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DIALECTICS OF SCIENTIFIC PROGRESS IN KARL POPPER, THOMAS KUHN, PAUL FEYERABEND AND IMRE LAKOTOS: A HERMENEUTIC STUDY

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Abstract
From time immemorial, science and scientific theories have been in progress. This is so because since the creation of the universe mankind has been faced with multifaceted problems that require authentic solutions. To this end, many theories have kept on springing up in order to proffer solutions to those problems. Put in another way, so many theories have been expounded, all in a bid to take care of problems of mankind. However, these theories have given rise to such questions as; how do we account for scientific theories? How do we account for the truth and certainty of these theories? What method leads to scientific progress? In their various philosophies of science, Karl Popper, Thomas Kuhn, Paul Feyerabend and Imre Lakatos gave their account of the part to scientific progress. This study employs the method of Hermeneutics to explore the dialectical nature of those various accounts of scientific progress. The study highlights that the part to scientific progress is not a one way traffic endeavor; it involves some forms of dialectics in the sense that theories are contradicted and opposed. This contradiction and opposition in turn bring out the best in such theories or even give rise to a new superior theory. This study recommends that scientists and seekers of knowledge should equip themselves with the knowledge of the dialectical nature of science. When this is done, science would no doubt be immune from conventionalism and stereotypes.
Keywords: Science, Dialectics, Scientific progress

Introduction

From time immemorial, science and scientific theories have been in progress. This is so because since the creation of the universe mankind has been faced with multifaceted problems that require authentic solutions. To this end, many theories have kept on springing up in order to proffer solutions to those problems. Put in another way, so many discoveries have been made, all in a bid to take care of problems of mankind. However, these discoveries have given rise to such problems as; how do we account for scientific discoveries?, what method leads to scientific discoveries? How do we account for the truth and certainty of these discoveries?

Owing to the above questions, some answers have emerged by way of ideologies. In the first instance, "instrumentalists deny that scientific theories about unobservable can be accepted as the description of an observable world"[1]. This implies that for them, the world is an experiential world so that any description of it must be experimental too. In their own postulation, the realists have it that "science sets out to explain and understand nature so that theoretical entities are postulated in a true scientific theory to explain that observable phenomena are real"[2]. On their own part, the relativists submit that "there is no objective truth; truth depends on the community that claims it"[3]. This relativistic conception is rather problematic because it implies that there is no objective body of science. All these are in a bid to arrive at an organized body of knowledge called science. In this regard some philosophers of science believe that there is a method to

achieving that. There are some philosophers that projected induction as the road to scientific progress. That is to say that scientific hypotheses, theories and laws are arrived at by means of induction. But induction has its problem; the problem of justifying the inductive inference from the observed to the unobserved. This is the problem of hasty conclusion. However, induction is not seen as method in the part of scientific progress by Karl Popper, Thomas Kuhn, Paul Feyerabend and Imre Lakatos. These philosophers hold that the part to scientific progress is dialectic in nature. Thus, the purpose of this study is to demonstrate that what is regarded as science has both a process and a method that gradually leads to scientific law. This process begins by scientific hypothesis which later progresses to scientific theory and finally culminates in scientific law.

Hermeneutics Of Dialectics In Scientific Progress In Karl Popper, Thomas Kuhn, Paul Feyerabend And Imre Lakotos

Karl Popper

Karl Popper having criticized and rejected logical positivism expounded an entirely new system of demarcating science from other forms of intellectual enquiry. To be sure, Popper's notion of science is no doubt prescriptive in the sense that it portrays a method that scientific endeavours should follow. This method is falsification. Popper asserted that falsification would purify science from prejudice, speculation, assumptions and superstitions which are inherent features of non-science. So for Popper, for any hypothesis to assume a scientific status, it must be subjected to falsification. It is in the light of this that Popper presents falsification as a criterion for demarcating science from non-science. This way science has to aim at laws that are empirically testable and capable of surviving repeated attempts aimed at falsifying them. Corroborating this position, Antti Salovaara and Jani Merikwi opine that:

> The best theories are those that appear easy to falsify (e.g ones that provide surprising explanation or predictions) yet gain corroborating evidence, that is, survive repeated empirical attempts that seek to refute them. This definition was also Popper's answer to demarcation problem: theories should be falsifiable – formulated in a manner that provides a means for empirical examination that may lead to the theory's refutation. Unfalsifiable claims, in turn, would not be considered scientific.[4]

Popper's falsification simply entails that good theories make bold and empirically testable claims that have the capability of surviving repeated attempts of falsification. Thus, according to Karl Popper "scientific progress requires provisional falsifiable theories and their refutation that show where the existing theories need to be corrected".[5] Thus, Popper's demarcation criterion should not be seen in its own sake. Rather it should be seen not just as an endeavor that demarcates science from non-science but more as an endeavor that seeks to demonstrate the progressive character of science.

As it were, Popper's falsification opened a new vista towards understanding scientific progress. This is so because "scientific progress, following the falsificationist method, emerges from propositions of theories, their refutations, and replacement with corrected theories that better explain the phenomena of interest.[6] Therefore, falsification for Popper, is a fecund method in science in that it aids the growth of knowledge as well as aids scientists improve on their theories by way of observing the theories that are lacking the scientific character. While commenting on Popper's falsification, Magee outlines its procedure this way:

> 1. Problem (usually rebuff to existing theory or expectation), 2. Proposed solution, in other words a new theory, 3. Deduction of testable propositions from the new theory, 4.

tests, i.e attempted refutations by, among other things (but not only among other things), observations and experiment, 5. preference established between competing theories.[7]

For him, science progresses by means of conjectures and refutations; we make bold conjectures that are as testable as possible and unfailingly find them wanting so that they are refuted and new conjectures are formulated. This way, hypotheses are counted as scientific only if they are falsifiable. That is why Popper explicates that "in science, more often than not, scientists put forward statements and conduct step by step testing. Thus, in the field of empirical sciences, more particularly, he (the scientist) constructs hypotheses or systems of theories, and tests them against experience by observation and experiment."[8]

Thomas Kuhn

In his *The Structure of Scientific Revolutions*, Kuhn argues that Popper's characterization of science only applies to extraordinary science and never to normal science. This implies that scientists may try to employ falsification of theories during the research period of extraordinary sciences and not during the research period of normal science. He posits that "normal science accounts for the overwhelming majority of the work done in basic science".[9] Thus, Kuhn's supposition is that to be scientific is to engage in normal science. He stresses this point when he posited that "finally, and this is for now my main point, a careful look at the scientific enterprise suggests that it is normal science, in which sir Karl's sort of testing does not occurs, rather than extraordinary science which most nearly distinguishes science from other enterprises."[10]

Kuhn introduced his idea of paradigm change and holds that normal science goes for what scientists do when a paradigm would have been established, and it is followed by extraordinary science. Thus, in the Philosophy of Kuhn, three concepts stand out, namely; paradigm, normal science and extraordinary science. He defines paradigm as "the entire constellation of beliefs, values, techniques and so on shared by the members of a given community".[11] Kuhn went further to speak of normal science as a puzzle – solving enterprise. He views normal science as an enterprise that seeks to solve a puzzle (problem) in the field of knowledge. Here it is worthy of mention that what Kuhn refers to as "Normal Science' is what Popper strictly calls "Science" as against pseudo-science.

Just as Popper holds that there is a criterion of progress in science, Thomas Kuhn equally posits that progress in science does not involve a simple line that leads to the truth. He therefore, propose that it involves more progress away from less adequate conceptions to more and better conceptions of the world. This way, new theories are built on previous ones. As a matter of importance, Kuhn's proposition is that scientific progress comes by way of revolution. Kuhn cited 'The Copernican Revolution' as an example of revolution in science. For him, revolution comes through a paradigm shift. In the Philosophy of Kuhn, a paradigm could be regarded as an exemplar, which is the very best among examples.

It can also mean a model, a pattern and a template. Examples of such paradigms are scientific laws, theories, applications, experiments, etc. Kuhn explains that in the progress of science, each paradigm is the first port of call before a superior one takes over.

Paul Feyerabend

Another important philosopher in this philosophical voyage is Paul Feyerabend. In his book – *Against method*, he launched an intellectual attack on the rationalist account of scientific method which encourages the search for a system of rules that should guide scientists in generating scientific theories. Feyerabend argues that science does not have a specific method so that any tradition that can actually lead to knowledge should be encouraged and adopted in science. To

further buttress his position, he contends that there should be proliferation of theories as a means of making progress in science. Little wonder he posits that "variety of opinions is necessary for objective knowledge"[12] For Feyerabend, relying on method inhibits and obstructs progress in science.

Feyerabend, like Popper, rejected induction as a method in science on the grounds that "induction is insufficient because it is bound to eliminate ideas simply because they do not fit into the framework of some older cosmology, but proliferation of theories leads to development of counter induction which is both a fact and is needed much more in the game of science".[13] Feyerabend also upholds the same view as Popper that the task of science is to give us a correct account of the world. Recall that Popper calls it satisfactory explanation about the world. Suffice it to say therefore, that Popper and Feyerabend argue that science has an aim and a goal which is to provide a correct account or satisfactory explanation about the world.

However, there is a point of divergence in Popper's and Feyerabend's account of science. While Popper expounded the method of falsification, Feyerabend, on his own part accounts for methodlessness in science. Rather, he proposed 'subjective wishes' of individuals as a way forward for growth and progress in science. According to him, it is these 'subjective wishes' that makes it possible for different individuals to exhibit freedom in the enterprise of science. An interesting thing in the point of divergence between Popper and Feyerabend is also the point of convergence between them; a critical and an analytic look at the 'subjective wish' of Feyerabend reveals a point of confluence with Popper's notion of conjecture. In popper's conjecture; the individual has freedom to hazard a guess. Thus, at the level of conjecture, science is not yet born just as it is with 'subjective wish' of Feyerabend. This simply goes to suggest that in the position of popper, science comes to being when conjecture assumes an objective status. In a similar fashion, in the position of Feyerabend, science is born when 'subjective wish' translates to objectivity.

Imre Lakatos

Imre Lakatos knowingly or unknowingly developed Popper's idea of falsification. In his Philosophy, he demonstrated how Popper's falsificationism has actually contributed in the history of science and Philosophy of Science. Lakatos projected what could be regarded as 'sophiscated falsification' whereby series of theories can combine and over time mature into a better theory. He called it research programmes. It is interesting to note that although Lakatos did not totally agree with Popper, he did not as well discard the principle of falsification. Instead, he proposed some changes as to how falsification should be adopted. Thus he stated:

> According to my methodology the great achievements are research programmes which can be evaluated in terms of progressive and degenerating problem shifts; and scientific revolutions consists of one research programme superseding (overtaking in progress) another. This methodology offers a new rational reconstruction of science. It is best presented by contrasting it with falsificatism and conventionalism, both of which it borrows essential elements.[14]

In his *Methodology of Scientific Research Programmes*; Lakatos expressed a somewhat radical view of popper's criterion of demarcation between science and non-science and contends that ' the problems of methodological falsification (Popper's falsification) are that we have no means to judge whether the theories of our successive theories decrease or increase and that methodological falsification lacks history of science".[15] Another interesting part of Lakatos' *Methodology of Scientific Research Programmes* is his mention of prediction and novel facts.

Expatiating on this, Wenceslao J. Gonzalez states that:

> Prediction appears in Lakatos' methodology of scientific research programs in at least three different levels: a) as an important aim of the research programs; b) as a procedure - a key method - to increase the scientific knowledge both theoretically and empirically; and c) as the way to access the scientific character of the knowledge claims - a form of evaluating results. At all these levels he (Lakatos) sees a connection between prediction and novel facts….. Moreover, the link between prediction of novel facts has an epistemological content which affects the methodological process of evaluating science according to the reliability of predictions.[16]

Lakatos sees prediction as the creativity of the human mind so that there is no limit to what the human mind can create. In making clear his point he holds that "all the research programmes admired have one characteristic in common. They all predict novel facts, facts which had been either undreamt of or have indeed been contradicted by previous rival programmes".[17]

In his subtle analysis and hermeneutic approach to Lakatos' position, Gonzalez opines that "Lakatos ordinarily uses prediction for the theoretical anticipation of a novel fact with a research program".[18] However, Lakatos somewhere in his book emphasized that "the novelty of a factual proposition can frequently be seen only after a long period has elapsed".[19] Lakatos went further to criticize the position of logical empiricists on their position that scientific hypotheses follows from the concordance with experimental data. Lakatos believes in the primacy of prediction.

Thus, for him, "new scientific hypotheses are assumed not simply in order to catch up gaps between data and theory but in order to predict novel facts".[20] According to Gonzalez, "Lakatos' conception considers a research program as degenerating when accommodating known facts, whereas he conceives that a progressive program is one which anticipates new facts".[21]More still, Lakatos posits that when the program ceases to anticipate novel facts, its hard core might have to be abandoned."[22]

In the Philosophy of Lakatos, prediction plays a very vital role in scientific progress and in the interpretation of scientific change. He sees scientific progress or change from point of view of superseding of theories. That is to say that "one research programme supersedes another if it has excess truth content over its rival in the sense that it predicts progressively all that its rival truly predicts and some more besides".[23] From the foregoing, one could see that the position of Lakatos is perceived more as a support to Popper's position rather than an attack. After all, Lakatos submitted that "a research programme is successful if it leads to a progressive problem shift and unsuccessful if it leads to a degenerating problem shift".[24] In similar view, he opines that "without falsificationist research, when faltering the inductivist research only, scientific progress halts".[25] Looking at the above, one sees a great similarity between Popper's Falsification and Lakatos' Methodology of Scientific Research Programme.

Evaluation And Conclusion

A critical look at the various accounts of scientific progress as expounded by Karl Popper, Thomas Kuhn, Paul Feyerabend and Imre Lakatos demonstrates that scientific progress takes on a dialectic movement. This is very much observable in the way scientific law is achieved which is from scientific hypothesis to scientific theory and finally to scientific law.

Hypothesis: Ifechi Ndianefoo defines hypothesis as "a tentative statement of fact to be subjected to further test before it can be accepted as confirmed"[26]. By this very definition, hypothesis in

science is understood to be probationary, which means that it has not been fully worked out or agreed upon. In expatiating upon the nature of hypothesis, Ifechi Ndianefoo avers that:

> A hypothesis by its nature occurs accidently and can arise from diverse sources. It may spring from deeper insight, intuition or hunch that ranges from spiritual, philosophical, mathematical to even common sense, for example, the intuition that Newton had about the gravitational hypothesis which later hardened into the law of gravity[27].

In the long run, hypothesis been a tentative endeavour implies that it gets to be acceptable when it is in line with a well – established fact. On the contrary, a hypothesis becomes false and not to be accepted when it is contrary to an established fact.

Scientific Theory: By its nature, scientific theory is superior to hypothesis but inferior to scientific law. This is so because it is an intermediary between hypothesis and scientific law in the dialectics of scientific growth. Scientific theory by definition "is an empirical statement offering explanation of phenomena based on already discovered regularities"[28]. In bringing out the non-finality nature of scientific theory in the scientific process, the explanation adduced by Ifechi Ndianefoo comes to mind. He hints that "theories are therefore regulated 'assumptions and explanations' warranted by the observed but only sustained by reason which seeks out the relationship between the observed and the hidden which is explained to be related to it"[29].

By this definition, one can understand that the difference between hypothesis and scientific theory is that while the former is purely tentative, the latter is a regulated assumption.

Scientific law: This could be regarded as the synthesis in the dialectics of scientific process. From the definitions of hypothesis and scientific theory one can rightly observe that this dialectic process originated from hypothesis to scientific theory which finally culminates in the scientific law.

In line with this, Ifechi Ndianefoo states that "scientific laws grow out of observations, concepts and hypothesis; laws generally have more observational status than theory"[30]. He defines scientific law as a "statement of universal facts which has been tested repeatedly and confirmed to reflect facts of the world"[31].

Endnotes

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