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KARL POPPER'S CONCEPTION OF METAPHYSICS AND ITS PROBLEMS

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Abstract. In this paper I intend to thoroughly analyse Karl Popper's relation to metaphysics. I start with his first writings, where he states the differences between science, pseudoscience and metaphysics. I then describe how his thoughts on the subject evolved to culminate in his reflection on metaphysical research programmes and the need for a revival of natural philosophy. A major concern is Popper's famous testability criterion to set apart science from non-science. I point at the problems of the conception of metaphysics as non-testable theories (which are similar to the problems of the conception of metaphysics as theories involving unobservables) and, in order to avoid these problems, I propose to retain nothing but the traditional conception of metaphysics as the general theories about the nature of the world. This leads me to the conclusion that science is not only an empirical task but also, and in a very important sense, a speculative one.

Keywords: Metaphysics; science; pseudoscience; testability; generality; speculation.

1. Introduction

A great ambivalence towards metaphysics can be detected in Popper's writings. It is also possible to detect a change in his views in the sense of an increasing appreciation of metaphysics. According to him, it is quite obvious that metaphysics cannot compete in excellence with science. Metaphysics is vaguer and inferior in many other aspects (Popper (1982) p.199). It is notably inferior in testability. However, Popper always looked at metaphysics as something important. But his main concern was science and that is perhaps the reason why he is not always precise about the meaning of the term 'metaphysics'. Here and there he uses the terms 'metaphysics' and 'philosophy' arbitrarily, but 'philosophy' usually encompasses ethical issues. He also makes no attempt to define metaphysics. He made it clear that he did not believe in definitions, which he associated with Platonic and Aristotelian Essentialism. For Popper, philosophy is not meant to answer the 'what is?' kind of question. Philosophy tries to solve problems.

2. Science, pseudoscience and metaphysics

Nevertheless, Popper briefly distinguishes three ways of using the term 'metaphysics' (1956, p.74):

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- the theories that cannot be verified (positivist way);
- the theories that cannot be tested (his own);
- general theories about the nature of the world (traditional way).

Popper fought against the first conception, not because he believed that metaphysics could be verified, but because he did not believe neither that science could be verified. He hence fought against the conception of metaphysics as a set of theories that contain unobservables (unobservables cannot be verified). Scientific theories that involve concepts that cannot be observed should not therefore be considered metaphysical, provided they have testable consequences (Popper 1956, p.108).

Popper proposed the second conception, derived from his well-known demarcation criterion between testable scientific theories and other non-testable theories. And he preserved the third conception. For example, atomism was a metaphysical system in sense 2 and in sense 3, i.e., 'in the sense that it was not testable, but also in the sense that it conceived the world in terms of a vast generalization, on the grandest scale: "There is nothing but atoms and the void. (Leucippus, Democritus)" (Popper 1956, pp.191–2).

In *Die beiden Grundprobleme der Erkenntnistheorie* (1930-1) Popper sets out the principles of his conception of the status of science and its relationship with metaphysics according to his demarcation criterion. Opposing the logical positivists' demarcation criterion based on the verification principle, according to which only scientific propositions have meaning, Popper distinguished science from metaphysics according to the testability criterion.

The testability of a theory[1] is, above all, the ability to conceive an experience capable of refuting it; is to be empirically falsifiable. Testable theories run the risk of being refuted through the submission to empirical tests. What distinguishes the claims of science is that they have this ability. But scientific theories *are not verifiable*: they cannot be confirmed or proved to be true through testing, as the logical positivists claimed. All scientists can get with tests is either a falsification or a corroboration (a result that does not refute those theories). Corroboration does not imply, however, that the theories are true.

Metaphysical theories, as scientific theories, are unverifiable, i.e., they cannot be considered true. But differently from scientific theories, they are not testable. Therefore, they are not falsifiable. We cannot envision an experience to refute metaphysical theories. For instance, metaphysical theories in favour of determinism or indeterminism, of realism or idealism, cannot be definitively corroborated or refuted. However, given that metaphysical theories, as scientific theories, are attempts to solve certain problems, they are criticisable. They are criticisable in view of the problem they intend to solve, even though the solution presented is never final. But it is possible to discuss whether, for the time being, they solve the problem or

not, whether the solution is fruitful and if it does not contradict previously accepted knowledge.

As for scientific theories, they are not only open to criticism but they are also empirically falsifiable. However, the falsifiability of a theory is not a condition for it to be meaningful. It is just the condition for it to belong to the scientific domain. Metaphysical theories, just like scientific theories, are meaningful and endowed with interest. In *The Demarcation between Science and Metaphysics*, penned in 1955, Popper introduced an image to illustrate the relationship of science to metaphysics and meaning: the square (1963, pp.341–94). Imagine a square that represents the set of statements of a language in which we want to make science. The square should then be divided with a horizontal line in an upper half and a lower half. In the upper half write 'science' and 'testable', and in the lower half, 'metaphysics' and 'non-testable'. Thus we can see that metaphysics does not lie outside the limits of language, of meaning (the square). Metaphysics cannot be banned as meaningless; the logical positivists were wrong. Meaning does not coincide with testability. Metaphysical ideas are meaningful ideas, even if they cannot be empirically falsified through the confrontation with experiments taking place in defined spatio-temporal coordinates.

Popper warns, however, that there are some theories that pretend to be *verifiable* while they are not. But those are not, he stresses, metaphysical theories. They are rather theories that belong to what should be classified as pseudoscience. Pseudoscience claims to be science but is based on the wrong idea of science as something verifiable (the wrong idea of the logical positivists). Thus, instead of the typical falsifiability of science, i.e., its typical demand of unfavourable cases, pseudoscientific theories support their ideas through the enumeration of cases that allegedly 'verify' them, i.e., thorough the accumulation of favourable cases.

In addition of resting on a misconception of science as something verifiable, it is also characteristic of pseudoscientific theories to shun falsification. And how do they do it? By including theses that allow them to pervert the result of a falsification in a way that it looks like as yet another alleged verification. According to Popper, this is the case of psychoanalysis — originally a metaphysical theory —, Marxism — originally a scientific theory because it was refuted —, and astrology. It was their refusal to run the risk of refutation, their immunization against criticism that made of them all pseudosciences.

Taking into account that for Popper rationality is the submission to criticism, pseudosciences should thus be considered irrational. Any theory, be it scientific or metaphysical, is rational as long as it is a sincere attempt to solve a problem, therefore exposing itself to criticism. Unlike pseudosciences, both science and metaphysics make use of the rational method, the critical method. Popper not only believed that both science and metaphysics share the same goal — to understand the world — but he did not distinguish the philosophical method from the scientific method. The

rational method consists in detecting a problem and discussing it critically, proposing solutions, building conjectures and evaluating them. It is the method of trial and error[2] that consists in the following steps: at first, a problem arises; subsequently, theories are created in order to find solutions; then, these theories are evaluated through criticism (if they are not scientific), or through criticism and severe empirical testing (if they are scientific), testability being a kind of especially scathing criticism. The result can then be the elimination of errors and the adoption of a particular theory because, for example, it allows unexpected discoveries that rival theories do not. The cycle restarts with the emergence of new problems; but it restarts departing from the previously accepted version of knowledge. This is, according to Popper, the only human method of acquiring knowledge: a knowledge that is always provisional and subject to deception.

In view of this, and following the very train of Popper's thought, I must conclude that in authentic metaphysics there is no room for dogmatism, i.e., no escaping from criticism. The true meaning of 'dogmatic' is this, 'escaping criticism', and not 'the absence of an empirical basis'. Authentic metaphysics, by its own conjectural nature and its rational and non-testable nature, cannot be dogmatic. 'Dogmatic metaphysics', sadly a common expression, is therefore a *contradictio in terminis*.

I hence propose a clarification or extension of Popper's thought: to designate as 'pseudometaphysics' what he simply called 'bad metaphysics'. Pseudometaphysics, similarly to pseudosciences that immunise themselves to testability, are alleged metaphysical theories that, using subtle mechanisms of self-contradiction, immunise themselves against criticism. They are 'pseudo' because authentic metaphysical theories are the ones that, though untestable, can be defended or criticized rationally. Therefore, Popper's criticism is never directed against what is untestable, but against what is 'pseudo'. Rationality is not restricted to testability, i.e., not restricted to science. However, it is absent in pseudoscientific and pseudometaphysical theories.

But why are their theories not testable, if metaphysicians, unlike the proponents of pseudoscientific and pseudometaphysical theories, do not fear criticism? Popper answers as follows: a metaphysical system is a theory or set of theories whose level of universality is so high that it ends up in a hopelessly distant level from the testable science of an era (1935, p.277). At the time, no crucial experiment can be conceived to test that metaphysical system. This is why, according to Popper, the theories of Aristarchus and Copernicus were, at their inception, not scientific, but metaphysical: none could suggest a crucial experiment to refute them (D. Miller 1974, p.120). But the failure in discerning an empirical refutation for metaphysical theories (during a period of time or, perhaps, forever) does not make them meaningless or illegitimate.

3. A rather indistinct distinction

Curiously enough, it was Popper's very demarcation criterion (testability) between science (testable) and non-science (non-testable) that led him to the seemingly paradoxical conclusion that science incorporates elements that are not testable and that metaphysics can become testable; and hence it is not possible to draw a line separating metaphysics from science once and for all — those are shifting sands. He promptly recognized that his criterion cannot be too strict when distinguishing science from metaphysics. The line of demarcation is too fluid: 'As far as science and metaphysics are concerned, I certainly do not believe in anything like a sharp demarcation.' (Popper 1956, pp.159–60). If we mind looking at the history of science we have to arrive at the conclusion that '(...) in almost every phase of the development of science we are under the sway of metaphysical — that is, untestable — ideas.' (Popper 1982, p.161). Metaphysical ideas and problems have dominated the development of science for centuries (Popper 1956, p.192–3).

As early as 1934, in his *Logik der Forschung* (The Logic of Scientific Discovery), Popper argued that, to get a picture of the evolution of science, ideas and hypotheses should be visualized as particles suspended in a fluid of metaphysics (1935, pp.277–8). Testable science is the precipitation of those particles at the bottom of the vessel, where they settle down in layers of universality. The thickness of the deposit grows with the number of layers. Each new layer corresponds to a theory more universal than those that lie beneath it. As a result of this process, ideas that floated in the high metaphysical regions can sometimes be reached by the growth of science. By making contact with science, they settle on the bottom.

We can infer from this picture of the evolution of science as a gradual transition from metaphysics to science that, according to Popper, science emerges from metaphysics. At the same time, science transforms metaphysics by making it, or at least some of it, scientific: '(...) the transition between metaphysics and science is not a sharp one: what was a metaphysical idea yesterday can become a testable scientific theory tomorrow; and this happens frequently' (D. Miller 1974, p.123).

That this transformation of metaphysics into science causes a feeling of strangeness it is only natural. For example, Elie Zahar remarked that 'a statement is after all either scientific, i. e., empirically falsifiable, or else irrefutable and hence metaphysical; so we have here two disjoint classes which seem to leave no room for an intermediate category.' (2007, p.207). For Popper, however, this is true only if the factor time is introduced, i.e., it is true for a certain period of time. However, the situation may evolve. We do not need to introduce an intermediate category to blur the boundaries between what is refutable and what is irrefutable, since there is room for an evolution from one to the other. A metaphysical theory, even if it is completely metaphysical during a certain period of time, may not be metaphysical forever, for it

can become testable. And, to understand this evolution, it is better to think in terms of ideas and theories, instead of isolated statements or propositions.

Nevertheless, as notes Musa Akrami (2009, pp.397–416), it is difficult to see how the testability criterion, which is intended to distinguish between testable science and non-testable pseudoscience and metaphysics, can be combined with this image of science coming from a metaphysical fluid.

The thing is, though Popper preaches for the need of a demarcation criterion, his own cannot be applied once and for all: what is not testable now may become testable in the future, may eventually become part of science. As a consequence, it may seem somewhat superfluous and contradictory to conceive a demarcation criterion for something that cannot be clearly demarcated... Popper himself recognizes that *the meaning* of the demarcation between science and metaphysics, 'if any, should not be overrated' (1956, p.161). However, he warns, *the problem* of demarcation is highly meaningful, because all important problems of the logic of science are related to it: for example, the problem of the rationality of scientific hypotheses is associated with their testability; and the problem of choice between theories is related to the possibility of demarcating rational theories from irrational beliefs (Popper 1956, p.162). The point is therefore *rationality*; i.e., as we have seen, his main concern was to distinguish science from irrational pseudoscience and pseudometaphysics, much more than to distinguish between rational science and rational metaphysics.

But because the fate of some good metaphysics is becoming part of science, authors like Musa Akrami (2009, p.397–416) and Thomas J. Hickey (1995/2005), consider with some pertinence that for Popper metaphysics has a residual role for science. Seemingly, for Popper, the virtue of metaphysics depends on the quality of its contributions to science; science is the measure of its value.

4. Back to natural philosophy

However, things are not so simple. Actually, Popper encompasses both metaphysics, philosophy of science and science in what was once called 'natural philosophy'. And the value of all three of them actually depends on their contributions to *natural philosophy*.

As Nicholas Maxwell duly noted at the opening of his article *Popper's Paradoxical Pursuit of Natural Philosophy* (2004), for Popper philosophy of science is not a simple meta-discipline whose subject is science, being, in this sense, divorced from science. And philosophy of science is even less a discipline devoted to technical issues concerning the meaning of the words of a language, or to the conceptual analysis and the justification of propositions. Popper never showed interest in language and in debates about words. He did not believe that we could understand science through the

analyses of the meaning of words (his arguments with Wittgenstein are legendary).

Popper's conception of philosophy of science is close to natural philosophy as it was practiced in the time of Galileo, Descartes, Newton and Leibniz: an interpenetration of metaphysics, philosophy, physics, mathematics, astronomy. And natural philosophy has its roots in the pre-Socratic thought whose central theme was the study of the structure of the universe and our place in it.

According to Popper, neither science nor philosophy can abandon the pre-Socratic idea of an underlying unity of everything. At the end of Quantum Theory . . .'s 'Metaphysical Epilogue' (1982), Popper states that the most appropriate aspiration a metaphysician can have is to bring together all the aspects of the world (not only scientific) in a unified picture capable of enlightening men, an image that may one day become part of a better image, more comprehensive and truer.

Popper usually prefers the word 'cosmology' to describe that conjoint activity of science and philosophy: 'All science is cosmology, I believe, and for me the interest of philosophy, no less than science, lies solely in the contributions which it has made to it.' (1935 p.xviii). The term 'cosmology' can be found in several passages of his works, not only associated with science but with metaphysics and philosophy: '(. . .) it is a fact that purely metaphysical ideas — and therefore philosophical ideas-have been of the greatest importance for cosmology. (. . .), metaphysical ideas have shown the way.' (Popper 1935, p.xxiii). In Quantum Theory . . . (1982), however, he uses the term 'natural philosophy' ('all civilizations of which we have knowledge have tried to understand the world in which we live, including ourselves, and our knowledge: it is the great task of sciences and of natural philosophy to paint a coherent and understandable picture of the world. All science is cosmology.' Popper 1982, p.1) to name what he previously referred to as the 'problem of cosmology': 'I, (. . .) however, I believe that there is at least one philosophical problem in which all thinking men are interested. It is the problem of cosmology: the problem of understanding the world — including ourselves, and our knowledge, as part of the world.' (1935, p.xix). Since 'cosmology' is now a recognized scientific discipline, we will prefer, as Maxwell does (2004), the term 'natural philosophy'.

Popper was quite clear in maintaining that natural philosophy (cosmology) belongs legitimately to philosophy: 'To say that since it deals with factual issues it must belong to science rather than to philosophy is not only pedantic but clearly the result of an epistemological, and thus of a philosophical, dogma.' (1963, p.98); this is so even though he acknowledged that, taking into account some of its methods, cosmology had gained a great affinity with what may be called more properly 'physics' (1963, p.98). But, as we have seen, for Popper all science is natural philosophy (cosmology). Theoretical physics is part of natural philosophy, in the sense that it aims at improving our understanding and knowledge about what lies behind what we observe in the world, and in terms of which the observable phenomena can be

explained and understood. On the other hand, metaphysics is also part of natural philosophy: the usefulness of metaphysics is to contribute to natural philosophy, the endeavour to understand the world and our knowledge of the world. Popper saw himself as an amateur natural philosopher, an amateur who conceived a research programme characterized by realism, by indeterminism, the idea of the reality of dispositions, the interpretation of probability as propensity in quantum mechanics, and by a rationalistic and evolutionary epistemology.

Taking into account Popper's demarcation criterion, and since what characterizes natural philosophy is a union of metaphysics and science, therefore, natural philosophy, as indeed science itself, branches off, on the one hand, in testable science, and, on the other, in untestable metaphysics.

Let us not forget that, for Popper, the problems of philosophy are problems that are not 'purely' philosophical. This is why metaphysics is able to serve natural philosophy. Actually, Popper suspects that, in general, there are no 'pure' philosophical problems: 'Genuine philosophical problems are always rooted in urgent problems outside philosophy and they die if these roots decay.' (1963, p.95). They may be originally mathematical, physical, political, religious, social, artistic, etc., problems. Therefore, it is possible to correctly name a problem as philosophical, in case it is more related to the problems and theories discussed by philosophers than to the theories investigated by science, even if it stemmed from science (it is the case, for example, of the problem of indeterminacy in quantum physics): 'The fact that experimental work is done in connection with them does not make them nonphilosophical.' (Popper 1992, p.13)

There are therefore genuine, if not 'pure', philosophical problems. Scientific problems are not the only genuine problems, says Popper, hence disagreeing again with Wittgenstein (1992, p.11). There are genuine philosophical problems, and they are philosophical even if they incorporate factual components, similarly to many problems in physics involving a strong mathematical component. But Popper does not even believe in this kind of classification. What matters are the problems, not the disciplines. To classify a problem as belonging or pertaining to science or to philosophy is to yield to a distinction between disciplines that was carried out for historical and administrative reasons. The problems of natural philosophy cross the borders of all disciplines, philosophy (metaphysics, epistemology, ethics ...), physics, biology, history, etc.[3]

5. A metaphysically programmed science

When Popper developed his reflection on what he called 'metaphysical research programmes' it became even clearer that the testability criterion leads to the conclusion

that science incorporates elements that are not testable and that metaphysics can become testable.

From the late forties of the 20th century on, Popper clearly argued that metaphysics is an inseparable part of scientific thought. He asserted the existence of metaphysical research programmes in the history of science. This is what Professor Rafe Champion describes as Popper's 'metaphysical turn' (2013). It consisted in the recognition of the presence of metaphysical ideas that form a framework of assumptions and presuppositions for scientific research.

It should be borne in mind that, for Popper, the central problem of epistemology is the growth of knowledge. It is therefore of primary importance to recognize the fact that metaphysics plays such a big role in this growth.

During the fifties, photocopies of pages about the metaphysical research programmes that Popper was preparing as the addendum of his *Logik der Forschung*, circulated among his colleagues and students at the London School of Economics, and were then much discussed. Popper himself states that he started speaking in classes about metaphysical research programmes since 1949 (1992, section 33). However, the volume's publishing was delayed, and for so long that the three volumes of the Postscript of Logik der Forschung were published only in the early eighties: *Realism and the Aim of Science, The Open Universe: an Argument for Indeterminism* and *Quantum Theory and the Schism in Physics*. The latter contains the 'Metaphysical Epilogue' which was the source of inspiration, through the photocopies of the fifties, of Imre Lakatos and his 'methodology of scientific research programmes'. This is the reason why Lakatos' notion of 'scientific research programmes', his personal version of Popper's unpublished papers, as well as his lessons, went public first (Champion (2013) and also note 42 by the editor in the Preface of Popper 1982, p.32). About the change of name by 'some of my colleagues,' Popper remarks (1982, p.32) that the programmes certainly belong to science, but they don't have the testable nature of scientific theories, are much more difficult to criticize, and therefore easier to follow uncritically. And, in case the programmes become scientific theories, then there is no reason to designate them as 'research programmes'.[4]

The term 'metaphysical research programme' (henceforth MRP) designates, in the words of Popper, 'a possible framework for testable scientific theories.' (1992, p.195). It is a set of criticisable, but not testable, metaphysical ideas which tend to unite and support one another. They result from general visions of the nature and structure of the world and general visions of the problem of physical cosmology. And they are 'research programmes' because they give science a goal. They provide the criterion for evaluating the success and the innovative power of theories as explanations of phenomena. They guide the formulation of big hypotheses to be subjected to empirical testing. And they incorporate a vision of the most pressing problems, as well as a general idea of what can be accepted as suitable solutions for those

problems and of what is a true discovery (Popper 1982, p.161). In short, a MRP is a scientific development of metaphysical ideas. The term 'programme' also suggests a certain historical continuity; it refers to something that remains the same during a certain period of time, in spite of changes in the status of testable theories.

What is thus at play here are neither arbitrary nor subjective criteria that can be reduced to social, material and ideological bases. MRPs are truly intellectual strategies, heuristic hypotheses suitable for the advancement of an investigation. This is the reason why there is a metaphysics operating in virtually all stages of scientific activity, a metaphysics with a regulating role that shows in which direction to go.

6. Criticism

Due to the fact that, in general, MRPs are implicit in the theories, attitudes and judgments of the scientists, they are rarely discussed. Popper is aware of the risk that MRPs run when conveyed by educators in an unconscious way and are uncritically accepted by generations of scientists. It is because they are often subliminally accepted, through a tacit agreement among the scientists of an era, that they can become an obstacle to scientific development: 'These programmes are only occasionally discussed as such: more often, they are implicit in the theories and in the attitudes and judgments of the scientists.' (Popper 1982, p.161). When accepted uncritically, they are difficult to detect by their own followers.

But problematic situations happen in science, especially when there is inconsistency in theories; or when there is inconsistency between theory and experiment (falsification of theories); and, more important, when there is inconsistency between the theories and the MRP. Then scientists become aware of the MRPs, says Popper. A suspicion that the adopted MRP is based on a false metaphysics arises when it leads to bad results or debouches in a deadlock. An unexpected discovery (the case of quantum physics) or the creation of a new theory capable of shaking the *status quo* (the case of Einstein's relativity) may also require a new and revolutionary MRP. Scientists start thinking that the adopted MRP is neither the only heuristics possible, nor even the most fruitful one, and consider the possibility of alternatives (Popper 1982, p.33). Therefore, even if the acceptance of a MRP may be implicit, it does not mean that they are not open to discussion and revision. Although irrefutable, the MRPs are open to discussion. If scientists become aware of their presuppositions, criticise them and arrive at the conclusion that they do not meet the initial expectations the MRPs can be modified or replaced. This is why criticism, not the encomium, of these programmes should be encouraged.

A programme's metaphysical core is not testable but this is exactly why criticism is necessary, as only criticism can lead to the reformulation and reconceptualization

of the problems involved. Popper differs, not only from Lakatos, but also from Kuhn whose paradigms are not subjected to criticism. In the 'Introductory Comments' of *Quantum Theory* ... (1982), Popper himself compares his MRPs with Kuhn's concept of 'paradigm', pointing out that MRPs must be seen as a situation that can be rationally criticised and that scientific revolutions should be viewed as paradigm shifts that are the result of rational criticism (1982, p.31–2).

7. The weakness of Popper's conception of metaphysics

Popper's attempt to revive natural philosophy, as well as his meditation around metaphysical research programmes show evidence of his recognition of the presence of metaphysics in science. The point to remember is that, when Popper recognizes that science adopts metaphysical research programmes, he is acknowledging that the same science that, according to his demarcation criterion, was 'testable', eventually includes, in its very core, presuppositions, basic principles and methodological conventions that are not testable. And if these resist to severe criticism they may legitimately continue to be adopted — even though it is not possible to make them testable.

When thinking about Popper, what comes to mind is this emblematic theme of his philosophy: testability as the demarcation criterion between science and non-science. Although Popper was the creator of this conception, it is now being used by many other philosophers of science. For example, Elie Zahar sees the atomistic hypothesis as metaphysical, not because it is a general theory about the nature of reality, but because it was not testable at the time it was conceived:

> The Greeks put forward atomism in response to a purely philosophical problem: that of reconciling the Parmenidean thesis of the immutability of Being with the undeniable existence of phenomenal change. (...) The hypothesis was initially untestable and hence metaphysical; for any observable state-of-affairs could be claimed to have arisen from the movement of some system of atoms, the latter being provisionally left unspecified (2007, p.208).

Yet, we have seen that for Mukrami and others, the greatest problem of Popper's conception of metaphysics as a set of theories that are not testable is the 'mysterious' passage from metaphysics to science, from non-testability to testability. I am going to argue that this problem derives from the very conception of metaphysics at play here, a set of theories that are not testable.

For Popper, the ten most important MRPs in the history of science were Parmenides' block universe; the atomism of Leucippus and Democritus; the geometrization of Pythagoras, Plato, Eudoxus, Calipo, Euclid; the essentialism and potencialism

of Aristotle; Renaissance physics, a synthesis of Platonic geometrization and atomism (Copernicus, Bruno, Kepler, Galileo, Descartes); Hobbes', Descartes' and Boyle's theory of the clock-universe; Newton's, Leibniz's, Kant's and Boscovich's dynamism; Faraday and Maxwell's fields of forces; the unified field theory of Riemann, Einstein and Schrödinger; Born's statistical interpretation of quantum theory (1982, p.162–4). Besides these, he considered metaphysical (because non-testable at some point in time) Aristarchus' and Copernicus' theories, the theory of evolution, the cell theory, the theory of bacterial infection, sensationalism, and psychoanalysis, provided it is not interpreted as constantly being verified (therefore becoming a pseudoscience).

In addition, in many of his works, Popper emphasizes that great services to science were rendered by such *metaphysical* theories as atomism, the corpuscular theory of light and the theory of terrestrial motion. They became scientific when they eventually became testable, i.e., when they were presented in a falsifiable way, which means it was possible to choose empirically between them and rival theories.

I shall not analyse these examples one by one here, but just a glimpse at this impressive list is enough to conclude that we face theories that are extremely different from one another. Yet the testability criterion allows Popper to consider both the atomistic theory (which was indeed a metaphysical theory about the general nature of reality) and the theory of bacterial infection as metaphysics. It allows him to consider realism or idealism, determinism or indeterminism, the Theory of Forms *as well as* the corpuscular theory of light or the theory of terrestrial motion as metaphysics.

How can this be acceptable? It is true that at least at some point in time all of these theories were not testable, but is this enough to classify all of them as metaphysical? I will argue that non-testability is a necessary but *not sufficient* reason for a theory or a hypothesis to be classified as metaphysical. Due to their very nature — theories about the general nature of reality — all metaphysical theories are indeed non-testable, but not all non-testable theories should be considered metaphysical.

It is clear that we are adopting here nothing but the traditional conception of metaphysics which Popper adopted as well but to which he added his own conception. Why wasn't the traditional conception of metaphysics enough for him? Why did he have to emphasize the testability factor, when metaphysics, general theories about the world, are not testable anyway due to their very nature?

I believe that Popper had to emphasize the testability factor because his main concern has never been to distinguish science from metaphysics, but to distinguish science from pseudoscience. For a short time in his youth, Popper was a Marxist; he also studied diligently the works of Freud and Adler. These doctrines, which he later classified as pseudosciences, quickly disillusioned him and, as a result, fuelled his admiration for genuine science. This led him to the pursuit of a criterion to distinguish scientific theories from non-scientific theories.

Popper subsequently demarcated science from pseudoscience according to the

testability criterion. The problem is he did not stop to demarcate pseudoscience from metaphysics clearly. He included both of them in the non-testable theories drawer. However, as we saw, he himself pointed in passing an important difference between metaphysics and pseudoscience (and pseudometaphysics): criticisability. Metaphysical theories can be submitted to criticism, while pseudoscientific theories (and pseudometaphysical theories) avoid criticism.

What I think is lacking in Popper's thought is the next step: to make more of the traditional conception of metaphysics and state that albeit both metaphysics and pseudoscience being sets of non-testable theories, metaphysical theories are *general* and *criticisable*. Pseudoscientific theories are *non-general* and *non-criticisable*, while pretending to be scientific. Pseudometaphysical theories are *general* but *non-criticisable*. And scientific theories are *non-general* and *criticisable* (even testable). *Generality*, not only criticisability, is a key point. If Popper had undertaken this step then he would not have stated, as he did, that both the original atomism *and* the theory of bacterial infection were metaphysical theories.

Popper's conception of metaphysics suffers from the same problem of another conception of metaphysics at play in the philosophy of sciences: the conception of metaphysics as theories involving unobservables, i.e., that relate to processes and entities to which there is no empirical access or which can be detected only indirectly. The conception of metaphysics as the set of theories involving unobservables allows us to consider the hypotheses of the existence of the neutrino and the positron at the time they were conceived as metaphysical, because neither the neutrino nor the positron were then observable (the existence of the neutrino took twenty six years to be corroborated while the existence of the positron took only six years). But we would rather consider them as scientific hypotheses.

These two conceptions of metaphysics simply generate too much confusion in the philosophy of sciences; they do not help to understand science nor metaphysics. The confusion can be dissipated, however, if we stick to the traditional conception of metaphysics. According to this conception, atomism was indeed a metaphysical theory, a general theory about the nature of the world; but the corpuscular theory of light and the theory of terrestrial motion were originally theories of *speculative physics*. The same goes for the theory of cell and bacterial infection that Popper viewed as metaphysical but should rather be considered as speculative science or, in this case, *speculative biology*. And the neutrino and positron hypotheses were *speculative physics*. This is so, not because these hypotheses were born in a scientific context, but because they do not present the required degree of generality. This does not mean, however, that metaphysical presuppositions were not involved. For instance, in the case of the neutrino, the metaphysical presupposition that there is always something preserved through change was involved.

Popper himself sometimes tellingly hesitates in what nomenclature to apply and

speaks of 'speculative physics': 'Such research programmes are, generally speaking, indispensable for science, although their character is that of metaphysical or speculative physics rather than of scientific physics.' (1982, p.165). Curiously, in order to keep his demarcation criterion, Popper prefers to associate 'speculative physics' to 'metaphysics' than to associate it to 'physical science'.

Nevertheless, hypotheses that cannot be empirically corroborated or refuted but have a particular or local nature, i.e., they apply to specific entities and specific, local problems —such as the bacterial hypothesis or the hypotheses about specific atomic particles —should not be considered metaphysical.

Although there are generalizations in science, scientific statements, *stricto sensu*, are not absolutely universal. Take the case of a metaphysical statement like 'There is only one substance', be it energy, field forces, corpuscules, spirit, God ... This claim has a high degree of generality, since it concerns all the entities which depend upon one substance. As Kit Fine says, in metaphysics we do not talk of cats and dogs or electrons and protons but of material particulars; we do not talk of thunder and lightning or wars and battles but of events (2012, p.16). Due to this degree of generality, metaphysical statements do not refer to anything in particular. Generality in science, however, is restricted to a given set of entities. Therefore, what follows the quantifier 'all' is a specification, like 'all planets', 'all molecules', 'all virus'. Generality in science can also be spatial or temporal, as in the case of the ether. Ether was postulated to fill all the empty spaces. But the theory concerned something particular, ether, not the fundamental nature of the world. Nonetheless, as a scientific theory, it was based on metaphysical presuppositions. The character of spatial generality of the theory was, for a start, based on the metaphysical presupposition of the uniformity of nature.

Therefore, my position implies the refusal of Popper's demarcation criterion.[5] Localized and restricted theories should be considered scientific, even though a crucial experiment cannot be conceived for them. I thus believe that there are scientific hypotheses that are not testable or are unobservable; I believe that scientific theories typically have testable parts and parts that are non-testable or are unobservable; moreover, I believe that scientific theories have parts that are metaphysical (for example, everything is energy; indeterminism reigns in the universe, time is continuous, the whole is the sum of its parts, etc.).

If we accept that science is not only empirical, but also speculative, then not all theories that contain unobservables or are non-testable are metaphysical. And we should accept it, as 'empirical science' is a highly imprecise expression. A glance at the history of science is enough to arrive at the conclusion that science is far from being carried on solely through empirical testing (testing would not even be possible without theory, as Popper repeatedly wrote).

As I see it, speculation in science occurs in two fronts: localized speculation,

what I called 'speculative science', and metaphysical speculation, the development of general theories about the nature and structure of reality. Metaphysical speculation is not a task reserved to philosophers. Scientists become metaphysicians when they elaborate general theories about the nature and structure of reality as a whole (though they may also adopt a ready-made metaphysics, as it happened with atomism). An example of metaphysics made by scientists is Faraday's theory of the universe as a field of forces; it also seems to be the case of the superstring theory whose scientific status is under discussion, largely due to its distance to the empirical realm. Even though today's metaphysical theories made by scientists have the particularity of being largely mathematized, they share with the philosophers' metaphysics such a high degree of generality that they cannot be thoroughly corroborated or thoroughly refuted.

As they often have parts which are speculative, scientific theories cannot be said to be testable *tout court*, but only partly testable. Speculative science is meant to become testable sooner or later. However, metaphysical parts of scientific theories cannot become testable. Therefore, what Popper defended, that metaphysical theories can become testable, does not *stricto sensu* occur. Metaphysical theories can be, however, abandoned by science, in case they are not inspirational or prove to be scientifically unmanageable, as Descartes' vortex theory was abandoned in favour of atomism. The only possible 'test' of a metaphysical theory (and associated methods) that gives rise to a programme is thus indirect. A metaphysical theory proves its value in the testable theories and the experimental results that are developed under its guidance. When evaluating a MRP from the perspective of a scientist, what should be taken into account is whether it is fruitful for science or not, as well as the strength, when confronted with experimental tests, of the explanatory theories developed inside its framework.

The upshot is, if we accept that science is not only empirical, but also speculative, then we can abandon the conceptions of metaphysics as theories that contain unobservables or that are not testable, retaining nothing but the conception of metaphysics as general theories about the nature and structure of reality (which are unobservable and are not testable due to this very degree of generality). In fact, I believe that, in order to show the presence of metaphysics in science it is suffice to retain the traditional concept of metaphysics.

With this in mind, to figure out whether scientific hypotheses about unobservable or non-testable entities and processes are metaphysical or empirical would become less confusing, though distinctions are always complex in practical terms. But I am far from trying to present a strict demarcation criterion between scientific and metaphysical hypotheses. This is not even desirable, since what really matters is to acknowledge that there are metaphysical hypothesis at play in scientific theories.

8. Conclusion

In spite of the problems involved in his conception of metaphysics, Popper should be considered a metaphysics-friendly philosopher. Admittedly, sometimes he behaved like a reluctant friend, and no doubt his favourite friend was testable science. But his friendship with metaphysics blossomed over time as he recognized its great deeds. In the decades when positivism ruled over the Anglo-Saxon philosophy of science, Popper was a pioneer in the rehabilitation of metaphysics. Moreover, he preserved the traditional conception of metaphysics as the general theories about the nature of the world. Kant did not influence him to the point of making him a non-realistic. Since the beginning of his philosophical career, and against the logical positivists, Popper readily reckoned that metaphysical statements had meaning. Later, with his metaphysical research programmes, he ascribed a very important role to metaphysics in the growth of scientific knowledge. He urged metaphysicians to create unified theories of the world. And he tried to reassemble science, metaphysics and philosophy in an attempt to revive natural philosophy. We should bear in mind that this took place at a time when practitioners of science had been convinced, for almost two centuries, that it was not necessary for them to waste time with metaphysical or epistemological problems to be successful. In view of this, as Maxwell puts it right at the end of his (2004) article, Popper's attempt to revive natural philosophy was 'little short of heroic.'

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Resumo. Com este artigo pretendo levar a cabo uma análise aturada da relação que Karl Popper manteve com a metafísica. Começo com os seus primeiros escritos, nos quais Popper estabelece as diferenças entre ciência, pseudo-ciência e metafísica. De seguida, relato como evoluiu o seu pensamento acerca da questão em apreço até culminar numa reflexão sobre programas metafísicos de investigação e sobre a necessidade de renovar a filosofia natural. Uma preocupação maior é o famoso critério de testabilidade de Popper para diferenciar a ciência da não-ciência. Aponto alguns dos problemas da concepção de metafísica como as teorias que não podem ser testadas (que são semelhantes aos problemas da concepção de metafísica como as teorias que contêm inobserváveis) e, de modo a evitar esses mesmos problemas, proponho que se retenha apenas a concepção tradicional de metafísica como as teorias gerais acerca da natureza do mundo. Isso leva-me à conclusão de que a ciência é não só uma tarefa empírica mas, num sentido muito importante, é uma tarefa especulativa.

Palavras-chave: Metafísica; ciência; pseudo-ciência; testabilidade; generalidade; especulação.

Notes

[1] I write about theories instead of propositions, because Popper does not endorse the idea that a scientific theory is established by examining the meaning of its propositions. Contrary to what the logical positivists claimed, neither science nor metaphysics are reducible to their language. Therefore, Popper's testability criterion is intended to be applied primarily to theoretical systems; it should not be used as a scalpel technique to detect nonsensical propositions and associate them to metaphysics. He was convinced that his criterion allowed us to distinguish clearly enough between the theoretical systems of the empirical sciences and other theoretical systems.

[2] From the sixties on, with the creation of the 'Darwinist' bio-metaphysical theory to justify his ideas about the growth of knowledge, Popper started favouring the expression 'trial and error' instead of 'conjectures and refutations'.

[3] The analysis of what Popper considers to be the ten most important MRPs leads him to the conclusion that the fundamental problems of cosmology or natural philosophy are: the problem of change; the problem of matter and space; the spatial structure of the universe; of causality; the atomic structure of matter and its stability; the interaction of matter and light. Regarding the problem of change, Popper notes that until now there are only three theories: atomism, the theory of power and action of Aristotle and the perturbation theory of fields that, as atomism, aims to explain the qualitative change through quantitative changes. Regarding the problem of matter (from Parmenides, Timaeus and the atomists, through Descartes, Leibniz, Newton, Kant, Boscovich, Faraday-Maxwell and its influence on Einstein, de Broglie and Schrödinger), Popper concludes that its development was speculative. (Popper 1982, p.165).

[4] Joseph Agassi, another of Popper's collaborators, remarked about this issue: 'For my part I have stressed the fact that the important research programs are rooted in metaphysics: sets of problems generated by a metaphysics. Lakatos, however, preferred the label of scientific research programs, since the answers to the problems generated had better be scientific and then handled empirically. There is little difference in the naming.' (1981, p.250).

[5] The testability criterion has yet some other problems. Amongst them, like Larry Laudan says 'the untoward consequence of countenancing as 'scientific' every crank claim which makes ascertainably false assertions'. Cf. Laudan 1983, p.121. However, my aim here is not to return to the debate around the problems of the demarcation criteria between science and non-science, but to point at the problems concerning the conception of metaphysics stemming from Popper's criterion.