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Inductivism and Science: An Appraisal of Scientific Methodology

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Abstract

Inductivism is the claim that induction is the basis of proper scientific inquiry. Induction holds that we can infer that what we know to be true in a particular case or cases will be true in all cases, which resemble the former in certain assignable respects. Sequel to this, proponents of inductivism such as John Stuart Mill, Francis Bacon etc rejected every rationalistic or idealistic approach to scientific knowledge; instead, they suggested experience as the basis for any knowledge that is worthwhile. The history of philosophy has been characterized by arguments and counter arguments on what should constitute the nature of scientific methodology and this has led to absolutism in science that is, the belief that scientists must adhere to some stipulated method (s). This work employs critical method, functional analysis and hermeneutical method to appraise the above stated claim by first of all establishing the roles played by the human reason and a priori ideas in the scientific enterprise. After this, we will also examine issues surrounding the *methodology of science as raised by philosophers of science like Popper, Kuhn, Lakatos, and Feyerabend etc. consequently; we will conclude that science has more to do with pragmatism via relativism which can be certified by some landmark achievements in the history of science.*

Introduction

The history of science has been characterized by some sort of absolutism and consistency ranging from inductivism to hypothetico-deductive methods. Induction is generally referred to as a "method of reasoning from a part to a whole, from particular to generals, or from the individual to the universal". Many scholars consider this method of inference as the foundation of the scientific ingenuities and sequel to this; science is taken as an ideology. Therefore, any discipline that does not concur to this scientific method is always labelled a counter-ideology. In consonance with the above claim, any knowledge that does not have recourse to ordinary sense experience is considered meaningless.

In the light of the above, we shall start by beaming our search light on the proponents of inductivism and their assertion that the true test of logic is experience. They rejected the argument of the rationalists and the Aristotelians who argued that beyond our ordinary experience of things we have intuitions – "rational" intuitions – of ontological connections that structure things in ways not apparent to our ordinary sense experience of the world. Mill *ipso facto* formulated his five methods of scientific investigation; namely: method of difference, method of agreement, joint method of agreement and difference, method of residue, and method of concomitant variation. These methods shall be examined in the course of this work.

If one should hold the above claim as posited by the inductivists to be true, how can we account for scientific laws and predictions? For example, it can be accepted that A is B (Chidi is honest) than to accept that A will always be B (Chidi will always be honest). One cannot use that Chidi is honest today and infer that he will always be honest because an incident in future may counter this claim; thus, there lays the problem of induction.

This work will critically examine inductivism as a sole method of science and series of debates on what underlies progress in science by resolving questions like: Going by the claims of inductivism, how do we prove scientific laws and predictions? Is it possible to establish a cause-effect relationship between events whose occurrence has been invariably associated in the past? What are the roles played by human a priori ideas in the scientific enterprise? Can a particular method hold sway in every field of study since the world which we want to explore is a largely unknown entity? Can inductive method be certified as the sole method of science? What principle (s) underlies growth in science? Does strict adherence to a particular method (Absolutism) facilitate or retard progress in science?

Scientific laws and predictions are always transcending the world of experience. In the course of this work we shall examine Mill's Inductive method in light of this thereby leading us to hypothetico-deductive method in science as postulated by William Whewell, Jevons etc. This paper will also examine different postulations made by philosophers of science against the backdrop of inductivism and hypothetico-deductive methods in science on what should constitute the methodology of science and what facilitates progress in science.

We will achieve the above stated goal by doing justice to the following:

- Inductive claims on the scientific methodology.
- Counter inductive claims on the methodology of science.
- A critique of inductivism
- Evaluation and conclusion

Inductive claims on the scientific methodology

Here, effort will be made in reviewing some scholarly contributions on the meaning and nature of induction as a basic scientific method.

Francis Bacon (at the beginning of the *Magana instauratio* and in Book II of the *New Organon*, Bacon introduces this system of 'true and perfect induction', which he proposes as the essential foundation of scientific method and a necessary tool for the proper interpretation of nature.

According to Bacon, his system differs not only form the deductive logic and mania for syllogisms of the schoolmen, but also from the classic induction of Aristotle and other logicians. As Bacon explains it, classic induction proceeds "at once from… sense and particulars up to the most general propositions and then works backward (via deduction) to arrive at intermediate propositions."[2] Thus, for example, from a few observations one might conclude (via induction) that all new cars are shiny; one would then be entitled to proceed backward from this general axiom to deduce such middle- level axioms as ' all new lexuses are shiny, 'all new jeeps are shiny,' etc. Axioms that presumably would not need to be verified empirically since their truth would be logically guaranteed as long as the original generalization (all new cars are shiny') is true.

As Bacon rightly points out, one problem with this procedure is that if the general idioms prove false, all the intermediate axioms may be false as well. All it takes is one contradictory instance (in this case one new car with a dull finish) and the whole edifice crumbles. For this reason Bacon prescribes a different path. His method is to proceed "regularly and gradually from one axiom to another, so that the most general are not reached till the last."[3] In other word each axiom that is, each step up 'the ladder of intellect' is thoroughly tested by observation and experimentation before the next step is taken. In effect, each confirmed axiom becomes a foothold to a higher truth, with the most general axioms representing the lost stage of the process.

Thus, in the example described, the Baconian investigator would be obliged to examine a full inventory of new Chevrolets, Lexuses Jeeps, etc., before reaching any conclusions about new cars in general. And while Bacon admits that such a method can be laborious, he argues that it eventually produces a stable edifice of knowledge instead of a rickety structure that collapses with the appearance of a single disconfirming instance. Indeed, according to Bacon, when one follows his inductive procedure, a negative instance actually becomes something to be welcomed rather than feared. For instead of threatening an entire assembly, the discovery of a false generalization actually saves the investigator the trouble of having to proceed further in a particular direction or line of inquiry. Meanwhile the structure of truth that he has already built remains intact.

Is Bacon's system, then, a sound and reliable procedure, a strong ladder leading from carefully observed particulars to true and inevitable conclusions? Although he himself firmly believed in the utility and overall superiority of his method, many of his commentators and critics had doubt. For one thing, it is not clear that the Baconian procedure, taken by it, leads conclusively to any general propositions much less to scientific principles or theoretical statement that we can accept as universally true. For at what point is the Baconian investigator willing to make the leap from observed particulars to abstract generalization? After a dozen instances? A thousand? The fact is, Bacon's method provides nothing to guide the investigator in this determination other than sheer instinct or professional judgment, and thus the tendency is for the investigation of particulars the steady observation and collection of data to go on continuously, and in effect endlessly.

Jonathan Dolhenty in his article titled "A basic introduction to the methods of science", Dolhenty holds that,

> It is the purpose of empirical science to discover the causes and laws of natural phenomena. This is done by induction. There are various phases that empirical science goes through to establish truth and these are generally known as inductive methods.

He went further to outline the phases of empirical science as observation, the establishing of hypotheses, and experimentation.

Observation: This, according to Dolhenty "is the close scrutiny and examination of natural occurrences in order to determine their courses and effects." There are two operations involved here:

(a) First, all the facts connected within the natural phenomenon under investigation must be identified and placed in their proper order.

(b) Second, these facts must be analyzed for the purpose of discovering the causal connectional between certain " antecedents" and "consequents" which appear in invariable sequences"

Establishing Hypotheses**:** According to Dolhenty:

> A hypothesis can be defined as a provisional explanation of a phenomenon, based on probable arguments until certified (or disproved) by subsequent evidence. It is the guiding norm in experimentation.

Hypotheses are generated as possible explanations based on the observation of certain physical events. But in order to verify a hypothesis as possessing some degree of certainty, more must be done. Further observation is necessary of course, but so is an important task of empirical science called "experimentation".

In his article titled "The many faces of inductive teaching" Richard F. Richard argues that:

> The inductive method also referred to, as the Scientific method is a process of using observations to develop general principles about specific subjects. A group of similar specimen events of subjects are first observed and studied; finding from the observations are then used to make broad statements about the subjects that were examined. These statements may then become laws of nature or theories.

In the above mentioned article, Richard cited an example of the inductive method:

Extensive observations of many species of land-dwelling turtles reveals that the observed turtles have shells, lay eggs and eat a diet of plants as well as insects. From this, it could be induced that all land turtles have shells lay eggs and eat plants and insects. The data gathered from observing some example of land turtles is applied as a general rule about land turtles.

He concluded by saying that inductive method "is an extremely effective process for obtaining general observation –based information about the world."

Writing in his article titled; "Induction, deduction, and the scientific method", Irving Rothchild conceives induction "as a form of logic used by scientists to identify similarities within a group of particulars; a process of looking for a general characteristic in a set of group of observations." According to him "we use some form of induction in almost every kind of scientific endeavour; no matter how it is defined, induction amount to making and collating observation."

Sequel to his empirical stand for every inquiry, investigation, and pursuit for knowledge, John Stuart Mill (1882) posited five methods of induction namely:

1) Direct Method of agreement: This states that "If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon

Symbolically, the method of agreement can be represented as follows:

ABCD occur together with wxyz

AEFS occur together with wtuv

Therefore A is the cause, the effect, or part of the cause of w.

2) Method of Difference: which states that: If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or an indispensible part of the cause, of the phenomenon.

ABCD occur together with wxyz

BCD occur together with xyz

Therefore A is the cause, or the effect, or part of the cause of W.

3) Joint Method of agreement and difference: This method simply represents the application of the methods of agreement and difference. It states that if two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common gave the absence of that circumstance: the circumstance in which alone the two sets of instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon. Symbolically, this method can be represented as:

ABC occur together with xyz

ADE occurs together with xyw also BC occur with yz therefore A is the cause, or the effect, or a part of the cause of x.

4) Method of Residues: According to this method:

> Deduct from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents.

If a range of factors are believed to cause a range of phenomena, and we have matched all the factors, except one, with all the phenomena, except one, then the remaining phenomenon can be attributed to the remaining factor. Symbolically, the method of residue can be represented as:

ABC occur together with xyz

B is known to be the cause of y

C is known to be the cause of z

Therefore A is the cause or effect of x.

5) Method of Concomitant Variations: If across a range of circumstances leading to a phenomenon, some property of the phenomenon varies in tandem with some factor existing in the circumstances, then the phenomenon can be attributed to that factor. For instance, if we have various samples of water, each containing both salt and lead, were found to be toxic, and if the level of toxicity varied in tandem with the level of lead, one could attribute the toxicity to the presence of lead.

Symbolically, it can be represented as (with ± representing a shift):

ABC occur together with xyz

A± BC results in x± YZ.

Therefore A and X are casually connected.

Unlike the preceding four inductive methods, the method of concomitant variation doesn't involve the elimination of any circumstance. Change in the magnitude of one factor results in a change in the magnitude of another factor.

If method refers to particular processes that must be followed for something to be done, then, by implication the method of a thing determines its progress and achievement. The question we will try to resolve in the course of this paper is: going by much scientific ingenuity in the recent times, can the strict inductive method of science be responsible for such? Before we will consider this question, let us now consider what other philosophers of science have to say on the claims of the inductivists.

Counter inductive claims on the methodology of science

Karl popper (1963) on his side towed a different line against the inductive method of science as asserted by Mill and most scholars we have reviewed. According to Popper, the central problem in the philosophy of science is that of demarcation, i.e., of distinguishing between science and what he terms 'non-science', under which heading he ranks, amongst others, logic, metaphysics, psychoanalysis, and Adler's individual psychology. Popper is unusual amongst contemporary philosophers in that he accepts the validity of the Humean critique of induction, and indeed, goes beyond it in arguing that induction is never actually used by the scientist. However, he does not concede that this entails the skepticism which is associated with Hume, and argues that the Baconian/Newtonian/Mill's insistence on the primacy of 'pure' observation, as the initial step in the formation of theories, is completely misguided: all observation is selective and theory-laden—there are no pure or theory-free observations. In this way he destabilizes the traditional view that science can be distinguished from non-science on the basis of its inductive methodology; in contradistinction to this, Popper holds that there is no unique methodology specific to science. Science, like virtually every other human, and indeed organic, activity, Popper believes, consists largely of problem solving.

Popper, then, repudiates induction, and rejects the view that it is the characteristic method of scientific investigation and inference, and substitutes falsifiability in its place. It is easy, he argues, to obtain evidence in favour of virtually any theory, and he consequently holds that such 'corroboration', as he terms it, should count scientifically only if it is the positive result of a genuinely 'risky' prediction, which might conceivably have been false. For Popper," a theory is scientific only if it is refutable by a conceivable event. Every genuine test of a scientific theory, then, is logically an attempt to refute or to falsify it, and one genuine counter-instance falsifies the whole theory." In a critical sense, Popper's theory of demarcation is based upon his perception of the logical asymmetry which holds between verification and falsification: it is logically impossible to conclusively verify a universal proposition by reference to experience (as Hume saw clearly), but a single counter-instance conclusively falsifies the corresponding universal law. In a word, an exception, far from 'proving' a rule, conclusively refutes it.

Every genuine scientific theory then, in Popper's view, is prohibitive, in the sense that it forbids, by implication, particular events or occurrences. As such it can be tested and falsified, but never logically verified. Thus Popper stresses

> that it should not be inferred from the fact that a theory has withstood the most rigorous testing, for however long a period of time, that it has been verified; rather we should recognize that such a theory has received a high measure of corroboration and may be provisionally retained as the best

> available theory until it is finally falsified (if indeed it is ever falsified), and/or is superseded by a better theory.

Thus, while advocating falsifiability as the criterion of demarcation for science, Popper explicitly allows for the fact that in practice a single conflicting or counter-instance is never sufficient methodologically to falsify a theory, and that scientific theories are often retained even though much of the available evidence conflicts with them, or is anomalous with respect to them. Scientific theories may, and do, arise genetically in many different ways, and the manner in which a particular scientist comes to formulate a particular theory may be of biographical interest, but it is of no consequence as far as the philosophy of science is concerned. Popper stresses in particular that there is no unique way, no single method such as induction, which functions as the route to scientific theory, a view which Einstein personally endorsed with his affirmation that 'There is no logical path leading to [the highly universal laws of science]. They can only be reached by intuition, based upon something like an intellectual love of the objects of experience'. Science, in Popper's view, starts with problems rather than with observations—it is, indeed, precisely in the context of grappling with a problem that the scientist makes observations in the first instance: his observations are selectively designed to test the extent to which a given theory functions as a satisfactory solution to a given problem.

For Popper, the growth of human knowledge proceeds from our problems and from our attempts to solve them. These attempts involve the formulation of theories, which if they are to explain anomalies, which exist with respect to earlier theories, must go beyond existing knowledge and therefore require a leap of the imagination. For this reason, Popper places special emphasis on the role played by the independent creative imagination in the formulation of theory. The centrality and priority of problems in Popper's account of science is paramount, and it is this, which leads him to characterize scientists as 'problem-solvers'. Further, since the scientist begins with problems rather than with observations or 'bare facts', Popper argues that the only logical technique, which is an integral part of scientific method, is that of the deductive testing of theories, which are not themselves the product of any logical operation. In this deductive procedure conclusions are inferred from a tentative hypothesis. These conclusions are then compared with one another and with other relevant statements to determine whether they falsify or corroborate the hypothesis. Such conclusions are not directly compared with the facts, Popper stresses, simply because there are no 'pure' facts available; all observation-statements are theory-laden, and are as much a function of purely subjective factors (interests, expectations, wishes, etc.) as they are a function of what is objectively real.

On his part, Thomas Kuhn (1996) in his book *The Structure of Scientific Revolution* holds that progress in science is marked by paradigm shift. Once a paradigm shift has taken place, the textbooks are rewritten. Often the history of science too is rewritten, being presented as an inevitable process leading up to the current, established framework of thought. There is a prevalent belief that all hitherto-unexplained phenomena will in due course be accounted for in terms of this established framework. Kuhn states that scientists spend most (if not all) of their careers in a process of puzzle-solving. Their puzzle-solving is pursued with great tenacity, because the previous successes of the established paradigm tend to generate great confidence that the approach being taken guarantees that a solution to the puzzle exists, even though it may be very hard to find. Kuhn calls this process normal science.
As a paradigm is stretched to its limits, anomalies — failures of the current paradigm to take into account observed phenomena — accumulate. Their significance is judged by the practitioners of the discipline. Some anomalies may be dismissed as errors in observation, others as merely requiring small adjustments to the current paradigm that will be clarified in due course. Some anomalies resolve themselves spontaneously, having increased the available depth of insight along the way. But no matter how great or numerous the anomalies that persist, Kuhn observes, "the practicing scientists will not lose faith in the established paradigm for as long as no credible alternative is available; to lose faith in the solubility of the problems would in effect mean ceasing to be a scientist."

Imre Lakatos (1978) sought a methodology that would harmonize these apparently contradictory points of view, a methodology that could provide a rational account of scientific progress, consistent with the historical record.

For Lakatos, what we think of as a 'theory' may actually be a succession of slightly different theories and experimental techniques developed over time, that share some common idea, or what Lakatos called their '*hard core*'. Lakatos called such changing collections 'Research Programmes'. The scientists involved in a programme will attempt to shield the theoretical core from falsification attempts behind a protective belt of *auxiliary hypotheses*.

Whereas Popper was generally regarded as disparaging such measures as 'ad hoc', Lakatos wanted to show that adjusting and developing a protective belt is not necessarily a bad thing for a research programme. Instead of asking whether a hypothesis is true or false, Lakatos wanted us to ask whether one research programme is better than another, so that there is a rational basis for preferring it. He showed that in some cases one research programme can be described as progressive while its rivals are degenerating**.** A progressive research programme is marked by its growth, along with the discovery of stunning novel facts, development of new experimental techniques, more precise predictions, etc. A degenerating research program is marked by lack of growth, or growth of the protective belt that does not lead to novel facts.

In his book *Against Method* and *Science in a Free Society* Paul Feyerabend (1993) defended the idea that there are no methodological rules which are always used by scientists. He objected to any single prescriptive scientific method on the grounds that any such method would limit the activities of scientists, and hence restrict scientific progress. In his view, science would benefit most from a "dose" of theoretical anarchism. He also thought that theoretical anarchism was desirable because it was more *humanitarian* than other systems of organization, by not imposing rigid rules on scientists.

> For is it not possible that science as we know it today, or a "search for the truth" in the style of traditional philosophy, will create a monster? Is it not possible that an objective approach that frowns upon personal connections between the entities examined will harm people, turn them into miserable, unfriendly, self-righteous mechanisms without charm or humour? "Is it not possible," asks Kierkegaard, "that my activity as an objective [or critico-rational] observer of nature will weaken my strength as a human being?" I suspect the answer to many of these questions is affirmative and I believe that a reform of the sciences that makes them more anarchic and more subjective (in Kierkegaard's sense) is urgently needed.

Feyerabend's position was originally seen as radical in the philosophy of science, because it implies that philosophy can neither succeed in providing a general description of science, nor in devising a method for differentiating products of science from non-scientific entities like myths. (Feyerabend's position also implies that philosophical guidelines should be ignored by scientists, if they are to aim for progress.)

To support his position that methodological rules generally do not contribute to scientific success, Feyerabend provides counterexamples to the claim that (good) science operates according to a certain fixed method. He took some examples of episodes in science that are generally regarded as indisputable instances of progress (e.g. the Copernican revolution), and showed that all common prescriptive rules of science are violated in such circumstances. Moreover, he claimed that applying such rules in these historical situations would actually have prevented scientific revolution.

The question we will try to resolve in the course of our study is: going by much scientific ingenuity in the recent times, can the strict inductive method of science be responsible for such? The literatures we reviewed unveiled some differences that existed between philosophers of science on what should constitute the method of science; therefore, this work will critically examine the positions of both the pro-inductivists and anti-inductivists.

A critique of inductivism

Judging from our journey so far, one can deduce that John Stuart Mill together with most scholars reviewed held induction to be the sole method of science and its achievements. Our effort here is not to revisit what is being characterized as Hume's debate of 18th century on the rational justification of inductive inference i.e. such questions like: what reason do we have to believe that our conclusions about observed instances may be extended (even with probability) to include unobserved instances? What reason do we have to think that we can draw reliable conclusions about future (unobserved) instances on the basis of past (observed) instances? Etc.

The reason for not beaming our research light to the afore mentioned questions is because despite all the criticisms levelled against science on this ground, it (science) is still making progress with a lot of scientific ingenuities as proofs. But the questions which will be addressed in this chapter are: Is induction the only method employed by scientist in attaining their conclusions? Judging by the scientific theories or general principles, does it not imply that science is paying tribute to some other methods other than induction? What should be the method of science?

To buttress more on the issues at hand, a close scrutiny on the five methods of induction as postulated by J.S. Mill will reveal that they are nothing but different ways of observing diverse chains of events thereby creating a link between them. Take for example, Mill's method of concomitant variation where one could establish the causal connection between two factors from the observation of a change in the magnitude of one phenomenon that is in tandem with the change in the magnitude of another phenomenon. But the questions remain: does scientific inquiry end with these particular observations? What warrants the possibility of the movement from these particular findings to scientific general principles/theories? Can the truth of an inductive inquiry be established by induction?

It is in the above light that we will consider some arguments posited by many scholars to disprove the strict empirical-based-inductive claim of the inductivists first of all considering what some scholars termed hypothetico-deductive method of science which has to do with the combination empirical and idealistic nature of scientific inquiries and theories thereby going in contrary to the pure empirical method of Mill and other strict inductive pioneers after which we will suggest a possible solution to the problem surrounding the method of science.

William Whewell (holds that gaining knowledge requires attention to both idea and empirical elements, to ideas as well as sensations. These ideas, which he called "Fundamental ideas" are supplied by the mind itself – they are not (as Mill protested) merely received merely from our observations of phenomenal world. Whewell explained that the fundamental ideas are:

""Not a consequence of experience, but a result of the particular constitution and activity of the mind, which is independent of all experience in its origin, though constant combined with experience in its exercise".

Ideas such as, Time, Cause and Resemblance provide a structure or form for the multitude of sensations we experience. The ideas provide a structure by expressing the general relations that exist between our sensations.

This was also corroborated by Hans Christian Oersted when he insists that:

> In order to achieve completeness in our knowledge of nature, we must start from two extremes, from experience and from the intellect itself. …The former method must conclude with natural laws, which it has abstracted from

> experience, while the latter must begin with principles, and gradually, as it develops more and more; it becomes ever more detailed. Of course, I speak here about the method as manifested in the process of the human intellect itself, not as found in textbook, where the laws of nature which have been abstracted from the consequent experiences are placed first because they are required to explain the experiences. When the empiricist in his regression towards general laws of nature meets the metaphysician in his progression, science will reach its perfection.

Having seen the roles played by the human mind and ideas in scientific inquiries and theories as against Mill's strict inductive basis of science, one will be poised to ask; what should then stand as the method of science? Historically, answers to this question have split philosophers into various camps. Karl Popper holds that induction is a myth which never existed nor used in science rather that what facilitates progress in science is the falsifiability of a scientific theory. A test that could and does run contrary to predictions of the hypothesis is taken as a falsification of the hypothesis. A test that could but does not run contrary to the hypothesis corroborates the theory. On his part Thomas Kuhn that progress in science is marked by paradigm shift. Once a paradigm shift has taken place, the textbooks are rewritten. Often the history of science too is rewritten, being presented as an inevitable process leading up to the current, established framework of thought. There is a prevalent belief that all hitherto-unexplained phenomena will in due course be accounted for in terms of this established framework. Kuhn states that scientists spend most (if not all) of their careers in a process of puzzle-solving. Their puzzle-solving is pursued with great tenacity, because the previous successes of the established paradigm tend to generate great confidence that the approach being taken guarantees that a solution to the puzzle exists, even though it may be very hard to find. Kuhn calls this process *normal science*.

Paul Feyerabend defended the idea that there are no methodological rules which are always used by scientists. He objected to any single prescriptive scientific method on the grounds that any such method would limit the activities of scientists, and hence restrict scientific progress. In his view, science would benefit most from a "dose" of theoretical anarchism.

From the journey so far, one could decipher that there is no strict inductive method in science as asserted by Mill and his followers and that the issue of inductivism has been overtaken in the course of history of science going by the landmark achievements in science.

Evaluation

An appraisal of the journey so far will unveil that Mill's empirical claim that there is no rational intuition and nothing in the ontology of the world beyond what we know in ordinary experience which he also extends to the field of science will by implication do more harm than good to science if strictly adhered to. This is because in line with Bertrand Russell (1967):

> All knowledge which, on a basis of experience, tells us something about what is not experienced is based upon a belief which experience can neither confirm nor confute. …the principle of induction, while necessary to the validity of all arguments based on experience, is itself not capable of being proved by experience…

The general extension of the inductive findings to scientific laws and theories is definitely not done via induction because it eludes empirical observation on which induction is built. To expatiate more on the matter at hand, let us consider one of Mill's five methods of induction.

Method of agreement: This method states:

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

For example, a scientist who is investigating the cause of runny-stomach may face the following options.

- Chidi ate beans, rice, and meat and develops runny-stomach, fever, and cough.
- Peter ate beans, plantain and maize and develops runny-stomach, sore-throat, and catarrh.

If in more subsequent instances, there was a repeated agreement between beans and runny-stomach, then, he may infer that beans are the cause or the effect – runny-stomach. The creation of the nexus between beans and runny-stomach was made possible according to Kant, by the special operation of the mind's ability to organize, synthesize and unite our particular observed ideas. It was as a result of the application of one of the mind's categories, namely, the categories of relation (cause and effect) that made such possible. When the appropriate conception with which to colligate phenomena is chosen according to Whewell, another special process in the mind will also take place which is a process of inference through which one can infer a general law that will be applicable to the unobserved members.

The above processes are not empirically based which is quite different from the Mill's empirical claims, thus, for a holistic explanation of scientific method, the roles played by the reason/mind should not be relegated; hence, the hypothetico-deductive method of Whewell and Jevons etc. But the arguments and counter arguments that raged between philosophers of science [Popper, Kuhn, Lakatos, and Feyerabend etc.] on what marks the growth of science made the inductivism of empiricists like J.S. Mill and even the hypothetico-deductive method of Whewell to lose their relevance in the history of science.

One can deduce from the above stated philosophers of science (precisely Feyerabend) that strict adherence to methods (Absolutism) in science will hinder growth in science. An example of progress in science that abhorred such absolutism is *Copernican revolution*; Copernicus proposed a cosmology in which the *sun* was at the center and the *earth* was one of the planets revolving around it. For modeling the planetary motion, Copernicus used the tools he was familiar with which was in sharp contrast to Ptolemy's school of thought where cycles and epicycles(with some additional concepts) were used for modeling the movements of the planets in a cosmos that had a stationary Earth at its center. Many other landmark progress in science such as the replacement of Newton's theory of universal gravitation by Einstein's theory of relativity etc were all actualized as a result of refusal to adhere to any form of absolutism or consistency in science.

Conclusion

In conclusion, from our review of the arguments between some philosophers of science [Popper, Kuhn, Lakatos, Feyerabend etc.], one can rightly deduce that what they held in common was the fact that science is problem solving and thus, there is no single method such as induction, which functions as the route to scientific theory, a view which Einstein endorsed with his affirmation that there is no logical path leading to the highly universal laws of science.

Science starts with problems rather than with observations__ it is, indeed, precisely in the context of grappling with a problem that the scientist makes observations in the first instance: his observations are selectively designed to test the extent to which a given theory functions as a satisfactory solution to a given problem. From the fore-going explanation, one could see pragmatism in science because it is a result oriented discipline. Since mankind is faced with dynamic problems, restricting us to a particular method (Absolutism) or strict observation of rules (Consistency) will retard progress in science. This was certified by many examples of ingenuities in the history of science.

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