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The Limitations of Science: A Philosophical Critique of Scientific Method

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I. Introduction

Science as an academic discipline claims indubitable knowledge. Science seems to have no bounds in its area of study so long as it has to do with nature. As such its enterprise is not a concluded area. It is an on going process as new discoveries are being made along its stride. Science has contributed a lot to the alleviation and eradication of man's problems in nature. Science has put man into the understanding and manipulations of the process of nature. With the application of scientific method many of the mysteries surrounding nature have been dismantled. Most beliefs – superstitions and myths bewitching the human mind have been eroded by the knowledge of science.

The scientific image of the world affects every corner of human experience. It has given rise to a new temperament, a new faith in the power of reason to reveal the structure of things, it places new demands on political thought, ethics, religion, and psychology to establish their credentials on a similar basis.

Given the achievements of science so far, scientists believe that science can answer all philosophical and religious questions. They believe that any question that cannot be answered using the standard of scientific methods should be regarded meaningless or rejected (among such schools are logical positivism and logical empiricism). Yes, science has its area of study, this has circumscribed its area of competence, and using its method other areas of knowledge cannot be reached. Thus science has its limitations. That is, there are questions science cannot answer. Such questions are: How is science possible? Is science universally competent? Can science yield accurate pictures of hidden objects, mechanisms and processes? Can science discover all truth, or are these questions to which science simply cannot be made to apply? Is science our only route to knowledge? If science cannot operate in a given area, must we remain forever ignorant of that area? And what clams does science have on us? Are there ever situations in which we ought to reject the deliverance of science even though they seem rationally impeccable? These questions and others would be critically answered in the course of this writing.

Though science claims all-round knowledge, within itself, certain things are taken for granted. The presuppositions and assumptions of science cannot be subjected to scientific explanations. The presuppositions or foundational bases of science tend to limit science. They are what science itself cannot explained (using its method). This brings us to the area of metaphysics (philosophy). It is here that philosophy finds a place within itself for the successes of science. Science as we will see rests on unchallenged assumptions which deserve philosophical analysis. Also we will see, how metaphysics feared by scientists provides a background for science.

Those areas about human activities which limit scientific explanation are within the domains of metaphysics, ethics, religion, etc. The presuppositions taken for granted by science are the metaphysical provisions of science. So rejection of metaphysics means the destruction of the foundation of science.

The task of this writing is to critically assess the methods and operations of science with a view to locating the limitations of science. It will attempt to answer those questions raised above concerning the foundation of science. That is, whether science can within its domain of jurisdiction justify itself. Accordingly, this essay will proceed with the definition of science, and the critical scrutiny of the scientific method with a view to laying bare the presuppositions of science. The limitations of science will be seen as a critique of scientific knowledge in this essay.

II. What Is Science?

Science is a discipline, which is systematic and comprehensive. It is difficult to give a universally accepted definition of science. Science has been defined variantly by different people depending on the angle the discipline interests them. Etymologically, science is derived from the Latin word SCIENTIA which means knowledge. But then to define science as knowledge has its own problems. It gives the impression that science is the totality of knowledge and the totality of science is knowledge. It also suggests that since every field of knowledge constitutes knowledge, that all the fields of knowledge are by the same token scientific. The

definition of science as knowledge is part of the effect, the overwhelming attraction of science brought in the wake of scientific development.

Knowledge is a generic term that applies to different areas of human knowledge. The need to modify this definition has given rise to as many definitions as definers. For something to be a discipline implies that it has characteristic methods, addresses specific types of questions, advances specific types of answer and carries with a fund of results as well as a characteristic sets of proposition. It is in this light we will look into some definitions of science.

According to N. Campbell, science is defined as "the study of those judgements concerning which universal agreement can be obtained". He also sees science as a well ordered activity of discovery and explanation of whatever has been discovered. Francis Bacon sees science as "a combination of comprehension of nature and conquest of nature". Similar to Bacon's is the one articulated by A. F Uduigwomen. In his analysis, science is seen as a study of the mastery of man's material environment. (53). This implies the application of scientific knowledge, principles, laws and theories in solving man's environmental problems.

For Karl Popper, any meaningful definition of science must see science in the light of conjunctures and refutations (Aronowitz 8). It is the falsifiability of scientific facts that make them different from the moribund areas of human endeavour. Some others hold that science constructs theories on the basis of evidence in order to give explanation of facts. For Grace Umoren, "science is a systematic process of obtaining knowledge (and the knowledge obtained) through experimentation and empirical testing of speculations" (9). In this way, she sees it as a conceptual framework of interpreting the physical and its manifestation in terms of testable, falsifiable statements and theories supported by evidences and data.

In the view of Hempel, 'science seeks to explore, to describe, to explain, and to predict the occurrences in the world we live in" (1). According to him, scientific statements, therefore, must be checked against the facts of our experience, and they are acceptable only if they are properly supported by empirical evidence.

Science as we have seen is a kind of knowledge that deals with natural phenomena. It is a diverse discipline, this has made it difficult to reach a common datum of definition. For any definition of science to be acceptable it must both transcend the discrete meaning of particular sciences (like physics, chemistry, biology etc) and yet be inclusive of them all. For the purpose of this paper, science could be seen as the study of natural phenomena, in a systematized fashion all with the view of establishing patterns and rules that aid the reapplication in similar settings with similar results with the possibility of being tested, inter-subjectively verified, confirmed or refuted (confuted or falsified). This is to say that science is the activity of finding facts and then arranging them in groups under general concepts, and these concepts are then judged and tested by the factual outcome of the further actions which we base on them (Bronowski 211).

Unlike philosophy, science is concerned with material things and events. Science tries to provide natural explanations of events in its domain rather than explanations in terms of God's specific purpose or plan which is the area of theology. By this we mean that science is a way of explaining things, a way that ignores tradition and authority, which makes no reference to purposes and goals in nature, which represents the physical world as a mechanism moving according to its own law, not enmeshed with a spiritual force that guides it (Minton and Shipka xxvi).

A genuine science must be in tune with facts, and must get in touch with most of the relevant facts by experience and observation-in short by empirical process. In this sense, scientific explanations must operate within empirical constraints. Within the empirical constraint, science must exhibit some degree of objectivity in handling the empirical data. In one of his lectures, Prof. G.O Ozumba (of Philosophy Department, University of Calabar) articulated that the primary objective of science is to explain the phenomena of the physical world. This it does by developing answers, conceptions of the world that have clear and logical bearing on our experience and as such are capable of objective test.

Giving the above features, natural science is a theoretical explanatory discipline which objectively addresses natural phenomena with the general constraint that (1) its theories must be rationally connectable to generally specifiable empirical phenomena and that (2) it normally does not leave the natural realm for the concepts employed in its explanation (Ratzsch 15).

For every discipline, there is a method upon which it goes about its business. Science has a method called scientific and it claims with this method that it could arrive and explain everything. In the next section we will expose this scientific method. Here we will find out if science with its method could answer questions like: Can science provide answers to all the problems of mankind? Are there other areas of knowledge open to man which compliment science in entrenching man into understanding the reality of the universe? How was the scientific method arrived at?

III. What Is Scientific Method?

If we look at all the sciences not only as they differ among each other, but also as each changes and grows in the course of time, we find that constant and universal feature of science is its general method, which consists in asking. Is it so? To what extent is it so? Why is it so?

By scientific method we mean a definite procedure of carrying out scientific reasoning. In other words it is the persistent application of logic as the common feature of all reasoned knowledge. From this point of view, scientific method is simply the way in which we carry out experiments, test impressions, opinions, or surmises by examining the best available evidence for and against them. Scientific method is related to the type of object that is being investigated or studied. This means that scientific method is bound to change or vary from one scientific subject to another. For example, the physical sciences are concerned with material objects. In the biological sciences the objects of study are living things, chemistry studies chemicals while that of astronomy studies about the heavenly bodies. It is therefore clear that these different fields cannot use the same method. The methods vary and yet described as scientific. It is therefore confusing to talk of scientific method as if their exists a uniform method that is used in all the sciences.

However, it is important that the term "scientific method" refers to not really the method which the scientists use in their discoveries or experimentation. Rather, it refers to an attitude of the mind. It refers to the sense of rigor, rationality, objectivity, thoroughness, incisiveness (or detail), logic, consistency and coherence with which their inquiry is carried out. This attitude of mind when present in any programme of inquiry is said to be scientific. It is only when scientific method is understood in this sense that ambiguity is minimized or eliminated. It is in this understanding that Cohen and Nagel say "… but in essence scientific method is simply the pursuit of truth as determined by logical considerations" (192).

In the scientific parlance by scientific method, we mean the process of deduction and induction. That is, the method of science is either inductive or deductive. By deductive method, we mean the pattern of reasoning from general to particular, induction on the other hand is the pattern of reasoning from particular to general. Modern science is often contrasted with the science of antiquity as being inductive while the latter was "deductive". Accordingly, deductive and inductive reasoning are antithetical modes of inference.

Deductive logic (reasoning) is believed to be concerned with the conditions under which particular or instantial propositions are inferable from universal premises. Inductive logic (reasoning or method), on the other hand, is conceived as dealing with those inferences which enable us to derive universal conclusions from particular or instantial premises (Cohen and Nagel 273). Most of the scientific truths are arrived at through inductive method. In contrasting inductive reasoning with deductive reasoning, A.F Uduigwomen says "… While induction is the hallmark of science, deductive is regarded as the hallmark of logic" (72).

The insistence of modern science in inductive method is the acclaimed superiority of inductive method over deductive method. Such claim holds that inductive method of scientific inquiry is integrally connected with the discovery of scientific laws and theories. The advocates buttress their claim by saying that whereas the inductive method enables us to make a leap from the finite data of observation to a law covering all that are (i.e known present) and all that will or could be (i.e predicted future), deductive method can never advance to knowledge of the hitherto unobserved" (Uduigwomen 73).

Modern science uses inductive method in arriving at its truth. The function of science is to establish general laws covering the behaviour of empirical events or objects with which the science in question is concerned, and thereby to enable us to connect events, and to make reliable prediction of events as yet unknown. This process is known as inductive reasoning. All empirical sciences use this pattern of reasoning. Bringing induction to the simplest clarity, we mean a justification of a universal statement after the examination or observation of a finite number of cases. Inductive inference is described therefore as leading from premises about particular cases to a conclusion that has the character of a general law or principle (Bronowski 10). The conception of how scientific laws or theories are arrived at is called inductivism.

In inductive inference, we are given the impression that all the premises are probabilistic and as such the conclusion will be probabilistic. For example, we say that the statement
A is a Raven and it is black
B is a Raven and it is black

So far all Ravens observed are black and we therefore conclude that every Raven is black. Here we find that we have started with a particular and then to a more inclusive observation and then a general leap which says that all ravens are black. The danger here is that the next raven open to our observation may not be black. And one recalcitrant instance destroys the conclusion (Cohen and Nagel 278).

In scientific inquiry, it is taken that inductive inference from antecedently collected data leads to appropriate general principles but a close examination shows that all such generalizations are not conclusive but rather highly probabilistic. The following steps are found in an ideal scientific inquiry

(a) identification of problems – conceptual or empirical problems that can be investigated
(b) collection of relevant information through consultation of the library of knowledge
(c) formulation of a working hypothesis
(d) making inductive derivation of generalizations from analysis and classification of data collected and
(e) further testing of the generalizations (Hempel 11).

We can summarize the discussion of conception of scientific method by noting its three main components: hypothesis, deduction and tests. A hypothesis (theory) is formulated to account for the observed facts, from this general hypothesis we deduce a particular conclusion or as yet unobserved (inferred) fact; the particular conclusion is then tested and inferred fact is observed, the hypothesis is said to be confirmed. It is the confirmation of hypothesis through repeated tests that provide the ground for the formulation of laws.

The process of inductive method of science provokes a lot of questions. How valid is scientific method? Is it not a presupposition of science? Can the method of science (inductive reasoning) be justified (verified) as it is claimed to be the hallmark of science? On what foundation is the method of science? On what foundation is the method of science built? How can we possibly arrive at a hypothesis about unseen or unseeable entities? Is this not a problem of discovery? Those questions about inductive method will be critically assessed in the subsequent sections of this essay. Our next point of critical inquiry is the presuppositions of science as embedded in scientific method.

IV. The Presuppositions Of Science

In science, it is taken that with scientific method in operation (via naturalist concepts) all areas of inquiry would be answered competently. To some extent scientific explanation has promised well but there are areas science cannot completely claim knowledge of. If science justifies through explanation, (testing) of natural phenomena, then are natural phenomena the only reality? Are there no other areas of which science is incompetent to explain? Can science justify the base upon which it thrives? Can science justify some of its assumptions taken for granted or even the method it uses? Is there any metaphysical undertone in the method of science? These will we find out by critically looking into the presuppositions of science.

From at least 17^{th} century it has been recognized that some of the principles necessary to science are not empirically provable. It was David Hume who argued convincingly that the uniformity principle could not be proven by any means available to human. Yet most scientific generalizations depend on the assumption that nature is uniform. We cannot establish by experiment that nature is uniform, and that principle is not obviously analytical. We could see if explanation and prediction depend on general principles which rest on this uniformity principle, then scientific results will always be less than absolutely proven. There will always be at least a bit of ineradicable tentativeness to scientific results.

It has been argued that in order to preserve the rationality of itself, science requires some basic principles. These principles are the presuppositions which anchored on metaphysics, accepting Hume's conclusions concerning the logical and empirical unprovability of uniformity, Kant argues that various categories and principles of thought were built into the very structure of our minds and into the very operation of our conception. It is in this respect that G.O Ozumba argues in one of his lectures:

However, it is important to understand that the term 'scientific method" refers to not really the method which Scientists use in their discoveries or experimentation. Rather it refers to an attitude of mind.

Supportively pushing this argument further, John Ziman argues that "the credibility of science cannot be decided by formal logic, or by appeal to computer program, it depends on intuitive human capabilities such as pattern recognition, problem solving, and the interpretation of language" (91).

Ratzsch argues that there are a lot of philosophical assumptions which characterize science. And in spite of over years criticisms against such foundation, science has not been able to extricate itself from metaphysics. Though science claims to be empirical, the standard of its empiricality cannot be justified.

The following assumptions according to Ratzsch characterize science (17).

1. It has been historically assumed that nature is understandable. Were there no prospect of understanding nature, we would have less motivation to study it. This is what is called faith.
2. It is also a presupposition of science that nature is uniform, that processes and patterns which we see on only limited scale (since we have not examined all of creation, (nature) nor have we seen it during its entire existence) hold universally. Were that regularity not assumed, we could have no reason to think that laboratory events observed here and now could tell us about processes in the interior of distant star far in the past.
3. Nor could there be any grounds for believing that casual connections discovered yesterday would still hold tomorrow, that nature is predictable or that scientific results should be reproducible. (Here, Ratzsch traces this faith in the universality and stability of the basic rules of nature back at least to the Ancient Greek).

4. It is also a presupposition of science that observable patterns in nature provide keys to unobservable patterns and processes eg. Atom, molecules etc. The scientists have faith and confidence of the existences of these entities on the basis of larger – scale things that human can see: Cloud chamber tracks and so forth. Stressing further, Ratzsch argues that although those presuppositions are widely accepted, the metaphysical systems which originally supported them are not, and so philosophers and scientists in this century have looked for justifications for them. Sometimes they have wondered whether there are any.
5. Similar concerns have arisen over the objectivity, rationality and empiricality that are thought to characterize science. Why should science have those properties? Against this question, it has been argued that the nature of science must reflect the construction of reality, and that in some ways those properties of science are such reflections.

Ratzsch equating science with the Christian belief in God, sees the presuppositions of science as faith in God. Just like certain beliefs in Christianity cannot be logically and empirically be established, science assumes those fundamentals in order to justify its enterprise. It is on this basis that Ratzsch says.

The presupposition of rationality could be explained-because the world is the creation of a person who created with wisdom. We expect pattern, regularity and uniformity and we anticipate the understandability (at least in principle) of the world and the elegance of its pattern especially since the creator of the order in nature also created our reason (18).

Having in a nut-shell scrutinized the presuppositions of science, we will go further to critically justify their cognitive relevance in the practice of science. This leads us to the next section (limitations of science) which is the main task of this writing.

V. The Limitations Of Science

a. A Critique of Scientific Method

Science in its operation or practice claims knowledge and explanation of all physical phenomena. Science through its laws and theories have given explanation to the causal relations of phenomena and most of the things about science itself cannot be accounted for using the scientific method. There are areas of which scientific method cannot claim knowledge of. For the fact that scientific method cannot account for realities outside its boundary does not mean that those realities do not exist and cannot be accounted for by other means outside science and its method. The part of reality outside the boundaries of scientific explanation is beyond the competence of science.

Nevertheless, the prestige that science enjoys today is no doubt attributable in large measure to the striking successes and the rapidly expanding reach of its applications. Many branches of empirical science have come to provide for associated technologies, which put the results of scientific inquiry to practical use and which in turn often furnish pure or basic research with new data, new problems, and new tools for investigation.

In spite of the achievements of science, there arise questions on the competence of science. In order not to loose focus on our task, we raise these questions once again. Are there areas within which pure science cannot directly speak of? Can science discover all truth, or are there questions to which science simply cannot be made to apply? Is science our only route to knowledge? If science cannot operate in a given area must we remain forever ignorant in that area?

In attempt to proffer answers to these questions we begin with the validity of scientific method or the proposition of scientific methodology. The method of science is either induction or deduction or both. The snag in induction is that its truth or inference are not certain. The scientific conclusion or truth arrived at by way of induction is always probabilistic. For example 'A' is a Raven and it is black. 'As' so far observed are Ravens and they are black, therefore every Raven is black. Here we find that we have started with a particular and then to a more inclusive observation and then to a general leap which says that all ravens are black. The danger is that the next raven open to our observation may not be black and such instance renders the conclusion invalid.

Deduction as an alternative method, its inference suffers the same fate with induction, the problem here is that most inferences also take the very first step in the spirit if induction. Accordingly, to say that nothing is so and so or that things are so and so, we can only boast of having examined finite number of cases before general proposition which is only assumption. There does not seem to exist a veracious starting point upon which to base our conclusion. A good example comes into focus-when Descartes embarked on his deductive mission of finding a starting point upon which to build his entire knowledge, he committed the fallacy of overgeneralization. "I think therefore I am" involves so limited an examination that its standing as a confirmed particular case is inconclusive. Deductive method is given less priority in scientific inquiry. Inductive method is prepondently used in scientific investigations although its conclusion is highly probabilitistic.

Considering induction as scientific method, it has been criticized by many scientists as something that cannot be proved empirically or logically. It is something assumed in order to give organization and order to facts. David Hume (being the first) philosopher to give concern to the problem of induction) says that no justification of the principle is possible.

Accordingly, justification is providing reason for beliefs, and reason is concerned with methods of inferences, and inferences very broadly are either deductive (he calls its "demonstrative") or inductive (he calls it "probable", "causal" or "emperimental"). Hume proves that no reason, of either kinds could support the principle of induction, the principle which itself is the principle of non-demonstrative reasoning (Zabeeh 172). Arguing that the principle of induction cannot be supported either by deduction or induction. According to Hume (quoting Zabeeh as he quoted the "Enquiries")

All experimental conclusions proceed upon the supposition that the future will be conformable to the past. The endeavour therefore, the proof of this last supposition by probable arguments, or arguments regarding existence must be evidently going in a circle, and taking for granted which is the very point in question (180).

Induction has also been criticized by William Whewell. In opposition to induction as the standard of scientific method, he argues that induction was a conception supplied by the mind and superimposed upon the facts (Brody 93). By this, induction as the formulation of a hypothesis is not mere generalization from observation nor is it an additional observation, it is a creation of the mind. Once the mind supplies this hypothesis, the hypothesis can be tested. For example, (many scientists believe that) Kepler was able to formulate a hypothesis about the orbit of Mars that fits all of the known facts at that time, suggested new facts and was eventually confirmed by experimental tests. According to Boruch Brody, Kepler did not simply generalize from the observed elliptical orbits of the planets. He had to 'see' those orbits in the data. But although the data suggested the idea to Kepler they did not logically imply what Kepler saw (93).

Also in the same opposing camp against the principle of induction validity is Bertrand Russell. He concludes that the general principle of science, such as the belief in the reign of law, and the belief that every event must have a cause are as completely dependent upon the inductive principle as the beliefs of daily life. Stressing further, he says

All such general principles are believes because mankind have found innumerable instances of their truth and no instances of their falsehood. But this affords no evidence for their truth in future, unless the inductive principle is assumed (Burr and Goldinger 525).

Going by the non-justification of the principle of induction which is the basic element of scientific truth and progress, one will infer that the assumption of induction is metaphysical. Science cannot justify itself on this basis. The principle of induction is one of the unresolved metaphysical issues. Unless science accepts that its presupposition (induction) is metaphysical, then the truth of science is skeptical. This brings us to these questions: is the principle of induction self-evident? If it is, this would be tantamount to rejecting empiricism (which seems to inform science with its foundation). If it is not, then any attempt to prove it would be doomed to failure. Should the principle of induction be transformed into an article of dogmatic faith. But dogmatic faith and science supposedly are mutually exclusive. This bring us to the realm of metaphysics – that is we can never be sure of the truth and certainty of science (theories), if any is true.

Consequently, science does not vanquish metaphysics after all it is on this ground, that Russell himself says that Hume has been able to demonstrate that pure empiricism is not a sufficient basis for science. On this understanding, we come to the conclusion that there is something transcendental about science. Russell stresses further, that from Hume's argument, it becomes incontrovertible that induction, being an independent logical principle is incapable of being inferred either from experience or from other logical principles and that in the absence of this principles science will definitely not be possible (Uduigwomen 82). Having seen that science is limited by the non-justification of the principle which is the basis of scientific method, we go to the issue of methodological consideration in science.

The issue of methodology is another problem limiting science. There is always the possibility of prescriptive methodology in the operations of science. This brings us to the question of a generally acceptable systematic way of generating hypotheses. This is the problem known as the "logic of discovery" and although a great deal of intensive work has been bestowed on it, no generally applicable pattern has emerged. So far methods of experimental inquiry (methods of discovery) are methods of the discovery of causal connections – that is, for the verification of laws – but not the discovery of hypothesis. You will agree with this writing that the issue of hypothesis is the issue of human value (which is into play in scientific enterprise).

The methodological construction of theories (like Newton's) which explain observed events by references to unobserved things is the main function of science. For Ernst Mach and Karl Pearson, science is merely an accurate and economical description of the world, whose practical task is to enable the scientists to make predictions. As a reaction against unified methodology, Mach is of the opinion that it does not matter what method the scientists follow to do this so long as the predictions come out right, that is with high probability.

In the same token, science has been criticized for lacking justification for any methodological prescription. Most philosophers of science are of the view that the tendency for methodological considerations is probing into metaphysical or epistemological one which is characteristic of contemporary work in the field (foundations of science).

If we look into the different methodologies as operationalism (of Bridgman), simultaneity (of Einstein), instrumentality, conventionalism, pragmatism, etc., we will see that the justification of superiority of one methodology over another cannot be logically and empirically ascertained. It is in this direction that philosophical content of science (as a discipline) has changed, the search for a unique scientific method seemless urgent than it once did. It is clear that there is no such thing. This leads us to infer that the method of science is a mixture – the properties of which vary from one science to another – of logical construction and empirical observation, the component standing in a roughly dialectical relation.

On the epistemological status of science other questions arise. When we adopt a scientific theory concerning, say, unobservable entities such as elections or quarks, does science give the right to say that we know that those theories are true? Can science yield accurate picture of hidden objects, mechanisms and processes?

In the light of these questions, the cognitive status of theories have provoked and attracted criticisms from many quarters ranging from seeing theories as the creation of the mind to its non-existence as an entity (dependent on the mind). The realists claim that theories are explanation of realities that are meaningful to people that belong to the relevant scientific community. In reaction, the idealists believe that theories are ideas that subsist in the mind, they do not have any independent reality outside the mind.

The problem with theories (ie in its claim to cognitive status) tends to limit the competence of science. In science, it is noted that some concepts used lack full definition, this leads to axiomatization where presuppositions of principles provide the base for scientific operations. This principles are aprioric in nature. Being aprioric in nature make science not empirically defensive of itself. The process of axiomatization in our view has a metaphysical undertone.

In the same standing, the lack of specific definition of concepts makes application of theories complex. A theory may be applicable to many bodies of empirical findings: By this we mean that there is the difficulty of knowing to which area a theory applies. The issue of relativization of theories is germane at this point. These are conceptual problems. The fact of the possibility of alternative theories is also a problem as far as the problem of choice, simplicity, testability, relevance, and adequacy is concerned. It is in this regard that Ratzsch says And if subjective and human factors affects at least some of our thinking, perceiving and theorizing, why think that the way we happen to (or have to) theorize about reality even could be exactly the way things are especially in the light of some of the startling results of 20th century quantum mechanics and relativity (85-86).

Ratzsch goes further to say that data undermine theories, i.e., they do not prove or establish any specific theories, and any body of data can be explained in any number of alternative theoretical ways.

Another argument we adduce against the existence of theoretical entities (e.g electrons, atoms, molecules, quarks etc) is the view that scientific inquiry is aimed, in the last analysis, at providing a systematic and coherent account of the facts, of the phenomena we encounter in our sense experience. And its explanatory assumptions should strictly refer only to entities and processes that are at least potential facts, potentially accessible to our senses. Hypotheses and theories that purport to go essentially behind the phenomena of experience can at best be useful formal devices but not claim to represent aspect of the physical world. In this standing, we say that theories are rather the result of creative insight on the part of humans.

In view of the above, we posit that theories do not arise automatically from observational data. Contrary to inductivist views, the situation seems to be when scientists collect data, they have to have some presuppositions, some idea of what is or what is not going to help this particular study (Ratzsch 24). Here the scientist's personal value comes in. This leads us to the question of objectivity in science.

Science claims the objectivity of knowledge in its enterprise of description, explanation and prediction of events. It has been criticized as lacking objectivity since the scientific activities are within the domain of some principles and these principles are the human values. For instance, the collection of data as they come to one with no selection principles the result would be a collection of bits of information largely unrelated to each other and probably irrelevant to whatever one is studying. But the fact is that scientists must organize their data, and they do so in accordance with prior suppositions or theories about what is related to what, what items are of the same or distinct kind and so on.

If those hypotheses and theories, although sometimes suggested by empirical data, are at least in part the results of subjective, inventive human processes and if they in turn direct data collection and organization, then is not the objectivity in science compromised? On the prior suppositions, we say the complete objectivity and empiricality of science is confuted as they are product of human value which cannot be proved by science itself. The lack of any presuppositions or a prior restraints on the process guarantees its objectivity. Basing the entire process on empirical data alone guarantees its empiricality (Ratzsch 23). Of course we have noticed that

science cannot be done at all in the absence of presuppositions about uniformity of nature, the consistent operation of causal mechanism and so on.

The idea of conventionalism as adduced by Henri Poincare indicates that the convention of science is a creation of human spirit. Like Kuhn, Poincare sees "laws and theories as conventions which if experience does not compel the scientists to adopt a specific convention, at least guides him in one direction rather than another (Passmore 329).

If we should follow Poincare, it means that if laws are conventions, definitions in disguise, the language (atoms, molecules, ions, electrons) we deliberately construct in order to talk about the movement of particles, then the scientist is a creator, however, on the face of conventionalism (or Kuhn's paradigm), Passmore says "this doctrine destroys the objectivity of science, converts it into a species of poetry (328).

In shaking or denying the complete objectivity of science, this paper agrees intoto with Ratzsch when he writes:

… science has progressed historically by virtue of employing values, and that success can be explained in part because such values nudge science towards the truth, and that the closer a theory is to the truth, the more successful and powerful it will be (95).

b. **The Indispensability of Other Areas of Knowledge**

So far, we can see that science which claims to be the embodiment of all knowledge has certain things which it cannot itself explain via its method. This again tells us that there are areas of knowledge that are beyond the competence of science. That is, science cannot pass judgement on proposition of Ethics, Aesthetics, Religion, Metaphysics etc. It is also in the light of this, that limitations of science are properly understood. This answers the question: What are the areas within which pure science cannot directly speak of?

The area which is metaphysically beyond the validation of science is the foundational principles of science (i,e, accepting those foundations as legitimate or rational). Here the justification rests on something other than scientific method. If science can not justify its foundation (within its method), then there are some non-scientific justifiable bases for accepting science. This means that science cannot be the only basis for beliefs. For there to be a well established system, there must be recourse to metaphysics. It is in this regard that Nicholas Rescher argues "only through metaphysical propositions can systematic uniqueness be assured" (165).

Given this position, we can see that science cannot give any ultimate naturalistic or mechanical explanation for the existence of the universe with which it deals. For example, the issue of gravitational force is used to explain other things (it serves as principle for explanation of falling bodies and movement of the universe) but its explanation lies beyond itself. To make explanation of phenomena, one needs prior principles. To explain those prior principles, according to Ratzsch, one must have prior principles, and so on. Ultimately, one must just take some foundational principles as given, and those given will a fortiori not be either generated or explained by science. It is in support of this that we buy the view of Trigg. Thus:

We must transcend our particular limitations and show how this is possible, if we want to reach out to a mind – independent reality (121).

Consequent upon this we may ask: can we arrive at a conception of reality which explains how this conception came about and how adequate it is as a description or explanation of this reality? In answer to this, Cathy Legg asserts that this is possible if we appeal to metaphysics for an independent validation or grounding, of this conception (678). In view of this, we can say, on validation, science is limited by its own invalidation.

On the issue of the ultimate purpose of our existence or of the universe, science is lacking. The belief in purposes cannot be observed, and therefore cannot be addressed by the methods of natural science, which are tied to observation. Outside science, it has been taken that observables are linked to purposes. In human relations observations are connected to human purposes, intentions and so forth, these, science cannot legitimately validate within its own domain. It has been argued that, the fact that science does not make use of the concept of ultimate purposes in no way suggests that the concept is not meaningful or important.

It is also argued that the method of investigation that is deliberately restricted to the naturalistic (or the purely material or mechanistic) will not be competent to deal with most of the fundamental questions of morality and value, psychology, theology and religion, philosophy and some other areas as well.

The empiricists (especially logical positivists) have been attacked against the denial or non-cognizance of concepts of ethics, philosophy, theology etc. The positivists seriously deny such concepts and where they admit the legitimacy of such notions, they try to correct their "deficiencies" by molding them into shapes which conformed to what were taken to be the demands of natural science. For instance "murder is wrong" cannot be seen as meaningless by the positivists or reduce to scientific or naturalistic interpretation. This is the area of ethics. On this platform, we accept the position of Ratzsch when he argues:

If the methods of natural science as now practiced are indeed inappropriate for those areas, then extending natural science into them will inevitably involve a reduction at some point, and some segment of reality will get distorted and deformed as it is forced into an inappropriate conceptual cage (102).

In line with Ratzsch, we adduce that any attempt to extend natural science into ethics or religion is mistaken. Also, the reduction of ethical or moral and religious concepts suffers category mistake. What sets those other areas off both from natural and from each other is the applicability of characteristics, descriptive and explanatory concepts which are not appropriate to purely natural science, but which are essential to the area in question (Ratzsch 104). For instance, one cannot do justice to ethics without concepts of 'right' and 'wrong' (and justice). There is often appeal to reason in explaining human actions. Theology loses its content if one is not allowed to talk of God, sin and salvation. In all, we notice that these three areas require the notion of responsibility.

Another area of limitations of science we want to bring into focus is found within the domain of science proper. These limitations result from the facts that it is humans who do science. The possibility of doing science depends on human fundamental intuitions concerning what is or is not conceptually feasible. Science depends on (the conscious) variety of human normative concepts, such as: What is good evidence, what conclusions can be rationally drawn, and what is the right way to proceed. It depends on human conscious processes, on human perceptual abilities, on available technology, on the available funding (research of interest) which often depends on the quirk of politics. It is on this basis we see the view of Steven Rose comes in handy:

Choices made in a variety of different places by a variety of committees, taking specific decisions about what sorts of science and technology to develop, and what sorts of science and technology to ignore. These are intrinsic to the current development of science (130).

Given the above positions, we have no good reason to be confident of our infallibility, and even if we try to be objective in order to avoid error and distortion, our values will always dictate the result. In this mirror, we cannot say that our fallenness and finitude do not play role in science.

In view of all these points articulated above we hold that science has deficiencies and limitations. There are many areas of reality of which science with its method is not competent to make a claim. Because those areas elude science, should not be the reason why they do not exist as claimed by the empiricists.

VI. Conclusion

We appreciate science in the light of its progress in the enhancement of human life, and in providing to some extent explanation of phenomena. Scientific progress requires that more and more new information (discoveries) will be added to man's knowledge of the world. Science is a great expedient by which the environment is subjugated to our will.

The basic aim of science (as appreciated) is the description, explanation and hence the prediction of natural phenomena for the betterment of the living condition of man. To some extent science has been able to tackle a lot of man's problems. A few examples justify this assertion. With adequate explanations regarding earth's movement, man can now boast of a good astronomical and metrological knowledge of the world, thus making possible the forecast of whether for aviation and farm production. Very heavy ships are used for transportation, exploration, fishing and warfare today as a result of Archimedes' explanation of why and how objects float (Uduigwomen 53). The achievements are numerous and inexhaustible.

As pointed out in this writing, scientific method is concerned with verification and conformability. And it is the confirmation of hypothesis through repeated tests that provides the ground for the formulation of laws. The formulation of laws (generalizations) constitutes the end product of scientific method.

In view of this, the importance of scientific method can be summarized thus: scientific method minimizes the shock of novelty and the uncertainty of life. And scientific method is one of the effective ways of strengthening the love of truth. It forestalls arbitrariness and enhances investigative vigor. It develops the intellectual courage to face difficulties and to overcome illusions. It is the way to increase the general body of tested and verified truth. Scientific method limits our pretensions and supplies us with corroborated truth. Above all, the spirit of scientific method will continue to hunt other fictitious means of attaining the truth. (40) It is in support of these values that A.F Uduigwoem writes: "Among other achievements science has to a large extent liberated man from dogma and superstition in the study of nature and man" (154).

However, science has its shortcomings or negative achievements especially in the area if depersonalization and alienation of man from his environment. Although it is not the position of this paper to give a detailed discussion of the pros and cons of science, mention should be made on them. For instance the memories of the destructions by the two world wars are pointers to this. The threat of nuclear warheads and environmental pollution have not given a good picture of scientific achievements.

Having shown on the areas where science is competent, we are of the view that such achievements should not be overemphasized. Science as highlighted above is not the only avante garde to knowledge. The prominence given to science has challenged other areas of knowledge to the extent that philosophers have to turn back to critically assess the competent of science. It has been made clear in the course of this essay that science is an aspect of knowledge and therefore cannot tell us everything.

In view of this, we can completely say that science is pretentious of the claim of comprehensiveness of knowledge. If any part of reality lies outside the boundaries imposed on science by its methods, that part of reality will be beyond the competence of science. It is the position of this writing to hold that, if any knowledge is artificially restricted to scientific knowledge, we will thus be sheltering ourselves and our beliefs from the relevant portions of reality. Those who restrict science to the material, but wish the authority and competence of science to be unlimited, have responded to the claims that natural science cannot accommodate the concepts of ethics, philosophy, theology and metaphysics. Even in science there has not been consistency in what science claims to be its arena. This is why Alozie says "In science, Isaac Newton is correct from the point of Newtonian physics. Newtonian physics might be flawed from either Einsteinian or Heisenberg's perspectives in physics (Uduigwomen viii).

Consequent on this, we say that natural science has its limitations, and pushing it into areas beyond its jurisdiction comes at the cost of violence to the invaded areas, and without much particular profits especially if one has an outdated conception of science (eg. the positivists or empiricists) as those behind such attempt almost always do. Whether one finds such attempts promising to not, it can be seen that when questions such as those of ultimate origins arise, scientific method cannot be effectively applied.

In the face of that applicability, we cannot fruitfully investigate such questions at all. In short, scientific method does not work there, we cannot escape from sheer speculation, subjectivity, prejudice and ignorance. Common as that position is, we have already seen that it is incorrect. If science itself is legitimate and can be rationally accepted, then since it cannot validate itself, there has to be some other legitimate means of validation. The price of holding out for science as the only legitimate basis for belief is the illegitimacy of science itself, and that seems too high a price. The dismissal of metaphysics by the logical positivists means we cannot reflect on the nature of science ie we cannot justify it, providing rational ground for it. The validation of science is metaphysics (philosophy). It is in this respect that Prof. G.O Ozumba says "the spirit of critical and valuidated inquiry is philosophy, while philosophy clothed with objectivity, repeatability, systematicity and practical creativity gives rise to science". Hence we say first philosophy (metaphysics) is then defended as the source of the criteria, or more generally as the provider of the framework within which science can operate.

The view that all legitimate human knowledge had to be validated on the basis of science (sensory observation) was a dogmatic and misconceptual epistemological standard of knowledge (of the logical positivists). This standard cannot be logically and rationally established. In the words of Watkins "such standard is the scientists religion" (33).

It is true that science, of course is the human discipline which deals most explicitly and thoroughly with the observable, and many saw it as the most spectacularly successful epistemological enterprise ever (Ratzsch 36). On this achievement, we ask: Did this mean that all human knowledge was scientific knowledge? What science did not know or could not know was beyond the range of real knowing. The above assumption of the positivists misses the mark. If science knows only the empirical and what follows from it, and if science is the only human access to knowledge, then human knowledge is restricted to what is physical and material. How do we account for religious knowledge, ethical knowledge, etc? If what science can know is the material, then the material does not provide the whole truth. The question of God, the mind, sin, right and wrong, and justice are beyond the competence of science.

In the face of all these, we are of the view that the scientific psychology is dogmatic, materialistic, too narrow, at best merely partial knowledge. It is our position to say that what science cannot tell us other areas of knowledge can. For instance, if astronomy will not tell us if we will be lucky or unlucky today, then astrology will. Does science seem to make it difficult to believe God exists? Then our hearts inform us that he does exist. Does science fail to prove convincingly that we should all love one another and stop hating? Then mystical insight will supply the proof. The proofs of all these are metaphysical. This Fritjof Capra the theoretical high-energy physicist observes, "Science as a whole would be complemented by the intuitive ways of poets, psychics, mystics and many other equally valid approaches" (Alozie 79).

The human yearning for mystery, drama, and meaning cannot be ignored. This is the metaphysical part of man. Even Kant who was himself a devastating critic of metaphysics had to admit that the human being had a natural and irresistible tendency towards metaphysics (Omoeregbe 133). By this, we know that man cannot live by science alone, it is in support of this position that Kurtz writes "these human longings can be satisfied by a deliberate cultivation of the arts in such a way as to richly complement rather than destroy critical intelligence …. (Burr and Goldinger 435).

In the same manner we agree with theologians who have incessantly argued that there are "limits" to scientific inquiry and that it cannot penetrate the "transcendental realm" and poets who have decried that deductive logic and experimental method which they claim denude experience of its sensuous qualities. Science cannot be censorious and intolerant, nor cut itself off from new discoveries (revelations) by making judgments antecedent to inquiry.

Consequent upon this, we say that extreme form of scientism can be as dogmatic as subjectivism. Science, as we have seen rests on unchallenged assumptions which deserve philosophical analysis. If there is a conflict between science and philosophy, it is not between two bodies of truth, it is an internal conflict within human experience as the mind struggles to form a comprehensive picture of the whole while the pieces in the puzzle continue to change (Minton and Shipka xxvi).

In this discourse, we have seen the limitations of science, the areas beyond the competence of science. Also, we have proved that science cannot validate itself. Its foundation is built on certain assumptions which presuppose metaphysics. In all science is not the only legitimate knowledge of reality. The empiricist philosophy of knowledge is destroyed by the traditional, moral and religious values. It is on this perspective we buy the position of Paul Feyeraben, when he writes "if justice is to be done comparing science with other forms of knowledge, a thorough investigation of the nature, methods and aims of science must be carried out simultaneously with those of other forms of knowledge" (Uduigwomen 115).

To bring this essay home (to conclusion), we enlist a quotation from A.F Uduigwomen's History and philosophy of science.

To see life be wholistically, we need science plus ethics, religion, philosophy, art and other disciplines. Since development is a multi-dimensional process involving man in all spheres of life, a combination of all will not only help mankind to regain its lost sense of human values of morality and traditional culture caused by the deification of science, it will also go a long way in putting society on the path of balanced development (155).

This view presupposes that science is an aspect of knowledge and is supplementary to other fields of knowledge. Other fields of knowledge will continue to be with man as long as their relevance remains part of human nature. This is justified by Paul Feyerebend's philosophy of "Epistemological Anarchism", which holds that there are as many fields of knowledge as they are of relevance to man (Akpan 335).

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