

Situational Analysis of Scientific Traditions: Popper's hermeneutical and political turn in philosophy of science*

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Our analysis of Popper's philosophy of science focuses on his concepts of *tradition and situational analysis*. These concepts represent innovative Popperian contributions to a historical and hermeneutical turn in philosophy of science that most of his critics, especially Kuhn, fail to recognize. According to his historical view, Popper conceives sciences as a complex of traditions in continuous transformation and progress by means of rational discussion of theories. In order to grasp the rational progress of scientific traditions, Popper proposes an original method that he calls "situational analysis". This hermeneutical method seeks to understand the concepts, hypotheses, actions, practices, controversies and products that scientists made to solve problems in their specific historical contexts to improve the truth content of theories. In addition to his historical and hermeneutical turn, Popper also inquired about the social and political conditions for the progress of scientific traditions by means of intersubjective criticism of theories and conjectures. According to him, the rational discussion of ideas requires, as necessary conditions, plurality of ideas, intellectual humility, and freedom of thought and communication that can only exist in an open and democratic society. With these considerations, we may say that in addition to a historical and hermeneutical turn, Popper also contributed to a social and political turn in the philosophy of science.

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1. Introduction

Karl R. Popper is one of the founding fathers of contemporary philosophy of science and his ideas have significant relevance in nowadays. His vigorous criticism of the central theses of logical positivism opened up new perspectives for the analysis of the rationality of sciences. Some of these new views suggested by Popper since the 1940's would subsequently be taken up and developed by authors that fostered the historical turn in philosophy of sciences such as Thomas S. Kuhn, Imre Lakatos, and Larry Laudan.

One of Popper's most influential ideas in philosophy of science was to change the focus of scientific rationality from firm and absolute grounds towards the way theories change and evolve progressively through rational criticism. If the rationality of science lays in its peculiar progressive historical process, then scientific methodology should be a mean for promoting theoretical change for the search of truth rather than proving truth of given scientific theories. It is therefore necessary that methods in sciences be not conceived as methods of verification of hypothesis, but as methods of empirical refutation to foster new and better theories. Thus, progressive theoretical change can only be critically appreciated through rational reconstruction of scientific change.

In order to grasp the rationality of scientific theories through their process of change and improvement, it is necessary to conceive theories as historical traditions. Accordingly, Popper put forward a rational theory of traditions and a specific hermeneutical method for historical and philosophical interpretation of scientific traditions, that he calls "situational analysis". This method is as important as logical and methodological analysis of scientific theories, but it has not received due attention.

In this paper, I analyze Popper's concept of tradition and his hermeneutical method for understanding of scientific traditions and discuss the social and political conditions for the rational development of traditions. Highlighting these issues will perhaps gives us a better view of Popper's contributions to contemporary philosophy of science. However, I have to recognize that in the analysis of Popper hermeneutical ideas and his theory of rational traditions I do not apply the hermeneutical method of situational analysis proposed by Popper to understand the development of his philosophical thought. Perhaps applying Popper's method of situational analysis to his own philosophy of science would be a complementary and revealing interpretation of his work for future investigations. But I consider that the hermeneutical, historical and political turn in philosophy of science that Popper started in 1940's, especially in the context of the Second World War and the Cold War, is a necessary consequence of his core epistemological concepts like falsifiability and verisimilitude, since these concepts implies rational discussion of ideas, and comparative analysis of theories through scientific change. Popper himself points out this connection between the epistemological thesis that he presented in the *Logic of scientific discovery* and his central ideas of philosophy of history and political philosophy that he discussed later in *Open Society* and *The Poverty of historicism* (Popper, 1977, 115).

In the following section, I shall focus on the relation between the epistemic criterion of falsifiability and the rational reconstruction of the history of sciences. Then, I will discuss Popper's theory of rational traditions. In the third section, I will focus on the social and political conditions required for the progress of scientific traditions and subsequently I shall analyze his hermeneutical method for understanding them. Finally, I will highlight the virtues of his hermeneutical approach to philosophy of science for an epistemological, social, historical and political understanding of scientific knowledge.

2. Falsifiability, falsification and empirical under-determination in scientific progress

A central thesis of Popper's philosophy of science is that there is no firm, definitive empirical basis neither a strict and conclusive method for verifying or refuting theories. Rather, it is by convention that empirical grounds and methodology of sciences are accepted in a provisional and fallible way. "The bold structure of its theories rises, as it were, above swamp. It is like a building erected on piles...we simply stop when we are satisfied that the piles are firm enough to carry the structure at least for the time being" (Popper, 1968, 111).

Popper acknowledges that Otto Neurath rightly rejected the dogmatic idea that science has solid empirical grounds: "There is no way to establish fully secured, neat protocol statements as starting points of the sciences. There is no tabula rasa. We are like sailors who have to rebuild their ship on the open sea" (Neurath, 1983, 92). However, Popper is critical on Neurath's radical conventionalist view of empirical basis of science: "Neurath avoids one form of dogmatism, yet he paves the way for any arbitrary system to set itself up as 'empirical science'" (Popper, 1968, 97). To avoid empirical dogmatism and radical conventionalism, Popper elaborated his own view of the 'empirical basis' along with his criticism to induction to propose his central epistemological thesis that the rationality of science relies not on its empirical foundations, but rather on the way scientific theories change and evolve by the method of continuous empirical refutations:

These considerations suggests that not verifiability, but falsifiability of a system is to be taken as a criterion of demarcation. In other words: I shall not require of a scientific system it shall be capable of being singles out, once and for all, in a positive sense; but ... in a negative sense: *it must be possible for an empirical scientific system to be refuted by experience* (Popper, 1968, 40-41).

Popper is aware of the problem formulated by Duhem in 1906, known as under- determination problem, which is one of the most important questions in the philosophy of science of the Twentieth century. The central issue of this problem is that it is not only impossible to verify theories inductively, but also it is not possible to conclusively falsify or refute any theory or hypothesis at all. This thesis implies that there is no method for conclusive verification or refutation of scientific theories.

Duhem's argument is twofold. The first argument refers to theoretical dependence of observations, that means that every observation, every experiment presupposes a previous

acceptance of some interpretative theory. Thus, within the process of empirical testing, in case that empirical sentences show to be contradictory with the hypothesis, it is always possible to argue that what is wrong is not that hypothesis, but the theory out of which the empirical propositions are derived. Such an alternative is logically valid and in principle it is as reasonable to save the central hypothesis, as it is to save the interpretative theory and refute the hypothesis in question.

The second argument against strict refutations of theories is relative to the holistic nature of empirical testing of hypothesis. This means that we can never empirically test a single isolated hypothesis, but we always have to test a set of hypotheses interconnected against the observational sentences, which in turn, depend on other theoretical assumptions. Therefore, "...when the experiment is in disagreement with his predictions, what he learns is that at least one of the hypotheses constituting this group is unacceptable and ought to be modified; but the experiment does not designate which one should be changed" (Duhem, 1962, 187).

To solve these problems, Duhem sustains that scientific rationality goes beyond the scope of logic and methodology, and it necessarily enters in the realm of the sensible discussion and deliberation that he calls good sense (*bon sens*). This is a kind of prudential rationality that demands some basic moral and epistemic virtues, mainly intellectual humility:

Since logic does not determine with strict precision the time when an inadequate hypothesis should give way to a more fruitful assumption, and since recognizing this moment belongs to good sense ...nothing will delay the decision which should determine a fortunate reform in a physical theory more than the vanity which makes a physicist too indulgent towards his own system and too severe towards the system of another (Duhem, 1962, 218).

Popper accepts the theoretical dependence of observational statements and the holistic structure of empirical testing of hypothesis and therefore admits that it is impossible to refute strictly any theoretical hypothesis, because it is always possible to argue that experiments or observations are not reliable: "...no conclusive disproof of a theory can ever be produced... If you insist in strict proof (or strict disproof) in the empirical sciences, you will never benefit from experience" (Popper, 1968, 50). However, Popper offers a different but convergent solution to the problem posed by Duhem in order to establish falsifiability as a clear criterion of demarcation of scientific knowledge, which must be distinguished from actual falsification of hypothesis:

Hence, to repeat, we must distinguish two meanings of the expressions 'falsifiable' and 'falsifiability':

- (1) 'Falsifiable' as a logical-technical term, in the sense of the demarcation criteria of falsifiability. This purely logical concept- falsifiable in principle, one might say- rest on a logical relation between the theory in question and the class of basic statements (or the potential falsifiers described by them).
- (2) 'Falsifiable in the sense that the theory in question can definitively or conclusively or demonstrably be falsified ('demonstrably falsifiable'). I have

always stressed that even a theory that is obviously falsifiable in the first sense, is never falsifiable in this second sense. (For this reason, I have use as a rule the expression 'falsifiable' in the first technical sense. In the second sense I have as a rule spoken not of falsifiability, but rather of 'falsification and of its problems') (Popper, 2012, xxii).

Since strict refutations or falsifications are impossible, what the demarcation criterion of falsifiability points out is an effective methodological procedure to criticize theories and supplant them by better ones, with less errors, less false content and more truth content, that is, with more relative truth or verisimilitude.

The concept of verisimilitude is one of the most important Popper's contributions to philosophy of science. It highlights the heuristic value of scientific theories even more than their empirical corroboration. What most improve the verisimilitude of new theories are the new facts that discover and predict, rather than the known facts that confirm them. "... Truth is not the only aim of science. We want more than mere truth: What we look for is interesting truth...truth that has a high degree of explanatory power, which implies that it is logically improbable" (Popper, 1963, 229). For these reason scientists should seek to refute and not to confirm established theories by means of the deductive method of empirical testing of hypothesis (*modus tollens*).

To solve the logical and empirical under-determination problem Popper formulates a fundamental methodological rule: "First a supreme rule is lay dawn... It is a rule which says that the other rules of scientific procedure must be designed in such a way that they do not protect any statement in science against falsification" (Popper, 1968, 54). This supreme rule means that we should never save the central hypothesis under testing from refutation, in order to promote scientific progress in terms of increasing the verisimilitude of new theories with greater explanatory power, which, according to Popper, is the main aim of science (Popper, 2012, 132).

If scientists seek to refute theories and hypotheses then it is possible to detect errors and overcome them through the formulation of bolder and better theories. This non-conclusive process of conjectures and refutations is not a logical algorithm to carry out by isolated scientist, rather is an intersubjective process that takes place in discussions and controversies within a community of scientists.

3. Rational criticism and open society

Popper remarks that "Intersubjective testing is merely a very important aspect of a more general idea of inter-subjective criticism, or in other words, the idea of mutual rational control by critical discussion" (Popper, 1968, 44). Edward Shills considers that intersubjective criticism is a civic virtue that sharply distinguish rational intellectual and political traditions from any kind of authoritarian traditionalism, which "...is not only hostile to liberty, it is also radically hostile to tradition... In societies where liberty has already been established, traditionalism is the greatest

enemy of civility...” (Shills, 1997, 116). Popper also considers that mutual control by rational discussion is an essential virtue for the rational development of intellectual and political traditions. Popper sustains that a free and democratic society, that is an open society, is interdependent with the broad tradition of intersubjective criticism where scientific tradition may grow. In this sense, Popper asserts “Science and more specific scientific progress are the results not of isolated efforts but of the free competition of hypothesis... Ultimately, progress depends very largely on political factors, on political institutions that safeguard the freedom of thought: on democracy” (Popper, 1960, 155). This thesis is very important because it establish certain social and political conditions for the progress of scientific traditions and, therefore, it represents some kind of social and political philosophy of science, which is one of the most promising perspectives in the field (Popper, 1957, Popper, 1994, Kitcher, 2001, Turner, 2003, Velasco, 2004, Reisch, 2005, Lopez & Velasco, 2013).

According to Popper, in addition of plurality and freedom of thought and communication, it is also necessary intellectual humility for the development of science in an open society. This attitude is a guiding principle of critical rationalism, which is not only a way of thinking, but also a way of living. He formulates this principle as an aphorism: “I may be wrong and you may be wright, and with an effort, we may get nearer to truth” (Popper, 1994, xii). This epistemic and moral attitude is very similar to Duhem’s *bon sens* that we discussed.

Unlike Positivists and Kuhn, Popper does not think that a common framework such as physicalist language or a paradigm is necessary to carry out critical communication between different persons or communities. As a radical hermeneutical philosopher, he believes in the capability of human beings for understanding expressions from different languages and cultures. Thus, incommensurability is not a threat to rationality, as Kuhn believed, but quite the contrary: “If the readiness [to learn] is there, the discussion will be the more fruitful the more the partners’ background differ. Thus, the value of a discussion depends largely upon the variety of the competing views” (Popper, 1963, 352).

Popper extends the virtues and benefits of plural discussions and controversies to the political realm: “The tradition of rational discussion creates, in the political field the tradition of government by discussion, and with it the habit of listening another point of view; the growth of a sense of justice; and readiness to compromise” (Popper, 1963, 352). Government by plural and rational discussion is the main feature of a democracy in open societies and prevents monolithic traditionalism and authoritarianism, especially authoritarianism based in the monopoly of supposed universal truth in a person, group or social class, such as the philosopher- king that Plato describes in *The Republic*. Popper criticizes this kind of authoritarianism, that we may call “epistocracy”, in his *Open Society and its enemies*, along with any kind of social determinism, specially what he calls “historicism”.

Popper explicates his concept of historicism in terms of an epistemic and a political thesis. The first one is this:” I mean by historicism an approach to the social sciences which assumes that historical prediction is the principal aim...” (Popper, 1960, 3). The second thesis refers to scientism in politics: “It is scientific reasoning, historicist social science, which alone can tell us the direction

reasonable activity must take if it is to coincide with the direction of impending changes” (Popper, 1960, 50). This thesis involves a justification of authoritarianism and even totalitarianism in terms of an alleged unquestionable scientific knowledge. This is the main reason of Popper's critique of historicism and the main motive of his defense of the open society based on the tradition of rational criticism of traditions, included of course scientific traditions.

4. Popper's theory of rational traditions

The concept of tradition is so important that Popper himself put forward a specific methodological proposal for understanding scientific traditions. This methodological proposal actually constitutes one of Popper's most valuable contributions to history and philosophy of sciences, and one that also distinguishes him sharply from reductionist analytic philosophers. Popper believed that his methodological proposal for social sciences, which he called “situational analysis,” actually constituted a hermeneutic proposal. By vindicating a hermeneutic method, Popper moved radically away from the Positivists, who were extremely scornful of hermeneutic methods in the social sciences.

Karl R. Popper put forward an original view of history and philosophy of science that was very influential in the second half of the Twentieth century. The main idea of Popper is that the development of scientific knowledge is conditioned by historically inherited theories, methods, criteria and values, which orient the posing of problems, the formulation of hypotheses and their rational acceptance or rejection. Popper calls these inherited elements “tradition”. Years later, philosophers of science like Kuhn (1959) and Laudan (1977) elaborated this concept as a central part of their respective models of scientific change.

Popper's formulation of his concept of tradition is a response to Oakeshott's article published in 1947, “Rationalism in Politics” (1967). In this paper, in addition to questioning the universalist claims of modern contemporary rationalism, Oakeshott defends the importance of traditions in the sphere of moral and political knowledge against the hegemony of science and technology. In response to Oakeshott, Popper writes the essay “Towards a rational theory of tradition”, originally a lecture given at Oxford in 1948. In this article, Popper extends the significance of tradition to science in a turn to ground the rationality of scientific knowledge on historical basis.

Popper opposes the rationalist conceptions of modernity that regard tradition as an obstacle to objective and rational knowledge based on indubitable sources (reason or experience). He agrees with Michael Oakeshott's criticism to modern and contemporary philosophies that conceives rationality and traditions as incompatible. By opposing science and tradition, modern philosophers not only overlook the historical fact that it is impossible for us to “free ourselves entirely from the bonds of tradition. The so-called freeing is really only a change from one tradition to another” (Popper, 1963, 122). In addition to ignoring this issue, rationalist philosophers lost sight that traditions provide us with knowledge that has been created over centuries and millenniums: “If we start afresh, then, when we died, we shall be about as far as Adam and Eve were when they died...

We must stand on the shoulders of our predecessors. We must carry on a certain tradition” (Popper, 1963, 129).

Another important function of traditions is the development of a critical attitude that enables scientists and philosophers to question and reflect on the givens of traditions in order to be able to free themselves from their prejudices and taboos. This liberation may be achieved through the reflexive acceptance of tradition or through their rejection and replacement with new contents or a combination of acceptance and innovation. In any case, critical understanding of traditions is essential for true rationalism: “... there are only two main attitudes possible towards tradition. One is to accept a tradition uncritically... The other possibility is a critical attitude, which may result either in acceptance or in rejection, or perhaps in a compromise” (Popper, 1963, 122).

Outstanding authors in hermeneutics such like Gadamer and Ricoeur subsequently developed the dialectic between conservative acceptance and innovative change of traditions. Gadamer, for example, thinks that tradition does not exclude change and transformation. “What is transmitted by tradition can be criticized, corrected and supplanted... [Conversely] in ages of revolution, far more of the old is preserved in the supposed transformation of everything than anyone knows, and it combines with the new to create a new value” (Gadamer, 2004, 282-283). Thus, conservation and change confront and complement each other in the continuous movement of traditions. Kuhn also highlights this “essential tension” between tradition and innovation in the historical process of sciences (Kuhn, 1959).

Popper recognizes two types of intellectual traditions. There are specific traditions comprising specific theories and myths produced and transmitted by previous generations, which constitute “traditions of the first order.” These traditions are the principal source of our knowledge, and provide the subject matter of rational criticism:

The fact that most of the sources of our knowledge are traditional condemns anti-traditionalism as futile. But this fact must not be held to support a traditionalistic attitude: every bit of our traditional knowledge is open to critical examination and may be overthrown. Nevertheless, without tradition, knowledge would be impossible” (Popper, 1963, 28).

The task of critical analysis of traditional knowledge corresponds to another type of tradition, which is a transhistorical metatradition, lacking specific cognitive contents and consisting of a critical attitude and methodology. This “tradition of the second order” is the critical rationalism invented by Greek philosophers over two thousand years ago and one that has continued to be the most important feature of scientific knowledge, even today: “The Greek philosophers invented a new tradition – the tradition of adopting a new attitude towards the myths, the tradition of discussing them” (Popper, 1963, 126). This critical tradition has overcome traditionalism and dogmas in order to live rationally in and through specific traditions in continuous transformation.

Specific traditions of the first order and the transhistorical tradition of the second order not only fulfill different functions (source and criticism of knowledge) but also have very different

characteristics. Traditions of the first order are plural, always emerge in specific historical contexts and change continuously as result of the critical evaluation undertaken on them from the tradition of the second order. This last type of tradition is unique, invariable and of universal scope. Specific traditions of the first order merely provide material for critical evaluation. Conversely, the critical tradition of the second order undertakes a critical scrutiny of traditions, thereby fostering their change and progress. However, the critical tradition seems that has not changed significantly since Greek Antiquity.

Popper applies the interplay between first and second order traditions to explain the historical origins of sciences: "If however, science advances by the tradition of changing its traditional myths, then... you need two beginnings for science: new myths and new tradition of changing them critically" (Popper, 1963, 130).

In sum, it is possible to explain the rational progress of science as a synthesis of the two types of traditions: A metatradition that continuously questions and change specific scientific traditions towards an endless approximation to truth (verisimilitude).

5. Hermeneutic method of situational analysis

In addition to proposing a philosophical model of scientific change through continuous criticism of traditions, Popper also put forward a hermeneutic methodology for understanding the rationality of scientific traditions. Popper sustains that "a theory of tradition must be a sociological theory, because tradition is obviously a sociological phenomenon" (Popper, 1963, 123). Insofar as scientific traditions are historical and social events, philosophy of science is also a socio-historical discipline. It is perhaps for this reason that Popper was interested in the methodology of social sciences, particularly in hermeneutic methodology.

Popper accepted the idea that understanding is the goal of the social sciences and the humanities. However, Popper believed that understanding is not exclusive to social sciences, or to the humanities, but was also the goal of all science, included natural sciences: "I am prepared to accept the thesis that understanding is the aim of the humanities. But I doubt whether we should deny that it is the aim of natural sciences also" (Popper, 1972, 185). Popper criticizes both the Positivists, who sought to impose a mistaken natural science model on any discipline, and the hermeneutic humanists, who mistakenly took positivism as the only philosophy appropriate conception for natural sciences. Thus, Popper defends a wide and radical hermeneutic conception of natural and social sciences alike.

Popper also questions some hermeneutical approaches and methodologies in history, like the subjective empathetic understanding method of *Verstehen* proposed by Dilthey and Collingwood. Instead of the method of *Verstehen*, Popper defends situational analysis as a method of objective understanding. He first refers to this method in *The Open Society and its enemies* (1945, Vol II, Ch. 14), and in *The Poverty of historicism* (1957, sec. 31), but he further explains his method in other works like "Toward a rational theory of tradition", originally published in the *Rationalist*

annual (1949) and reproduced in *Conjectures and Refutations* (1963, Ch. 4), and “On the theory of objective mind” reproduced in *Objective Knowledge* (1972, Ch. 4).

The Open Society and *The Poverty of historicism* were written at the same time in the context of Hitler, Mussolini, and Stalin authoritarian regimes. Both of them are works of political philosophy that intend to defend pluralism and personal freedom against totalitarian states that represent his “war effort” and “were meant as a defense of freedom against totalitarian an authoritarian idea and as a warning against the dangers of historicist superstitions” (Popper, 1977, 115). However, Popper points out that “Both grew out of the theory of knowledge of *Logik der forschung* and out of my conviction that our often-unconscious views on the theory of knowledge and its central problems (...) are decisive for our attitudes toward ourselves and towards politics” (Popper, 1977, 115).

The most important epistemic, moral and political attitude is precisely critical or rational attitude understood as “openness to criticism – readiness to be criticized and eagerness to criticize oneself...the demand to extend critical attitude as far as possible might be called ‘critical rationalism’” (Popper, 1977, 116). The conviction that critical rationalism is a common ground for the progress in the spheres of knowledge, society and politics constitutes the core of what he calls his “metaphysical research program” (Popper, 1977, 148-151).

The method of situational analysis involves reconstructing the “problematic situation” faced by a scientist as a rational agent whose actions or works we want to understand as appropriate solutions to relevant problems in order to achieve better explanations of interesting phenomena. In doing this reconstruction “...we have to distinguish clearly between the metatheories of the history of sciences and the problems and theories of scientist” (Popper, 1972, 177). Consequently, situational analysis is a reconstruction of plausible actions and decisions of a scientific agent as a rational response to a specific problematic situation in order to propose new hypothesis and theories with more knowledge content and more explanatory and predictive force. In this sense, situational analysis does not offer descriptions or social explanations of actual behavior of scientists.

The problematic situation consists of the problem to which the theory seeks to respond and the “background” or “cognitive framework” in which the author raises the problem and attempts to resolve it. “This background consists, at least, of the language which always incorporates many theories in the very structure of its usages and of many other theoretical assumptions, unchallenged at least for the time being” (Popper, 1972, 165).

It is important to stress the idea of background knowledge, precisely because it defines a set situation that enables a person to raise certain problems, conjectures, solutions and critically assess them. This notion of background may be replaced by the concept of tradition of the first order. Background knowledge or specific traditions constitute an essential theoretical framework for understanding the scientific theories of the past and for evaluating the author’s rationality for proposing and attacking or defending those theories. Imposing theories or concepts from outside the author’s context to evaluate the rationality of his theories and arguments constitutes a “failure of historical understanding” (Popper, 1972, 169).

In sum, the method of situational analysis aims to find out the reasons that a scientist could possibly have to rationally propose, accept or reject certain hypotheses within his particular cognitive situation or background. In this sense, Popper acknowledges the practical and contextual dimension of scientific knowledge and overcomes the merely theoretical and abstract conception of science. On this point Popper agrees with Neurath's criticism of Descartes' strict theoretical conception of science (Neurath, 1983) and anticipates the historical, social and pragmatic turn in philosophy of science.

Thus, for example, in the case of Galileo's theory of tides, which Popper recognizes as false from the outset, he shows the rationality underlying Galileo's decision to maintain the hypothesis of the Earth's circular movement. In contrast to Galileo's critics who accused him of being dogmatic, Popper pointed out that "Galileo's method was correct when he tried to proceed as far as possible with the help of the rational conservation law of rotary motions" (Popper, 1972, 174). Popper explained that the failure of Galileo's theory of tides was not due to a failure of rationality in his argument, but rather to a flaw in the framework or background of his particular problematic situation. Galileo was aware of the unsatisfactory nature of his theory, but inasmuch as he had no tradition of other theories and laws (such as forces of attraction, for example) in his background, he was unable to develop the solution that Newton subsequently formulated in another problematic situation and background.

This inherited knowledge or background traditions are part of the "third world" or "objective mind", in Popper's terms, insofar as it involves a world of autonomous cultural objects (theories, ideas, traditions, hypotheses, interpretations, etc), rather than subjective events, depending on specific individuals. Popper sustains "the superiority of the third world method -consisting of critically constructing problematic situations- over that of the second world, consisting of intuitively reviving a personal experience" (Popper, 1972, 170).

Popper does not ignore the important function of the author or agent in the maintenance and transformation of traditions, since although they define limits for posing and solving problems, they are also an object of questioning and criticism on the part of the author, which promote changes and innovations within the same traditions that are handed down to them:

Thus, we may say that the most lasting contribution to the growth of scientific knowledge that a theory can make are the new problems which it raises, so that we are led back to the view of science and of the growth of knowledge as always starting from, and always ending with, problems –problems of an ever-increasing depth, and an ever-increasing fertility in suggesting new problems (Popper, 1963, 170).

Popper states that is precisely the change in problematic situations, rather than the success of theories that determines the progress of the sciences. In this respect, the most important function of theories is to raise new problems whose solution requires a change in the background or tradition from which they originally emerged. Hence, we can conclude that for Popper, the heuristic function

of theories for discovering and formulating new problems is more important than the degree of corroboration of these theories, although this plays a central role too.” The history of sciences must not be taken as a history of theories but rather as a history of problematic situations and their modifications (sometimes imperceptible, sometimes revolutionary) through the interventions of attempts to solve the problems” (Popper, 1963, 222).

6. Summary and conclusions

Our analysis of Popper’s philosophy of science focused on the concepts of tradition and *situational analysis*. These concepts represent innovative aspects in Karl R. Popper’s philosophy of science that are not present in the most popular interpretations and they seem to be closer to the programs of history and philosophy of science of some of his critics such as Kuhn, Lakatos, and Laudan who fail to acknowledge Popper’s contributions to historical understanding of scientific rationality.

The most distinctive feature of this new historical conception of scientific rationality consists precisely of conceiving it as a process of continuous transformation of scientific traditions. This process consists of the critical and creative use of the theoretical resources that scientists inherited from their predecessors for raising new problems whose solutions require the transformation of inherited tradition. Thus, innovation, discovery and the heuristic force of hypotheses and theories constitute the determining factor in evaluating the rational progress of scientific traditions.

As we have seen, the historical understanding of the rationality of traditions requires the hermeneutic method of situational analysis. If we take situational analysis seriously, we must recognize that this method seeks to understand the actions, practices and products that scientists made to solve problems in their specific historical contexts. To achieve this objective understanding, we must try to reconstruct the particular background knowledge -constituted by inherited concepts, methodologies and theories from traditions- as well as the controversies that took place in a specific cultural atmosphere and social frame. Consequently, Popper acknowledges that philosophy of science, considered as historical and rational reconstruction of scientific traditions in specific contexts, is a social discipline but not necessarily a social science. Rather it is motivated by metaphysical ideas about society, history and scientific rationality.

If rationality of theories must be evaluated in terms of its contribution to the progressive change of scientific traditions by rational intersubjective criticism in specific contexts, then we should not impose ahistorically a universal method and standard, but we have to take into account those methodologies available in the specific circumstances of the tradition in question. Otherwise, we would make a “failure of historical understanding” (Popper, 1972, 174) which is also a philosophical misunderstanding of the rationality of scientific traditions.

Rational decisions in confirming or refuting scientific theories require not only sharp methods of empirical testing, but also intersubjective controversies, deliberations and prudential judgments, which are a kind of dialogical rationality similar to Duhem’s idea of *bon sens*. According to Popper this kind of practical rationality demands some objective and subjective conditions. The main objective requirements are plurality of opinions, hypothesis, theories, traditions, etc. and freedom

of intersubjective criticism which is the essence of critical rationalism. These objective and internal conditions require in turn some external conditions such as an adequate social and political frame that safeguards liberty of thought and communication, which may only flourish in an open and democratic society. The most important subjective requirements are intellectual humility, fallibilism and readiness to learn from other persons and different opinions, traditions and cultures. The more different they are from our own traditions, the more we can learn from them.

Subjective moral and intellectual virtues, are reciprocally reinforcing with objective intellectual, social and political conditions of an open and democratic society. The democratic institutions safeguard pluralism and freedom of thought and communication and, at the same time, fallibilism and intersubjective criticism foster government by discussion and plural deliberation, which are the core of a republican democracy. The interplay of scientific and democratic traditions suggested by Popper represents an important contribution to a broad and innovating political philosophy of science, which nowadays is one of the most promising perspectives in the field.

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