' is not reliable.

4.3 Pragmatism as a Scientific Theory: An Application to Natural Selection.

In the preceding sections we argued that, when natural selection is gauged by the covering-law theory, it fails as a scientific theory since it does not meet some of the necessary requirements of the covering-law theory. The covering-law theory presupposes the correspondence theory of truth. But the correspondence theory of truth is not the only theory of truth. We have the coherence theory of truth which deals with the internal consistency of statements but is not conducive to any scientific theory. Consequently, the coherence theory of truth will not concern us in this section because in this section we wish to show that, although natural selection is not scientific as per the covering-law theory, it is scientific under the Peircean version of the pragmatic theory of truth.

Two brands of pragmatism may be distinguished. First, the meaningful as the "useful" or "workable" (Schiller, 1903 & James, 1897, respectively) and second, the meaningful as "success in inquiry" as advanced by Peirce (1935). The former brand does not presuppose any scientific method and therefore it will not concern us in this section. Our
concern here is to explicate the Peircean version of pragmatism which captures the scientific method. In this section we will show by examples from the history of science that "a scientific theory is much more than a collection of statements of fact and generalizations based on them" (Baum Robert, 1974, p. 481) which is what the covering-law theory is all about.

Let us first give a general explication of pragmatism and then proceed to show how the Peircean version of pragmatism captures the scientific method.

Etymologically, the philosophical term "pragmatism" is derived from the Greek term pragramata, which means "acts", "business". The term was chosen by U.S. logician Charles Sanders Peirce to refer to a way of making our ideas clear or to use his own words, for "a method of logic, a method of determining the meanings of intellectual concepts, i.e., of those upon which reasoning may hinge" (collected papers of Charles Sanders Peirce, Charles Hartshon (ed.), 1935; p. 464). Peirce's original formulation of the pragmatist principle is as follows; "consider what effects that might conceivably have practical bearings, we conceive the object of our conception to have. Then our conception of these effects is the whole of our conception of the object" (Ibid., p. 2). At the core of the above quotation, as with the other pragmatists like James (1897) and Schiller (1903), is the claim that the "meaning" of a
term or proposition consists in its being used in determinate and overt ways. That the meaning of a term or proposition consists in its being used in determinate and overt ways reduces pragmatism to a means-end theory. For the pragmatists the end is as good as the means.

Peirce's version of pragmatism is based on concrete habits or tendencies to action to which their acceptance leads. To Peirce, what a thing means involves its habits and habits lead to action. What the habit is, to Peirce, depends on when and how it leads us to act. Peirce claims that every purpose of action produces some sensible and practical result (Peirce, "How to make our ideas clear", in The process of philosophy, Epstein, 1967; pp. 770-771), e.g., drinking and smoking involve some habit and no wonder we hear of habitual drunkards and chain-smokers. Consider this example. A boy is in love with a "saved" christian girl. The girl gives him conditions for their marriage. One of these conditions is that the boy should also be "saved" and attend church every Sunday. The boy may turn out to be a habitual church-goer before and after he marries the girl. The "church-going" is an action which sprung from that first act of stepping into that church.

Pragmatism, according to Peirce, claims that our descriptions of things are to be understood as ways of dealing with those things, i.e., of finding out our
observation about them, proposing some hypotheses and checking the consequences of such hypotheses against the observations to show how those things work. Consider the following two example. "Midway between stations your motor car stops. You anxiously seek the cause. To find the cause is "the problem". Someone makes a "suggestion". Probably each member of the party makes one. The gas is out, a connection is broken, a piston is jammed, a feedpipe is clogged. You take the most promoting suggestion and try it out. "Trying it out" means deducing the consequences of the theory and comparing them with the facts" (Patrick, 1978; p.58). To find out what is wrong with the motor car one will have to look around the motor car (i.e., making observations), then he will have to develop some hypothesis (maybe a piston is jammed) and then try to test the hypothesis, if it works, then the hypothesis is verified, if not verified he will try another. Consider another example. A child refuses to eat his meal as children sometimes do. The parent seeks to know why the child refuses to eat the meal. To find the "why" is "the problem". His brother makes a suggestion. Maybe the mother did not buy the promised gift. The sister may suggest that the house-maid beat the child during the day. The father may suggest that the food is too salty, particularly when he is not experienced in matters dealing with the kitchen. The mother may suggest that the child has a headache. The mother will test each hypothesis by checking the behaviour of the
child once she presents the question to him, i.e., she will try to verify the hypothesis against the child's behaviour.

Let us explicate, step by step, Peirce's conception of pragmatism.

a) Occurrence of a problem

Peirce's pragmatism begins when there is some problem to be solved or a difficulty to be overcome in life, e.g., when a stranger comes to a Y-junction, he will have to do some thinking if he has not travelled through that road before. Among many African societies, there is a folk-tale of a hyena which, smelling meat, decided to find where the smell was emanating until the hyena reached a Y-junction and she could not decide which branch of the road to follow. The folk-tale ends by saying that the hyena put one leg on one branch and the other leg on the other with the consequence of tearing herself into two.

b) Observation

This step involves analyzing the situation very carefully and collecting all the facts bearing on the problem to be solved. In the analysis and collection of the facts, the Peircean pragmatism requires that we have to be fair and impartial and unprejudiced in our observation of the
facts. Impartiality of observation eliminates personal likings and biases; it is in the nature of science to be objective. It thus eliminates subjectivity in any scientific inquiry. Consider the case of the stranger above. For him to go forward to wherever he is supposed to go he will have to weigh the situation carefully, considering the direction of each destination.

c) Hypothesis

This step involves proposing a tentative solution to the problem. This is called the hypothesis or provisional theory (Patrick, 1978, p. 58). The proposed solution of the problem may come after a preliminary observation of a few facts in the situation, or at the very beginning of the investigation or it may come after years of laborious investigation as in the case of the search for a direct sea-route to India by European explorers which took many years.

Peirce’s version of pragmatism captures the scientific method in that it follows the above steps we have stated, i.e., it begins when there is some problem to be solved or some difficulty to be overcome. An analysis of the situation and very careful collection of all the facts bearing on the problem is carried out next. Then a solution of the problem is proposed, otherwise called an hypothesis or provisional theory. The hypothesis
furnishes the clue to work from. It is a conditional process of thought. If the theory is true, then certain events would follow. Consider this example. A physician, K, is called to see a patient, O, who is ill. To find the cause of the above trouble or the character of the disease, i.e., to diagnose the disease, is his "problem". He makes a few preliminary observations, e.g., whether the patient has a running nose, whether his eyes are red and whether he is shivering, among other observations. He asks such questions as the medical history of the patient and whether he finished the previous dose prescribed to him. The facts thus far observed then suggest a diagnosis – malaria. If it is malaria, then the patient's temperature will be high, although he will first appear to be shivering, and such like symptoms. He makes these tests and verifies his hypothesis, or disproves it.

Peirce's pragmatism is reflective. It presupposes scientific progress in the scientific method. The history of science is replete with scientific theories built on earlier ones as can be seen from the following account by W.T. Jones (1952, pp. 613-634). The sun appears to rise from the east and set in the west. Ptolemy of Alexandria offered an hypothesis affirming that the earth is fixed and stationary at the centre of the solar system, the other planets revolve around it. With increasing astronomical knowledge, Copernicus proposed to consider the sun as the centre of the solar system. The new theory
fitted the facts better - but not well enough. Kepler, studying the motion of Mars, substituted the eclipses for circles as the paths of the planets. Newton proposed the law of gravitation whereby every object in the universe attracts every other object with a force varying inversely to the square of the distance. Leverrier's observations revealed that Mercury does not move in accordance with Newton's laws; this led Einstein to come up with the theory of relativity which explains the erratic behaviour of Mercury. That the scientific method is progressive can be shown also by the discovery of the planets. Recently there have been reports in the electronic media that one more planet has been discovered. Thus scientific progress is reflective and accumulative. It presupposes the Peircean pragmatic theory of truth.

Now we wish to show that natural selection is scientific to the extent that it presupposes the pragmatic theory of truth.

First, we will consider Darwin's problem, which is a historical problem in the history of science; it is also a good illustration of scientific progress. In the second half of the 18th century it was generally believed that the earth had been created fairly recently. The estimates of how long the earth has been in existence were based on calculations using data found in the Bible. The age of
the earth was computed from Biblical chronology. Although there were some differences in interpretation, the estimated age was no more than a few thousands of years. All species of living things were held to have been created strictly according to the record of Genesis and to have remained unchanged ever since. This was the idea of the fixity or immutability of species. Comte de Buffon (1797-1788) was an early doubter of the doctrine of the fixity of species. He suggested that organic life has a common ancestry. Charles Darwin's grandfather, Erasmus Darwin, in his book Zoonomia published in 1794, says that warm-blooded animals have arisen from one living filament which acquires new parts and improves with time. In 1809, Jean Baptise Lamarck published his Zoological philosophy in which he queried the doctrine of fixity of species. Lamarck proposed a mechanism for evolution which suggested that by the direct action of environment on species, or by the use or disuse of organs by species, changes occurred which could be transmitted to offspring. This is the theory of Acquired characteristics.

In 1844, Chambers Robert published a book called Vestiges of the Natural History of Creation. In this book, he strongly supported the idea of evolution and advanced a mechanism which had a strong Lamarckian content. Charles Darwin was also doubtful of the idea of the fixity of species and he was inclined to the idea of evolution and he set to find out by what mechanism evolution occurs.
Next, Darwin made the following observations which were furnished to him during the voyage of His Majesty's service naval ship to South America (1831-1836). He observed, for example, that "domesticated ducks walk more and fly less hence bones of the wings weigh less than do the legs as opposed to those of the wild duck" (Charles Darwin, 1859; p. 10). Other observations he made are such as: "hairless dogs have imperfect teeth, longhaired and coarse animals are apt to have, as is asserted, long or many horns. Pigeons with feathered feet have skin between their outer toes, pigeons with short peaks have small feet, and those with long peaks large feet" (Ibid., p. 11).

We can summarize Darwin's observations thus: populations of animals and plants exhibit variations. He observed that some variations provide the organisms with an advantage over the rest of the populations.

Darwin's third step was to propose some hypothesis from which to work. One day while reading Malthus on population, it suddenly occurred to him how, in the struggle for existence, which he had everywhere observed "favourable variations would tend to be preserved and unfavourable ones to be destroyed. The result would be the formation of a new species. Here then I had at last a theory by which to work" (Ibid, p. v).
The most important sentence in the above quotation in relation to our work is "Here then I had at last a theory by which to work", i.e., he had found a hypothesis by which to work. The hypothesis is that in nature there is a struggle for existence. In the struggle, "favourable variations would tend to be preserved and unfavourable ones to be destroyed". Put in other words, Darwin's hypothesis is: there is a struggle for existence in organic life brought by the variations in organic life.

His final step was to test the hypothesis, i.e., his "theory by which to work" (Ibid, p. v). He reasoned thus:

When we reflect on this struggle, we may console ourselves with the full belief that the war of nature is not incessant, that no fear is felt, that death is generally prompt and that the vigorous, the healthy, and the happy survive and multiply.

Can we doubt (remembering that many more individuals are born than can possibly survive that individuals having any advantage, however slight, over others, would have the best chance of surviving and of precreating their kind... This preservation of favourable individual differences and variations and the destruction of those which are injurious, I have called Natural selection, or the survival of the fittest (Ibid, pp. 39-40).

Darwin's argument in the above paragraph can be put thus: all organisms are involved in a struggle for survival, since more organisms are born than can be sustained. Remembering that organisms exhibit individual differences,
then favourable variations furnish the organisms with an advantage in the struggle for survival. The survivors are selected since they are better fitted than their competitors to their way of life because of the characteristics they possess. The consequences which follow this preservation of the best fitted is that the best adapted organisms survive and produce offspring which inherit adaptations. In the course of time, favourable variations accumulate so that the whole nature of the species change. He was thus able to show that species are not fixed.

From the foregoing discussion, it can be seen that Darwin followed the scientific method to arrive at his theory of natural selection, i.e., he first had a problem to overcome, i.e., doubts over the idea of fixity of species, then he made observations during the H.M.S naval ship voyage to South America (1831-1836), then he proposed some hypothesis (i.e., that in nature there is a struggle for survival) and finally he drew up his theory of natural selection which was a consequence of the observation and the provisional theory (i.e., that if there is a struggle for survival, then it is likely that those organisms which are likely to survive in the struggle are those with favourable variations. Those with unfavourable variations would be destroyed in the struggle).
That natural selection was arrived at through the scientific method latent in the Peircean pragmatism can be schematized as below.

a) The scientific method latent in the Peircean pragmatism requires that an inquirer starts with a problem, then makes observations. Next he develops some hypothesis and finally tests his hypothesis to come up with a theory.

b) Darwin had a "problem" of doubting the idea of fixity of species. He made observations during the H.M.S. voyage (1831-1836). He developed the hypothesis that in nature there is a struggle for survival and from the hypothesis he developed his theory of natural selection.

c) This hypothesis works (i.e., fits the consequences of our experience) better than the hypothesis of the fixity of Species.

d) Darwin's theory is accumulatively progressive.

e) Therefore, Darwin's theory of natural selection is consistent with Peircean scientific methodology.

f) Therefore, it is not plausible for the covering law theory to claim that natural selection is totally unscientific.

h) Hence, it is doubtful whether the covering law theory fulfils sufficient conditions for scientific explanation.
CHAPTER FIVE

GENERAL CONCLUSION

5.0 Introduction

The aim of the study was to show that although the "one general law" which Darwin (1859, pp. 216, 241) had purportedly proved does not have the characteristics of a universal law and consequently, Darwin or any other person does not have any firm basis to call natural selection scientific if it is gauged by the covering law theory, nevertheless natural selection is scientific, at least minimally, in the Peircean sense. We have argued and still maintain that the covering law theory which presupposes the correspondence theory of truth does not stipulate sufficient conditions of scientific explanations.

The covering law theory falters as a model for scientific explanations because of the endemic epistemological presupposition of the "quest for certainty" latent in the correspondence theory of truth; the view that there must be an object to which every concept or proposition should refer. The covering law theorists take a realist stance, the epistemological contention that accords to the objects of man's knowledge an existence that is independent of whether he is perceiving or thinking about them.
We now proceed to show that the covering law theorists take a realist stance in their presupposition of the correspondence theory of truth. The covering law theorists maintain that for a proposition to be meaningful, it either has to be verifiable or falsifiable. To say that a meaningful proposition has to be "verifiable" assumes that there must be an object which must be experienced to make the proposition meaningful while to claim that a proposition must be falsifiable to be meaningful (Popper, 1973) indicates that the discovering of one contra instance falsifies a proposition. This presupposes that there are objects corresponding to our thoughts.

That there should be objects to which concepts and propositions should correspond is a mistaken notion (Dewey, 1968; p. 765, Richard Bernstein, 1967; pp. 380-385). It should be realised that we have some concepts without any corresponding images, e.g., "God", "liberty" or even "slavery". Due to this "epistemological mistake" of presupposition of objects corresponding to our thoughts by the correspondence theory of truth, the "pragmatic maxim ..." was offered to philosophers in order to bring to an end disputes which no observation of facts could settle because they involved terms with no definite meaning" (Ernest Nagel, "Two General Remarks on the Peircean version of pragmatism" in *The process of philosophy*, Epstein, 1967, p. 813). The Peircean scientific
methodology escapes the presupposition stated above because to Peirce, as with other pragmatists, concepts are essential to human thought as they serve as a way of doing things. The New Encyclopedia Britannica vol. 15 (1974, p. 540) reports:

The process philosophies of the pragmatist J. Dewey ... and still more controversially the philosophy of C.S. Peirce, an individualistic American logician and pragmatist, may also be taken as Realisms, even though they did not stress the basic relation to cognition; for these thinkers agreed that things as a fact do have, or may have, existence outside cognition, even though this existence was not reached from cognition nor defined through its relation to cognition. With them the cognitive relation was only an inessential afterthought.

What is important for the pragmatists is not the existence of entities in relation to cognition but the use and consequences of such use of the objects in question. Their philosophies are "process philosophies" because they emphasize ways of doing things rather than being or existence of things. On the above view, the Peircean scientific methodology escapes the endemic epistemological presupposition of the "quest for certainty" latent in the correspondence theory of truth.

5.1 Findings of the Study

The study pointed out two conclusions on the basis of the covering law theory and the Peircean conception of the scientific method.
The two conclusions pointed out are:

1) Natural selection does not meet the necessary conditions demanded by the covering law theory, i.e.,
   a) Natural selection does not invoke any universal law, and;
   b) it does not meet the epistemic requirements of scientific explanations as stipulated by the covering law theory.

2) Although natural selection does not meet the above conditions, it is, at least minimally, scientific in the Peircean sense.

The concern of the study was to show that although the covering law theory may be adequate in the physical sciences where laws of nature can easily be found, it does not stipulate sufficient conditions for scientific explanations. When natural selection is gauged using the covering law theory, it fails as a scientific explanation. Nevertheless, natural selection was found to be scientific in the Peircean sense.

5.2 Recommendations of the Study

The study makes the following recommendations.

1) Recommendation on the covering law theory.
2) Recommendation on the distinction between organic evolution Darwinism and the unscientific conclusions drawn from it.

3) Recommendation on the nature of Scientific Inquiry.

1) Recommendation on the Covering Law Theory

This recommendation is in relation to the exclusive use by the covering law theorists, of the correspondence theory of truth in the explication of scientific explanations, even with its limitations. The correspondence theory presupposes that there must be a substance to which every concept should refer. On the other hand that there should be substances to which concepts should refer is a mistaken notion (Dewey, 1968; p. 765).

It should be realized that we have some concepts without any corresponding images, e.g., "God", "liberty" or even "slavery". These are abstract concepts to which there are no corresponding images although we can distinguish cases of the application of these words from cases of their non-application. "Natural selection" is a case of an abstract concept without any corresponding image and it should not be considered unscientific on that basis.

It should also be realized that the covering law theorists are obsessed with the advances in the natural sciences and they acknowledged the methodology of the natural sciences
with the emphasis on knowledge as acquired from experience. But it is important to note that there are many methods of acquiring knowledge. There is testimony as a source of knowledge (i.e., the most common way of genuine knowledge about the past is to rely on the testimony of others, i.e., upon authority). We also have thinking as a source of knowledge (i.e., the view that the mind has the ability to discover truth by itself). There is also insight as a source of knowledge (i.e., the direct apprehension of knowledge that is not the result of conscious reasoning or of immediate sense perception). Each method should be recognised and no method should proclaim itself the genuine method of acquiring knowledge. If knowledge is to advance, then the complementarity of methods must be acknowledged.

2) Recommendation on the Distinction between Organic Evolution Darwinism and the Conclusions Drawn from it

This recommendation follows the ambiguity which underlies the term "Darwinism". In the narrow sense, it refers to a theory of organic evolution presented by Charles Darwin (1809-1882) and by other scientists who developed various aspects of his views while on the broader sense, it refers to a complex of scientific, social, theological and philosophical thought that were historically stimulated and supported by Darwin's theory of evolution.
In the preceding chapter, we showed that organic evolution Darwinism is scientific in the Peircean sense. Darwin described natural selection as a consequence of the "struggle for life" or "existence" (Darwin, 1859; p. 67). Social Darwinists (of whom Darwin was not one) claimed that Darwin's theory justified war, aggression and hostility between races and classes (Dobzhansky, 1977; p. 98). Such an interpretation of human relationships appealed to many in the heydays of capitalism and imperialism. Yet, in nature the struggle for life does not necessarily take the form of actual combat between individuals of the same species. Social Darwinists misinterpreted organic evolution Darwinism. Organic evolution Darwinism which is scientific in the Peircean sense should not, therefore, be confused with social Darwinism, i.e.; the unscientific conclusions which have been drawn from organic evolution for if this is done a category mistake is committed (Gilbert Ryle, "Descartes' myth" in The process of philosophy, 1967; pp. 480-493).

3) Recommendation on the Nature of Scientific Inquiry

In order to understand explanations in philosophy, it is inadequate to simply label them, for example, as "scientific". An examination must first be carried out thoroughly to find out not only what science is but what science does. Such an examination should not ignore the practice currently existing under the label. Science
sense should not, therefore, be confused with social Darwinism, i.e.; the unscientific conclusions which have been drawn from organic evolution, for if this is done a category mistake is committed (Gilbert Ryle, "Descartes' myth" in *The process of philosophy*, 1967; pp. 480-493).

3) Recommendation on the Nature of Scientific Inquiry

In order to understand explanations in philosophy, it is inadequate to simply label them, for example, as "scientific". An examination must first be carried out thoroughly to find out not only what science is but what science does. Such an examination should not ignore the practice currently existing under the label. Science existed long before logical positivism was born at *Wiener Kreis* (Vienna Circle). While we must acknowledge positive contribution to the economy and logical rigour on the part of the covering law model, the functional completeness and comprehensiveness of scientific inquiry latent (even if not explicitly stated) in Peircean pragmatism cannot be over-estimated.
1. **Axiom** - "A statement for which no proof is required and which, thus, occurs as a premise of many arguments but as the conclusion of none. It may be accorded this status either because it is held to be self-evident truth, as the axioms of Euclidean geometry were for a long time, or because it is thought to constitute an implicit definition of the terms it contains or to contribute, with other axioms, to such a definition". (Flew, 1979; p. 34).

2. **"Cash - Value"** - James' idea that ideas become true so far as they help us to get into satisfactory relations with other parts of our experience and that the true is the name of whatever proves itself to be good in the way of belief.

3. **Covering-Law Theory** - This is a philosophical analysis of the general structure of scientific explanations. This thesis holds that all scientific explanations are analysable in terms of two models i.e. the deductive-nomological and the probabilistic model, to which the Covering-Law theory can be divided. It is held that explanations which do not fit the Covering-Law theory are either incomplete or pseudo-explanations.
4. Counterfactual Conditional - Conditionals arising from such situation as "When planning for the future or reflecting on the past, we frequently carry on our deliberations by making assumptions that are contrary to the known facts. The result of our reflections are often formulated as contrary-to-fact conditionals (or "counterfactuals") having the form of 'If a were P then b would be Q, or If a had been P then b would have been (or would be) Q'". (Nagel, 1961; p. 70).

5. Explanandum - Latin word for what is being explained.


7. Initial Conditions - "particular statements, c, (state of affairs, events, etc.) which instantiate the attributes mentioned in the antecedent (i.e. the IF-clause) of the nomic statements" (Cannavo, 1974; p. 114).

8. Law-like - "Statements which if true, qualify for the designation "law of nature"" (Nagel, 1961; p. 48).

9. Laws of nature - "are descriptive; they describe the way nature works. They are certain uniformities that exist in the universe. They describe only what would happen under certain conditions. Descriptive laws are discovered but they are not made" (Hospers, 1967; p. 230).
10. Logical positivism - A term primarily associated with the Vienna Circle of the 1920s, whose most famous members were Schlick, Carnap, Neurath and Waismann. "The prefix 'logical' indicates partly that the topic for inquiry is meaning and partly that the doctrine is regarded as true as a matter of logic" (Lacy, A. R., 1976, A Dictionary of Philosophy; P. 165).

11. Model of a theory - "complete interpretation of that theory, other than the intended interpretation, which makes all the statements of the theory true". (Brody, 1970; p. 184).

12. Nomic inferences - "may be conveniently divided into two types:

i) Those whose conclusions are singular statements (sometimes called particular statements) and

ii) Those whose conclusions are laws or general statements that in some important sense resemble laws" (Cannavo, 1974; p. 114).

13. Pragmaticism - A term coined by C. S. Peirce in 1905 to denote his own particular variety of pragmatism, after the latter term had been appropriated and its scope widened by other philosophers.
14. Pragmatism - A philosophy which holds that the truth or value of a theory can only be judged by its practical results.

15. Realism - In epistemology, the view that the world exist exactly as we perceive it ("naive realism") or that fundamental particles of modern Physics are real and that it is out of them that objects we perceive in the world are constructed ("scientific realism"). In metaphysics, "realism" refers to the theory that "universals" have a real existence.

16. Science - A discipline which "seeks to discover and to formulate in general terms the conditions under which events occur, the statements of such determining being the explanations of the corresponding happenings" (Nagel, 1961; p. 4).

17. Scientific explanation - "A topically unified communication, the content of which imparts understanding of some scientific phenomenon" (Scriven, 1962; p. 112). "Science explains via laws" (Wilson, 1985; p. 2). By scientific law is meant a general and uniform regularity in nature, which has an infinite range both in time and space. There is no time or place at which the law will not hold true.
18. Scientific theory — "A deductive system consisting of certain hypotheses at the summit and empirically testable generalisations at the base." Braithwaite (1962, p. 47). We construct theories, unlike laws which are discovered.
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