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POPPER'S DEMARCATION CRITERION BETWEEN SCIENCE AND METAPHYSICS: A CRITICAL ANALYSIS

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Abstract

Karl Raimund Popper, (1902-1994) a leading apostle of anti-inductivism, holds that the main problem of philosophy of science is the problem of demarcation. Accordingly, the demarcation principle distinguishes science from non-science. To Popper, logic, metaphysics and psychoanalysis are likely to fall into the non-science group. Principle of induction has been accepted even though resentfully as the chief tool of scientific investigation by the positivists as well as the scientists in general. Popper rejects the positivistic approach and on the contrary proposes *falsifiablity* to furnish his iconoclastic project. This paper intends to indentify the problem of his very approaches in order to hold that in spite of some difficulties in the problem of induction itself, as the identifier of science, we do not have any alternative to save science from metaphysics. Finally, Popper's

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so-called demarcation criterion is extensively examined here with a view to defend material aspect of inductive generalization.

Key words: Inductive inference, falsifiability, confutibility, Vienna Circle.

Introduction

An important paper 'The demarcation between science and metaphysics' of Karl Popper, appeared in 1955 is obviously an outcome of a debate with Rudolf Carnap in 1932 during a holiday excursion at Tyrolese Hills in Scotland. (Popper, 1964) According to the information provided by Popper himself, the talk was fascinating and unforgettable from both their parts because they used their maximum tactic to put to rout to the opponent by logical arguments. Popper's essay is written after quite a long time following the discussion with Carnap to reply him sharply. Popper wrote this essay in a nostalgic mood remembering those beautiful moments with another famous member of Vienna Circle (VC) Herbert Feigl in company of their wives. Meanwhile, Carnap makes an outstanding impression on positivistic trend by his significant contributions to logical approach and meaning-criterion in their empiricist ideals. His ever-encouraging book to the positivists *The Logical Structure of the World* and some other essays published in *Erkenntnis* finally inspired them to look forward. To remember, Carnap is among very few of the positivists who leaves a strong footstep on the way to the executions of the spirit of positivism. In this essay, I hope to follow some of his important arguments against empirical sciences of which in most part, I do not hold it to be acceptable. The proposed demarcation of Popper is rather devastating which seems to do away with the spirit of science and its rusty track to growth of scientific knowledge. Obviously, his so-called principle of falsifiable or confutibility that he takes into account to demarcate between science and pseudo-science appears to be unjustified for the whole project. I will make an overview here to reexamine his proposed criterion to demarcate science from metaphysics and hope to show that the principle of

falsifiablilty was nothing but jumbling up science with metaphysics in the name of so-called demarcation. Knowledge, scientific knowledge particularly, is supposed to be stumbled-bloc and the reliability of any other knowledge may be far-reaching. Finally, I attempt to show that neither falsifiablity nor confutibility could provide a true demarcation principle between science and non-science. As a result, this so-called criterion of meaning appears to be a serious problem to the scientists as well as philosophers of scientific discussion.

Principle of falsifiability

Popper finds the problem of inductive generalization because he thinks that the singular or particular statement by which a universal statement is usually constructed does not adequately follow the rules of inference. As a result, there must have been gap (however little the amount is !) within the logical construction. His own point is (1959) "… from a logical point of view, that we are justified in inferring universal statements from singular ones, no matter how numerous; for any conclusion drawn in this way may always turn out to be false." (Popper, p. 4). He (1959) further holds, "the question whether inductive inferences are justified, or under what conditions, is known as *the problem of induction*."(Popper, p. 4.). Problem of induction no doubt is a serious problem in human cognitive discourse. C. D. Broad , once lamented, "Inductive reasoning is the glory of science but scandal of philosophy" (Broad, 1926). No matter how many singular instances are taken into consideration to find a universal proposition; something must be left to count further. Obviously, this logical myopia is extensively envisaged by Popper in his book *The Logic of Scientific Discovery* because he thinks that this perennial problem is unassailable. He opines (1959), "so the question arises why such a principle should be accepted at all, how we can justify its acceptance on rational grounds" (Popper, p 5.). If someone proceeds to investigate unremittingly to strengthen the proposition he/she might have been in fatigue; alternatively, if he/she explores a negative example at any stage, the whole assertion would be necessarily disproved. To him, science is a function of trial and

error process which never entails the absolute truth. And, for obvious reason J. D. Norton (2014) holds "doubting inductive inference in the generality is philosophically respectable". (Norton , p.1).

Popper faced the demarcation problem in 1919, he mentions. He is concerned about the problem by which logical empiricists make the line of demarcation between empirical science and 'pseudo-science' or metaphysics. To mention, this particular year (1919) had been chosen by Popper because Einstein's general theory of relativity was practically confirmed by the scientists in this year. It is known that Einstein's general theory of relativity was proven to be true in practice when scientists found that the exact deflection of light coming from the distant star is four arcs, which was professed by Einstein himself following the introduction of his theory some four years ago. I am not sure why Popper mentions the particular event that makes him changed to take hold of the problem of drawing the dividing line between science and metaphysics. One of the important reasons in this respect is that Einstein's theory of relativity was highly speculative and abstract in nature which is taken to be very far from observational interaction—the real nature of empirical science (Popper, p. 255). Obviously, Popper's explanation is paradoxical because Einstein's theory of relativity is highly speculative no doubt but it does not follow that it is devoid of any experimental ground. Popper (1964) very un-smartly puts a question that "all attempts to show that they were more or less directly 'based on observations' were unconvincing". (Popper, p. 225) All scientific theories in nature are of course highly formularized and well ordered generalization. It is understandable that a theory can never be made finally without having a relationship with observation and experiment. Theories of every kind including social sciences must follow the method of inductive accumulation. And inductive accumulation is a process that pile up all particular facts through extensive experiments and observations. Popper asks the *process* by which we can proceed to make a general proposition about nature. This is an old objection against inductive method, so in that sense his criticism against the formula is nothing new. "All crows are black", "all swans are white" or even "all men

are mortal" – these kinds of universal propositions must have some limitations but that does not follow that we have sufficient reasons to refute them. Final verification is very difficult indeed but on the other hand, final refutation has the same merit. Now I will take some problems in this regard Popper raised in his paper initially.

Popper's position as a critical rationalist

Popper's theory of critical rationalism had been exposed as the theory of falsification in particular but in general, it is much similar to that of the theory of pragmatism, a theory of epistemological relativism propounded by C. S. Peirce. Rejection of induction as the scientific method is the principal target of him. Critical rationalism is accepted here as a self-critical rationalism unlike that of traditional notion of rationalism that examines scientific results thoroughly by reason or experience. It sounds somewhat odd because in philosophy rationalism and empiricism became two distinct sources of human knowledge. But, here, popper claims that only those theories of science should be accepted if and only if it is falsified by our future experience. This position of Popper is extremely debatable: a) does not he even believe in any sort of human knowledge ? b) if not, then why does he named his book, "The Growth of Scientific Knowledge–one of his important books in epistemology"? To Popper, if he does not believe in scientific knowledge then it sounds very odd to think about the growth of knowledge. It is thus very unclear as to what actually he means to define knowledge. His (1959) very surprising proposition, "Science is not a system of certain, well established, statements: nor is it a system which steadily advances towards a state of finality. Our science is not knowledge….." (Popper, p. 278). He further asks, "….our guesses are guided by the unscientific, the metaphysical though biologically explicable faith in laws, in regularities which we can uncover –discover" (Popper, p. 278) by 'unscientific' and 'metaphysical faith', he means imaginative and bold conjecture which is soberly controlled by systematic tests, he claims. However, he does not mention about the meaning of

systematic scientific tests. Definitely, these systematic scientific tests are no less than the actual scientific investigation. It should never be denied that the nature of scientific truth is ever changing but at the same time, this ever-changing nature of science is the beacon of further truth.

Popper's view was developed in the light of Kantian and Hume's philosophy. These two important philosophers of eighteenth century had remarkably influenced Popper's philosophy of critical rationalism. I should borrow some words from an article by Felipe Fróes Coutoa and others (2021), "From Kant to Popper: Reason and Critical Rationalism in Organization Studies" :

> Our premise in this essay is that understanding Kantian reason means not only analyzing our own ability to theorize, but also seeking to approximate thought, ideas and critical reflections on the empirical world. In regards to the latter, we apply the critical rationalism of Karl Popper (1902-1994). His view on the falsifiability of theories and hypothetical-deductive science attributes great potentiality to Kant's writings, structuring a way of conceiving scientific knowledge in accordance to the metaphysics of real knowledge (Couto, Felipe Froes, *at el*, 2021, p. 57).

Popper on the other hand "was directly influenced by Hume's critique of induction, specifically by his argument that it is not possible to justify by demonstrative reasoning the principle of induction" (Zuzana Parusniková and others, 2018).

Popper's objection and reply

In his paper, Popper objects the widely accepted view of science, which is characterized by *observational basis* or *inductive method* while metaphysics is categorized by *speculative method* or *mental anticipation.* Popper does not believe that this is a good way to make the difference between science and metaphysics. At the very first, he mentions Einstein's theory of relativity as highly speculative and abstract in character is very far from scientific method. As a

result, he finally makes a conclusion that Einstein's theory has been much close to the speculative inquiry rather than observational. His claim and concern are untrue because Einstein's theory about the nature, particularly length of an object, mass and time are not *a priori* in all senses. It depends upon the velocity by which we are to force upon it. If anything is forced with the motion of light, its length, mass and time will be changed. That is famously known as length contraction ($L= L_{0 \sqrt{1- v^2/C^2}}$), time dilation ($T= T_{0/ \sqrt{1- v^2/C^2}}$) and relativity of mass ($M= m_{0 / 1- v^2/C^2}$). Robert Neidorf (1963) evaluates in such way, on Einstein's position: "the nerve of Einstein's special theory is contained in his redefinition of simultaneity for spatially separate events. To see the sense in which Einstein appears to be applying or recommending a positivistic epistemology…" (Neidorf, pp, 173-188) Popper claims the same even of Newtonian theory that comes out of *mental anticipation*. By mental anticipation, he means the way of making hypothesis that is supposed to be the way how metaphysics runs. But that is wrong. To press the issue we need to look forward to how to make a scientific theory. For all cases, we wonder about the nature and ask, why does it happen? Why there is something rather than nothing? Why the heavy object falls on the surface of earth rather than going upwards? Why two objects attract each other with certain amount of pull and is it true that an equal and same reaction should be for every action?

The first step is to ask, "why" question, for example; why the Earth rotates around sun or why day and night comes in turn? If you do not have any idea, just begin by making connection with possible theory in your head. The Second step is to frame a theory to explain a law. Scientific law is an explicit description of observed phenomena. To understand properly, you need to make hypothesis but it is not guaranteed that this hypothesis might be true. Hypothesis is logical anticipation that aims to describe the facts or set of facts. To remember, you can build several hypotheses at the same time without knowing the exact one. In that case, pick the just one by comparing another. And, finally, when you want to be certain, you need to verify your proposed result and this is how a scientific

theory, is built. It is absolutely true that scientific theory before going to be operated must need to be verified extensively. Certainly, *mental anticipation* or what Popper calls *metaphysical method* does not work to framing up scientific theory. What should be the role of such method to distinguish science from non-science?

On the other hand, he claims that many rule-of-thumb procedures based on superstitious belief had much more observational linkage. Even astrologers demand to have their operation based on a great deal of inductive attempt. Modern science rejects this so-called claim of astrologer of having their acceptability. So, observational basis, he demands, can neither be the exact criterion to be differentiated between science and metaphysics. We must follow the difference between belief and knowledge. Popper claims that superstitious belief had a role in scientific knowledge! He perhaps tried to mention some curious events in history from where scientists found their clue to find the cause– effect relationship. Auguste Kakule's discovery of the structure of Benzene is a fabulous event in the history of organic chemistry. In 1865 Kakule the famous German chemist, claimed to have pictured the chemical bond of benzene after dreaming of a snake eating its own tail. It is supposed to be a miracle but that was real. Another self-contradictory approach should be critically exposed here. Popper mentions that scientific approaches should be entirely critical. If the phrase 'critical' is taken to be scientific then what about the so-called miracle in science like the afore- mentioned incident of Kaule ? Popper (1964) writes, "Only if a theory successfully withstands the pressure of these attempted refutations can we claim that it is confirmed or corroborated by experience" (Popper, p. 256). He makes a very clear view about science that all scientific propositions must have the merit of empirical refutations eventually. And he claims, "all real tests are attempted refutations" (Popper, 256). Degrees of testability are important to him. As he did not have any tool to refute the scientific proposition instantly, he may accept it partially as to hope that it might be refuted once. If not, then what is to be the status of those kinds of propositions? Metaphysics or pseudo-science? To solve the problem he proposed

three kinds of testability: well-testable theories, hardly testable theories, and non-testable theories. (Popper, 1964). Non-testable are according to him metaphysics. (Popper, p. 257). That should be a good proposal indeed but this case is not satisfactory as we find so many scientific theories, which do not need to be tested or verified because these sorts of theories are taken for granted. If we do not accept the heliocentric theory of Copernicus, for example, many later scientific theories would lose their merits. Kepler's theory of motion builds within the structure of Copernicus is theory and it successfully explains the rotation of earth. Another very remarkable example of science is Einstein's general theory of relativity.

The exact problem of demarcation

Popper criticizes that theory of testability does not provide a suitable distinguishing mark because the way by which we demarcate science from non-science is not very clear to the philosophers. In the history of philosophy, this has always been a problem to find a clear-cut dividing line. All empiricist leaning philosophers had a simple tactic and that is testability, if anything is found to be un-testable or non-verifiable that is supposed to be non-science. That is of course the most serious problem in scientific epistemology. We admit that scientific knowledge is not a system of concept but a system of statement. These statements are reducible to elementary or basic statement. All basic statements are subject to verifiable that comes with the demand of inductive logic.

I will propose here Carnap's (1936) theory of *Testability and Meaning* to find the best solution to the problem raised by Popper. There have been two problems of theory of knowledge: question of meaning and problem of verification (Carnap, p. 420) . Under what condition a sentence can have meaning or what condition a sentence may be factually true is cognitively important and, another question about the verifiability is to whether a given sentence can be true or false. Carnap proposes, "Thus the meaning of a sentence is in a certain sense identical with the way we determine its truth or falsehood; and a sentence has meaning only if such a determination is possible." (Carnap, p. 420)

To face some objections against verifiability Carnap amends the position and proposes confirmation instead of verification or verifiability. I suppose this is very important because verification is conceived to be definitive establishment of truth but conclusive verification is unattainable. It is understandable that verification is an infinite process and it will never be finished by our limited observation. Instead, Carnap proposes "we may speak here of gradually increasing confirmation of the law." (Carnap, p. 425) In this regard, he thinks that the acceptance and rejection of synthetic proposition finally entails on conventional component. Degree of confirmation of a hypothesis is a case of probability and the probability of course depends of its degree as well. For example, take a sentence "There is a white bird in my corridor". In order to be ascertained whether it is a white bird I need to ask so many questions, is it actually a bird, is it white, is it not an artificial cotton-pulp or many other questions that may come successively. Even, question may arise about the degree of sight and angle of perception etc. that entails series of asking which finally jumble everything up. So, to avoid the intention of test-observation Carnap goes for *degree of confirmation.* "There is a white paper on my table", for example, is a sentence that can be confirmed rather than verification conclusively, here gradual confirmation is possible and that is a matter of convention, Carnap claims. However, to remember, degree of confirmation of a hypothesis is a degree of probability.

Popper on logical reducibility

Metaphysics is thought to be nonsensical twaddle because metaphysics speaks nothing, according to Hume as well as logical empiricists. The main objection against metaphysics is, it does not belong to empirical science. Hume in his *An Essay Concerning Human Understanding* makes a sharp distinction between meaningful and meaningless sentence. He thinks proposition concerning "matter of fact" and "relation of ideas" are definitely meaningful but other than these two categories are completely meaningless and proposed them to be 'sophistry' or 'illusion'. Popper asks, the word

meaningless conveys a derogatory evaluation and he also claims that the process by which elementary or atomic proposition is reduced from meaningful proposition is not logically flawless. The most amazing part of Popper's philosophy has been introduced with his principle of falsifiablity as the criterion of demarcation. Whether a theoretical system belongs to empirical science is a matter of serious debate where Popper claims that this is a very easy issue to confute them rather verification.

Testability and Meaning

Carnap writes "Testability and Meaning" in two phases of 1936 and 1937 in the "Philosophy of Science". Due to the technical problem of verification in itself, Carnap proposes confirmation instead of verification as he thinks that "verification is meant a definitive and final establishment of truth, then no (synthetic) sentence is ever verifiable" (Carnap, 420). As a result, we can only confirm a sentence more and more. By introducing this technique he is supposed to avoid limitless verification and series of encountering to strength the proposition. Further, testing of a sentence is something different to confirmation. He clarifies, a sentence is "testable if we know such method of testing for it; we call it confirmable if we know under what conditions the sentence would be confirmed" (Carnap, p. 420) Truly, testability or confirmability whatever the name is given by Carnap the *real* problem persists with the same complication. This complication is about the sanguinity of synthetic proposition whether it should be taken without minimum doubt. For example, "Swans are white" or "Man is mortal"– these sorts of universal propositions always lie on an un-cozy bed because no experiment is likely to be sufficient to make it 100 percent innocuous. For obvious reason, Popper (1964) claims, "to justify his view of the meaninglessness of metaphysics by constructing a language of science free from metaphysics" has failed (Carnap, 274). Alternatively, Popper claims that , …. this means that it must contain sentences which Carnap, Neurath, and all other anti-metaphysicians always considered to be metaphysical" (Popper, 1964). Even Popper gives an example of

an extreme form of metaphysical statement and asks Carnap that this type of statement can be proven meaningful accordingly to the criterion set in *Testability and Meaning.* He takes a statement like "There exists an omnipotent, omnipresent, and omniscient personal spirit". He uses physicalistic predicates very wrongly to justify this above sentence as meaningful.

For example, i) 'a is omnipresent' or Opos(a);

ii) 'a is omnipotent' or Oput(a);

iii) 'a thinks b' or Th(a, b).

According to Carnap, Popper claims, these type of sentences are not invalid in a wider sense. Popper further claims that many other sentences like 'a is a thinking person or, Thp(a), 'a is a (personal) spirit' or Spa(a) or even 'a is omniscient', or Okn (a) are like the same category. As a result, metaphysical sentences are not different in nature thereby they are not meaningless according to the so-called criterion.

I think Popper is very much wrong to understand Carnap's (1932) set of rules to eliminate metaphysics through logical analysis of language. Carnap sets a bunch of sufficient and necessary conditions to be a meaningful sentence. For example, "a" is a basic or elementary sentence that is to be examined. Just follow (Ayer, 62):

a) The empirical criteria for *a* are known;
b) It has been stipulated from what protocol sentences "S(a)" is deducible;
c) The truth-conditions for "S(a)" are fixed;
d) The method of verification of S(a) is known.

Now, if we place Popper's so-called sentence (There exists an omnipotent , omnipresent, and omniscient personal spirit) into the above structure of Carnap, what does it follow? Here, think about the word "omnipotent" or "omnipresent".

a) Do we know, what actually we mean by omnipotent?

'This robust man is omnipotent' or 'this man is heavy and extremely powerful so he is omnipotent'. I hope there is no wrong with that but 'absolute being is omnipotent and omnipresent' carries no meaning because its empirical criterion is unknown. The problem is not with the term omnipotent but when it ascribes on an unknown being then founds no meaning at all.

b) The more pertinent question here to ask is : from where such sentence, "absolute being is omnipotent" is deduced? For example, "crab" is an animal that is a member of arthropod. "This thing is a member of arthropod" is a basic or protocol statement that follows the requirements like "it has a segmented body", "it has joined legs" or " "its body is covered by shell". According to Carnap, we need to remember that all protocol sentences whatever its status must be able to be deduced from another one which must have referential footing.

c) Truth-condition or stipulation of deducibility must be fixed for all sentences. Here, this sentence "absolute being is omnipotent and omnipresent" does not follow the condition unlike arthropod.

d) Method of verification (* method of confirmation) final requirement of Carnap is absolutely absent in metaphysical word or sentence.

Finally, Popper is not convinced with the modification of Carnap's position as well as the positivists. He thinks, (1964) " acceptability in science depends, not upon anything like a truth-surrogate, but upon the severity of tests" (Popper, p. 279). That is absolutely true that Carnap's position is vulnerable to some extent but the nature of science is very much like that. On the other hand, "severity of test" is also the nature of science because scientific truth builds upon extensive and rigorous verification or confirmation of examples.

Now, the issue, which has been badly affected by Hume and others including Popper is the effectiveness of induction or inductive

inference in scientific activities. This case is not to be denied that we live in everyday's common inference for our daily routine. But in epistemological discourse skepticism is welcome and thereby question about the validity of such inference have been in much trouble. Popper outrightly rejects such possibility of accepting scientific proposition without question. His question produces great scandal in science as it appears to be the most discomfiting feature of cognitive philosophy. I will put some arguments and observations here against Popper in the light of Nicholas Maxwell's paper (1972) "A Critique of Popper's View on Scientifc Method". If any scientific theory appears to be sufficiently satisfactory for its empirical content and with course of time it appears to be insufficient to address the growing demand; should I reject the previous one as saying that science is nonsense. I say, no, because science is an ongoing unveiling pursuit of human quires. Popper does not agree with that. Newtonian physics is probably the best example in the present day;

a) To introduce a rival theory does not obviously reject the previous one. An acceptable new theory finds some difficulties in the predecessors. However, this can never proved to be false because this new theory should be accepted as problem solving activity.

b) Lastly, I will quote from Maxwell,

   Popper has failed completely to provide any kind of rationale for the methodological rules he advocates. That is, he has failed to provide us with any reason for holding that Popperian rules give us a better hope of realizing the aims of scientific enquiry than any other set of rules. Nor is it easy to see how this failure can be made good within a general Popperian framework. Consequently, Popper has failed to solve his fundamental problem—the problem of demarcation. He has also failed to exhibit science as a rational enterprise. (Maxwell, pp. 5-6)

Conclusion

Popper's methodological criticism against scientific method in general is extremely partial because there must have been a clear demarcation line between science and metaphysics. It is sometimes argued that science is something more than empirical evidence or observational interference; as a result they raise question about the so-called "demarcation line" between these opposed cognitive approaches. But this criticism is not well footed because science has a definite characteristic unlike to that of non-science i.e. metaphysics. In that case, sometimes in history science proves itself to be limited in the course of its further development. To remember, this limitations must have been envisaged as its own characteristic. To Popper, falsification should be the only way to characterize scientific method. Popper's method is utterly frustrating because he does not believe in scientific knowledge. Carnap, here, is very much technical to formulate his own strategy to refute the principle of falsifiability. More importantly, generalized sentence invokes some questions for its severe testability but at the same time it cannot be denied that the whole scientific knowledge and its application to the general or technical filed have been solely rest on that very knowledge. As a result, I do not have any reason to accept his principle of falsifiability.

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