Transversal
International Journal for the Historiography of Science

Transversal: International Journal for the Historiography of Science 2020 (8): 93-107
ISSN 2526-2270
Belo Horizonte – MG / Brazil

Special Issue – Historiography of Physics

Wittgenstein: Physics and Philosophy

Eduardo Simões[1]

Abstract:

The purpose of this article is to fill an interpretive gap in L. Wittgenstein's *Tractatus Logico-Philosophicus* in what has been overlooked by most scholars of the Austrian philosopher. It is the consideration of the possible influences that he would have suffered from the time of Mechanical Engineering studies and that reflected directly in his philosophy, especially those arising from the field of Physics. Due to the extensive restrictions that involve a scientific article, it will not be possible to present here what we believe to be the influences of L. Boltzmann's thought on the Wittgenstein *Tractatus* – which will remain for future work. However, we present the influences of H. Hertz's *The Principles of Mechanics* on at least three fundamental themes of Wittgenstein's *Tractatus*: on the ontological formalism of Tractarian objects, on the picture theory of language and on the conception of science of that work. It is expected that such clarifications will serve a new and important understanding of this seminal work of the 20th century, this time from the perspective of the relationship between Philosophy and Physics in Wittgenstein.

Keywords: Wittgenstein; *Tractatus*; Hertz; Mechanics, Representation

Received: 22 April 2020. Reviewed: 25 May 2020. Accepted: 29 May 2020.
DOI: http://dx.doi.org/10.24117/2526-2270.2020.i8.08

Introduction

It is not known exactly what is the real contribution of understanding a thinker's contextual biography to the understanding of the development of his own thought. There are things that can only be revealed in the proximity of textual readings, focusing on the reconstruction of the internal coherence of words, in an attempt to interpret his thoughts. In the case of the Austrian philosopher Ludwig Wittgenstein (1889-1951), however, it is necessary to pay attention to his intellectual biography, since his transition from Mathematics to Philosophy, through Mechanical Engineering, would leave more marks in his *Tractatus* than so far it has been recognized. His training as an engineer in Berlin and Manchester from 1906 until he finally went to study with the philosopher and mathematician Bertrand Russell (1872-1970) in Cambridge in 1911 does not mean just a hobby in terms of intellectual development. He really

[1] Eduardo Simões [Orcid: 0000-0001-7375-8574] is a professor in the Department of Philosophy at the Federal University of Tocantins. Address: Quadra 109 Norte, Av. NS 15, s/n. ALCNO 14, Bloco BALA 2, Sala 16 - CEP: 77001-090 - Palmas/TO – Brazil.
E-mail: eduardosimoes@uft.edu.br

became interested in Logic and Mathematics out of a personal interest in the philosophical foundation of Natural Science – he became interested in the Philosophy of Science. "The works by scientists which he read as a teenager – Heinrich Hertz's *Principles of Mechanics*, and Ludwig Boltzmann's *Populäre Schriften* – suggest an interest, not in mechanical engineering, nor even, especially, in theoretical physics, but rather in the Philosophy of Science" (Monk,1995, 38). It was through these works, whose access was given during his studies in Mechanical Engineering, that Wittgenstein provided us with one of the most comprehensive and thought-provoking philosophical works of the 20th century, the *Tractatus Logico-Philosophicus.*[2] This work, which includes topics ranging from ontology to mysticism, through subjects that involve the relationship between language and the world, between logic and mathematics and between philosophy and science. In it, after a considerable intellectual effort that aimed to address the limits of what can be said, Wittgenstein recognizes that his own sayings exceeded those limits and that, therefore, the work should only serve as a ladder that could be abandoned as soon as it had been climbed. The *Tractatus*' triumphant end is the decree of silence and mystical contemplation of the limits of language that presuppose the limits of the world, both components of the unspeakable sphere. Therefore, Wittgenstein closes the work with a solemn aphorism: "What we cannot speak about we must pass over in silence" (TLP, 7).

Even with the perception that he had spoken beyond the sphere of what can be said, even so, the themes involving the work are of great relevance and topicality and encompass problematizations that until today occupy the imagination of scholars who publish thousands of works about the *Tractatus*. In this article, a brief presentation of how science, especially Physics, was part of Wittgenstein's philosophical production, especially in the ontology of the *Tractatus* and its direct correlates, namely, in his notion of objects, in the picture theory of language and in the conception of science as something that contains elements *a priori*, the net of our description of the world.

The Ontological Formalism of the Tractarian Object and the *Principles of Mechanics* by Heinrich Hertz

On Wittgenstein's philosophical background, Gottlob Frege (1848-1925) and B. Russell always appear as those who formed the main philosophical impact on the young Ludwig. This view supported by numerous works on the *Tractatus* where his influences from the field of Physics, such as of Heinrich Hertz (1857-1894) and Ludwig Boltzmann (1844-1906), are not even mentioned, although, in the case of Hertz, this was one of the few people that Wittgenstein explicitly referred to.[3] And this is a consequence of the fact ignored by most interpreters of Wittgenstein's thought that seems to disregard one of his own statements regarding the nature of his work: "My work has extended from the foundations of logic to the nature of the world" (*Notebooks*, 2/8/1916). Therefore, if at first, the works of Frege and Russell served to give a scientific character to the language, exempting it from any and all mistakes that could be produced by its superficial form, in a second moment, it is the work of physicists that inspires the idea about what characteristics the world should have to be represented. From Russell and Frege, it can be said, Wittgenstein would have inherited the content, but from physics comes the form.

Due to the extension of this work, we will focus on Hertz's influence on Wittgenstein's thought and we will leave for another occasion what we believe to be Boltzmann's influence on that same work, namely, the notion of *logical space*, which it would have been tributary to

[2] Work that will be abbreviated here with the acronym TLP, accompanied by the corresponding aphorism number.

[3] In the works: *Notebooks* – 06/12/1914; TLP, 4.04; TLP, 6.361; *The Big Typescript* – 1933, for example.

Boltzmann's notion of *phase space* in statistical thermodynamics, as well as the theory of truth functions (truth tables), which is a generalization of that same notion of phase space.

We saw that Wittgenstein knew the work *The Principles of Mechanics – Presented in a New Form* by Hertz. Published posthumously, this 1894 work occupied the last three years of Hertz's life. Regarding its structure and purpose, its reading seems to point to the reality of *representation* within scientific theories: its form, content and purpose. It is, in fact, a critical method of analyzing philosophical problems within physical theories, that is, a method of philosophical clarification. With this method, it is possible to identify philosophical problems within scientific debates. As in the case of the introduction of concepts in Physics such as "force" or "energy" which, for Hertz, since they have indeterminate meanings, far from being resolved, should be eliminated, as they are pseudo concepts. To resolve the question of indeterminacy of meaning within physical theories, or, in Hertz's language, to "eliminate pseudo-concepts", he proposes a third way – *Presented in a New Form* -, replacing those presented by Newton and Maxwell, when founding the system on a field theory – "Given that the underlying image of a mechanical theory is a space filled with point-like particles" (Graβhoff, 2006, 9). The questions that remain are how would Hertz's influence on Wittgenstein's *Tractatus* have been? How would *The Principles of Mechanics* serve to explain the ontology of that work? How could Hertz's work be related to Wittgenstein's analysis of language?

Let us start with a first vestige. At the center of a group of aphorisms in which Wittgenstein deals with the nature of the proposition (TLP 4.01 to TLP 4.06), specifically in aphorism 4.04, the *Tractatus* says: "In a proposition there must be exactly as many distinguishable parts as in the situation that it represents. The two must possess the same logical (mathematical) multiplicity. (Compare Hertz's Mechanics on dynamical models)". Now the question is: and what is the approximation that we can make between the ontology of the *Tractatus* and the world of Hertz mechanics? Why does Wittgenstein quote Hertz at this point in his exhibition? Before answering these questions, let us understand what this aphorism means. There Wittgenstein is talking about ordinary propositions, in which "logical multiplicity" includes predicates and relations, in these cases, it must be possible to distinguish as many "meanings" in the situation as there are "significant terms" in the proposition. If it is not done, it will result in nonsense. Hertz says something around the same thing when he claims that a system that is the model of another must satisfy the condition "that the number of coordinates of the first system is equal to the number of the second" (Hertz, 1956, 175). And "if one system is a model of a second, then, conversely, the second is also a model of the first. If two systems are models of a third system, then each of these systems is also a model of the other" (Hertz, 1956, 175). This Hertzian conception of systems as models is also based on a kind of atomism, like Wittgenstein's logical atomism. In *The Principles of Mechanics*, Hertzian atomism presupposes a kind of vertical ascension that goes from the material particle, passing the mass to the material point, with the junction of material points forming the system. The mass itself is conceived as a unit of measurement and has nothing to do with the mass as it is commonly understood in Physics, including, Hertz admits in his system the existence of hidden masses. The philosophy of Wittgenstein's *Tractatus* is also built on the basis of logical atomism that leads to ontological atomism; that is why his job "has extended from the foundations of logic to the nature of the world" (*Notebooks*, 2/8/1916). This nature, which is based on the existence of objects, which are not material, but which presupposes the existence of the world as constitutive of facts. Since then, Wittgenstein denounces his debt with Hertz's thought: Tractarian "objects", like Hertzian "material particles" will be the flagships of his theories.

A doubt that still resides in the collective imagination of Wittgenstein scholars is about what would be the "object" of the *Tractatus*. Wittgenstein, at no point in his work, leaves us with a "practical" example of what an object would be. He was clear that, as a logician, his concern would have to be with how the complexes and objects are combined and not with

the question that there are complexes and, consequently, there must also be objects. For him, logic is primarily interested in the system by which we build symbols from even more basic symbols (TLP 5.555) and what it does is to present the parallelism between the *a priori* order of the world[4] and of thought. In the case of thought, the order of meaningful propositions; in the case of the world, the order of states of affairs; in both cases, says Wittgenstein, it is the order of possibilities. Likewise, the book I of *The Principles of Mechanics* introduces the physical concepts and theorems without reference to the external world, where all the expressed propositions are *a priori* judgments in the sense of Kant. They are affirmed by the "laws of the inner imagination" and the logical form.

Nevertheless, what is the object? Did Wittgenstein know an example of an object? In a passage from *Notebooks*, Wittgenstein already denounced his difficulties in answering this question:

> Our difficulty was that we kept on speaking of simple objects and were unable to mention a single one.
> If a point in space does not exist, then its coordinates do not exist either, and if the co-ordinates exist then the point exists too. That is how it is in logic.
> The simple sign is *essentially simple*.
> [...]
> It always looks as if there were complex objects functioning as simple, and then also *really* simple ones, like the material points of physics, etc.
> It can be seen that a name stands for a complex object from an indefiniteness in the proposition in which it occurs. This comes of the generality of such propositions. We *know* that not everything is yet determined by this proposition. For generality notation *contains* a proto-picture. [cf. 3.24]
> All invisible masses, etc. etc. Must come under the generality notation. (*Notebooks*, 21/06/1915)

In the paragraphs quoted, "material points" and "invisible masses" are used as examples of pseudo objects – "Hertz's invisible masses are admittedly pseudo-objects" (*Notebooks*, 12/06/1914).

In the whole form analyzed, an empirical sentence must refer to objects and their relations. Only in that case, can the truth-value of the sentence be determined. Therefore, according to the rules, in order to be able to judge the lack sense of the sentence, the object complex needs to be analytically divided into its atomic components: "The division of the body into *material points,* as we have it in physics, is nothing more than analysis into *simple components*" (*Notebooks*, 20/06/1915). Thus, in linguistic terms, the sense would be fully determined to the extent that "one name stands for one thing, another for another thing, and they are combined with one another. In this way, the whole group – like a tableau vivant – presents a state of affairs" (TLP, 4.0311). The object itself indicates the reference (the meaning); only in the context of the proposition of names (representatives of objects) makes sense. Wittgenstein emphasizes the terms "material points" and "simple components" to indicate the ultimate components of reality, with which it is fully possible to determine the propositional sense. Now, how could the lack of sense of sentences be decided by a mechanical theory like Hertz's?

To Wittgenstein, "Mechanics is an attempt to construct according to a single plan all the true propositions that we need for the description of the world" (TLP, 6.343). Ordinary language sentences are often about complex objects, their properties and their

[4] *A priori* order of the world is the order of possibilities, which is common to the world and to the thinking. It precedes every experience, makes every experience and does not adhere to any opacity or empirical insecurity.

relationships, so they are indeterminate – "It can be seen that a name stands for a complex object from an indefiniteness in the proposition in which it occurs. This comes from the generality of such propositions" (*Notebooks*, 21/06/1915). The language of Physics, on the other hand, defines systems based on small objects with atomic dimensions, whose indeterminacy is impossible. Thus, it is possible for someone to determine which set of atomic objects – the objects of the world – is part of a complex body.

Wittgenstein in his search for the determination of the propositional sense will struggle with the problem of reducing propositions about the external world for Physics. Even so, according to him, even if all *possible* scientific questions have been answered, our life problems will not even be touched (TLP 6.52), or, according to Hertz, even though the physical conception of material points and their movements have been theoretically resolved, the task of explaining complex physical bodies using ordinary language is still arduous (Hertz, 1956). It would be practically impossible to analyze each sentence of ordinary language for the level of its atomic components, especially, we could admit, as Wittgenstein at first admitted, that "relations and properties, etc. are objects too" (*Notebooks*, 06/16/1915). But when a physicist deals, for example, with a material body, he can easily understand it as a finite number of material points, related to any material point, that is, he can "establish a measurement system without reference to something other than measurable quantities and only measures them relative to each other" (Graβhoff, 2006, 9). Wittgenstein, with the concept of object as the ultimate element of reality, just as the material particle in Hertz is the ultimate element of the system, uses mechanics as an attempt to construct all the propositions we need for the description of the world according to a plan (*Notebooks*, 12/06/1914). Expressions like "as we have it in Physics" (*Notebooks*, 06/20/1915) show the familiarity with which he related to this field of knowledge. Elucidates how Wittgenstein adopted the mechanics' procedure: the division of bodies into material points, as occurred in Physics, adds to the process of dividing complexes into their simplest components.

Wittgenstein does not copy the physical analyses of complex bodies as an example among others of the known methods of analysis. For him, all the ordinary propositions of the external world, in the process of complete analysis, should be reduced to their ultimate elements, in this case, to names. This is the same as Hertz thought, for whom all ordinary bodies in the external world would be analyzed in such a way that their elementary components were produced from material points. In the case of Wittgensteinian analysis, which is directly linked to language, the names would be linked to the true objects of the *Tractatus*, simple, eternal, indestructible. In the certainty of the existence of such objects, as last correlates of names, it is that the absolutely determined sense of the propositions would be preserved. In the objects, we would have the guarantee of the substance of the world of the *Tractatus*, just as we would have it in the material particles of Hertz.

From Hertz's terminology, Wittgenstein uses, for example, the concept of material point: "We must not forget that the description of the world by mechanics is always quite general. There is, for example, never any mention of *particular* material points in it, but always only of *some points or other*" (TLP 6.3432). Written in this way was the aphorism above in the first translation of the *Tractatus* by Ogden (assisted by Ramsey), where it juxtaposed the English translation with the original German, as desired by Wittgenstein. However, "this clear request by Wittgenstein is disregarded in all later English editions" (Graβhoff, 2006, 19). This is the case, for example, of the second translation by Pears and McGuiness (Wittgenstein, 1961b). In this second translation, when Pears and McGuiness translate the aphorism 6.3432, the translation comes out as follows: "We ought not to forget that any description of the world by means of mechanics will be of the completely general kind. For example, it will never mention *particular* point-masses: it will always talk about *any point-masses whatsoever*". The point is that this translation, as it stands, makes a mistake by distancing itself from Wittgenstein's theoretical pretension, which was to identify his

"object" with the formal concept of "material particle" of Hertz's mechanics. When the two translate as *point-masses* (Massenpunkt) what would actually be *material points* (materielle Punkte), they create a notion that Wittgenstein interpreted such points in the same way as they are treated, for example, in the physics of particles, that is, from the perspective of a realistic theory.[5] If so, the Tractarian object as a tribute of the Hertz mechanical system would be empirical and would have, for example, properties such as being heavy, hard, colored (TLP, 2.0131). Such an interpretation would agree with those of many who insist on the materiality of Tractarian objects that, even though they are not material, "contain the possibility of all situations" (TLP, 2.014). These complications by Wittgenstein that lead, for example, the Vienna Circle to serious mistakes in the interpretation of the *Tractatus*.

If we understand simple objects like Pears and McGuiness' point-masses (*Massenpunkt*), our understanding will be that they are impressions or sense data. Such an idea would thus produce an objectivist reading of the *Tractatus*. The idea that sense data are such objects is an empirical way of looking at them, but it is completely doubtful that this was what Wittgenstein had in mind when he spoke of simple objects. Since they are from Hertz mechanics, as we have seen, this is not the path to a correct interpretation. Those who carefully read *The Principles of Mechanics* clearly perceive that the *material points* (which the aphorism 6.3432 talks about) are not the simple elements postulated by particle physics. Simple objects, for example, are called by Hertz "material particles". By calling his simple objects material particles, he can deceive his reader into thinking that such objects have to be interpreted as physical entities. However, there are several reasons why this is not so, for example, what Hertz says about the first book of *The Principles*, where he deals with such matters: "The subject-matter of the first book is completely independent of experience. All the assertions made are a priori judgments in Kant's sense" (Hertz, 1956, 45). When it is believed that Wittgenstein misread Hertz's work, it is believed that his object was also something material – Pears and McGuiness made this mistake when translating the aphorism 6.3432 of the *Tractatus*.

> The biggest flaw in the translation by Pears/McGuinness is the inconceivable rendering of "*materielle Punkte*" as "point-masses". In the preface the translators state that the authorized first translation by Ogden and Ramsey "has been revised in the light of Wittgenstein's own suggestions and comments in his correspondence with C. K. Ogden about the first translation". In the correspondence we find nothing to justify the changes of TLP 6.3432. (Graβhoff, 2006, 20)

While we talk about the external world and the matter itself, Hertz and Wittgenstein speak of *material points*, that is, of logical elements, whose function would be to provide a feature of generality and formal independence to their systems. If Pears and McGuiness paid attention to the guidelines given by Wittgenstein to Ogden, they would certainly have a hint of how to translate the technical terms of these passages. According to Wittgenstein guiding: "To get the right expression, please look up the English translation of Hertz's 'Principles of Mechanics'" (Wittgenstein, 1983, 35). And why do we insist so much that this is how we should interpret the Tractarian ontological formalism? Roughly speaking, because we could not simply ignore the imperative Wittgensteinian present in the *Prototractatus* (2.0141) which says: "Let the thing be the material point" ("*Das Ding sei der materielle Punkt*"). If we understand "thing" like "object", *Ding* like *Sache*,[6] we will see that here Wittgenstein

[5] We see that this was not Hertz's pretension, let alone Wittgenstein's. It is reinforced, therefore, that Wittgenstein's "object" is identified with the Hertzian concept of "material particle" and not of "material point", which is more identified with the *Tractatus* "state of affairs".

[6] With regard to the concepts of "thing" and "object", there is no evidence (as some scholars of Wittgenstein's thought think) that he put them in a situation of opposition (*Ding* X *Sache*). In the

commands us to think in this way. Otherwise, he would give us only an empty indication and depending on our interpretation saying: "The thing is the material point" ("*Das Ding ist der materielle Punkt*").

Aware of the functionality of the material points in Hertz mechanical system and of the objects in the *Tractatus* ontology, it remains for us to understand how Wittgenstein's notion of picturing is a tribute of the Hertz mechanical system.

Wittgenstein's Picture Theory of Language as a Tribute to Hertz Mechanical System

In a group of aphorisms that deals with the picture theory of language (TLP 2.1-3.5), having claimed that the world is the totality of facts, Wittgenstein proceeds to investigate a subset of that totality, namely, the pictures: in particular the proposition as a fact which is capable of representing other facts.

In Hertz's time, the concept of representation was in vogue. *The Principles of Mechanics*, for example, points to the reality of *representation* within scientific theories. Hertz uses the term representation as *Darstellung*; a term that does not mean a representation as a reproduction of sensory impressions, but as equivalent to "cognitive schemas", "formulas", "models" – schemes consciously constructed for knowledge. As Janik and Toulmin said (1991, 140), "in this mode of representation, men are not merely passive spectators to whom "representations", like Humean "impressions" or Machian "sensations", just *happen*". Based on the assumption that Wittgenstein was heir to this way of conceiving representation, we propose that his notion of picturing deals with an appropriation of the notion of *representation* of Hertz's *Principles*.

Hertz, as we said, uses the term *Darstellung* when he wants to qualify a scientific representation as such, for example, the graphic representation as currently used in Physics. But it mainly uses the term *Bild*, which in German literally means "picture" or "image" – "images produced by our mind and necessarily affected by the characteristics of its mode of portrayal" (Hertz, 1956, 2). With this same connotation, the term *Bild* is used in the *Tractatus* in aphorisms that deal with the picture theory of language. Representation and picturing are, therefore, common terms among these authors that point to the same reality, namely, that "we picture facts to ourselves" (TLP, 2.1).

In the context of our claim that Wittgenstein's work "has extended from the foundations of logic to the nature of the world" (*Notebooks*, 08/02/1916), we were convinced that the picturing for Wittgenstein was still problematic: "The difficulty of my theory of logical portrayal was that of finding a connection between the signs on paper and a situation outside in the world. I always said that truth is a relation between the proposition and the situation but could never pick out such a relation" (*Notebooks*, 27/10/14). Nevertheless, two days later, in the light of Hertz's theory, he already had an answer to this problem: "The *internal relation* between the proposition and its reference – the method of symbolizing – is the *system of coordinates* which projects the situation into the proposition. *The proposition corresponds to the fundamental coordinates*" (*Notebooks*, 29/10/14 – emphasis added). "Internal relation", "coordinates system" are terms that are part of Hertz's mechanics. But, how to understand such inspiration? Or how to support statements about this proximity? As

Tractatus, things or objects indicate simple constituents of reality. Wittgenstein, right from the start, affirms both (TLP 2.01). When he puts "things" in parentheses right after he has defined the state of affairs as a connection of objects, it seems that he draws attention to his preference for the concept of "state of affairs" and not that of "state of objects", it would be very strange. However, there seems to be no relevant difference: the object that is known (TLP 2.0123) is the same as the thing (TLP 2.012 to TLP 2.0122) known.

was said earlier, in order to understand the issues that inhabited Wittgenstein's mind at the time of writing the *Tractatus*, his biography cannot be belittled: he is someone who came from Mechanical Engineering, with a reading of the issues Physics was concerned at the time and with a good knowledge of such issues. As for the picture theory of language, for example, Griffin (1998, 140) clarifies that the main exponents that would have influenced Wittgenstein in its formulation would have been the physicists Ludwig Boltzmann and Heinrich Hertz, but, mainly, Hertz. In what way? How to sustain this inspiration? Where is the approach?

In the aphorisms that deal with the picture theory of language, Wittgenstein states: "We picture facts to ourselves" (TLP, 2.1) and "a logical picture of facts is a thought" (TLP, 3), that is, "we think the world!". And what does this mean? In what relationship is the world and the thought? In what sense does the association of real objectivities correspond to thoughtful objectivities? How can a correspondence between two different fields be thought of? To Wittgenstein, trying to solve this problem using the naive concept of picturing, that is, thinking that there is an "empirical" correspondence between the proposition and the world is an error. For the relations between a proposition and the world are not object relations but of logical order. How, then, to understand the logical relationship between proposition and world? And how to understand the Hertzian affiliation, at this point in the reflections of the *Tractatus*?

As we said, Wittgenstein starts his picture theory of language with the assertion that "we picture facts for ourselves" (TLP 2.1); Hertz, on the first page of the introduction of *The Principles of Mechanics*, writes "We form for ourselves images or symbols of external objects and the form we give them is such that the necessary consequents of the images in thought are always the images of the necessary consequents in nature of the things pictured" (Hertz, 1956, 1). Apparently, according to what Hertz said, there must be certain conformity between nature and our thoughts. Wittgenstein affirms something very similar: that there must be something in common between figure and fact (TLP, 2.16; 2.161), there must be conformity because our names must behave as objects behave. And what should representations share with their facts? Among other things, Wittgenstein states that the figure must have the same numerical multiplicity as its fact (TLP, 4.04 b). Hertz postulates that one system, which is the model of another, must satisfy the condition "that the number of coordinates of the first system is equal to the number of the second" (Hertz, 1956, 175). And that "if one system is a model of a second, then, conversely, the second is also a model of the first. If two systems are models of a third system, then each of these systems is also a model of the other" (Hertz, 1956, 175). Even our thoughts are representations, so they must be situated in this internal relationship: "The relation of a dynamical model to the system of which it is regarded as the model is precisely the same as the relation of the images which our mind forms of things to the things themselves" (Hertz, 1956, 177). In this system, the simplest things we have to deal with in representations or models are, for Hertz, "material particles" or "material points". In Wittgenstein's case, they are "objects". Objects are eternal (TLP, 2.027), they cannot be destroyed. For Hertz, his material points are also "invariable and indestructible" (Hertz, 1956, 46). A system is an aggregate of material points; the world is, at least in part, an aggregate of material points. The models, the representations we make of the world, are constructed in a similar way, from the symbols that represent these material points.

Hertz's proposal was to determine the limits of physics from within himself, and the idea of a model came around when he was studying the nature of Maxwell's theory and trying to understand what his equations said about electromagnetic phenomena.

> On that occasion, Hertz had the idea that Maxwell's equations, in fact, said nothing about the physical nature of these phenomena. They were nothing more than mathematical formulas capable of providing a logical apparatus for dealing with physical phenomena. These systems or models are not derived from experience but

> correspond to logical constructions from which facts from experience can derive. (Margutti Pinto, 1998, 85)

The point of approximation between Hertz mechanics and Wittgenstein's picture theory of language can be sought precisely in the understanding of two formal concepts: object, in the *Tractatus*; and that of material particles in *The Principles*. Regarding the *Tractatus*' object, we saw that it is not an empirical object; about it really is, Wittgenstein prefers to let the logicians of posterity, through the process of analysis, find out. It is a formal concept necessary to the Tractarian system since its postulation allows the propositional sense to be fully determined. As for Hertz's "particles" and "material points", we have also seen that these are formal concepts (Hertz, 1956, 45). And about "correctness or incorrectness of these investigations can be neither confirmed nor contradicted by any possible future experiences" (Hertz, 1956, 135). This is because, what is called "*The Principles of Mechanics*" are propositions "which satisfies the requirement that the *whole of mechanics* can be developed from it by *purely deductive reasoning without any further appeal to experience*" (Hertz, 1956, 4 – emphasis added). It is Hertz himself who insists that his judgments are *a priori*, that they cannot be confirmed or denied by experience and that they are deductive reasoning, and we are not qualified to deny it. The most important fact to be highlighted in his theory is that it was obtained from the analysis of the symbols used in scientific discourse, seeking their formal and factual meanings and rejecting the meaningless questions that arise from the illogical use of symbols and not from legitimate problems generated by the facts. It is about decoding and understanding the world from a conception of representation in a symbolic system. And it is in this way that Wittgenstein's picture theory of language, as a tribute of Hertz's model theory, must be understood: the correspondence between thought (language) and the world is of a logical and not an empirical nature. Picturing consists of the relation by which the figure imposes itself on the fact; it is what makes one fact a figure of the other (TLP, 2.1513). The truth, in this case, is nothing more than the formal identity between facts and thoughts. The role of logic in this context is to present the parallelism of the orders *a priori* of the world and of thought. In the case of thought, the order of significant propositions; in the case of the world, the order of states of affairs.

Hertz and the Philosophy of Science of Wittgenstein's *Tractatus*

Anyone who reads the *Tractatus* and finds at the end, specifically from aphorism 6.3, comments about the natural sciences, has the impression (by the "growing" organization of his aphorisms) that those comments are a kind of attachment and that appear there as a consequence of his elucidations about logic and mathematics – by the way, most of his interpreters make this mistake. But if we look at Wittgenstein's real intentions, comments about the natural sciences are an integral part of his project.

The picture theory of language, which we discussed in the preceding item, was also an integral part of Wittgenstein's philosophy of science, advocated as an attempt to interpret the difficult problem of the relationship between theory and nature while avoiding the realist/anti-realist dispute within a scientific theory. That his conception of scientific theory, considered as the only field subject to meaningful propositions, was successful, was desired[7] – although it had the unfortunate consequence of inspiring an ontological interpretation. One way to "deviate" from such an interpretation was to emphasize in its theory the purely representational character such as that of physical theory, demonstrating its independence from external foundations through a clear and simple representation, thereby relieving itself of confusion about the *status* of the formal elements of the constructed theory – "But how

[7] "The totality of true propositions is the whole of natural science (or the whole corpus of the natural sciences)" (TLP 4.11).

remarkable: in the familiar theorems of mathematical physics there appear neither things nor functions nor relations nor any other logical forms of object! Instead of things what we have here is numbers, and the functions and relations are purely mathematical throughout!" (*Notebooks*, 20/06/1915). That is why the *Tractatus'* absolutely simple object, in addition to being indestructible, is also indescribable. Its functionality, besides guaranteeing the formal consistency of the system, still has the additional advantage, as an ontological counterface of language, to guarantee the determinability of the linguistic sense – "The requirement that simple signs be possible is the requirement that sense be determinate" (TLP, 3.23).

To Wittgenstein, the demand for the representational character of science was fulfilled by Hertz's mechanics, which became prototypical for science in the *Tractatus*. In the analysis of the propositions of natural science, mechanics was exemplary because, according to Wittgenstein, it presents a successful attempt to bring the description of the world in a unique way: "Mechanics is one attempt to construct all the propositions that we need for the description of the world according to a single plan. (Hertz's invisible masses.)" (*Notebooks,* 06/12/1914) and in the same idea, he said: "Just as with the number-system we must be able to write down any number we wish, so with the system of mechanics we must be able to write down any proposition of physics that we wish" (TLP, 6.341). According to Wittgenstein's understanding of the *Tractatus*, Hertz's system of hidden masses made a coherent representation of mechanics, but it also demonstrated the general and abstract interpretation of the *status* of a philosophical theory: "We ought not to forget that any description of the world by means of mechanics will be of the completely general kind. For example, it will *never* mention *particular* point-masses: it will only talk about any point-masses *whatsoever*" (TLP, 6.3432), and in his *Notebooks* (06/12/1914) he says that: "Hertz's invisible masses are *admittedly* pseudo-objects". Thus, a good theoretical representation equal to mechanics, involving pseudo objects as a constituent part, shows the generality and formal independence of the system; and this should be the case for any representation of the natural sciences, regardless of how they might appear.

But what would be Hertz's role in the relationship between the picture theory of language and the idea of Wittgenstein's different scientific descriptions, represented by different types of nets? Following a trend in theoretical physics of his time, Hertz uses mathematical models and physical concepts, along with deduction techniques such as logic and critical analysis, in order to explain and predict physical phenomena in a rational way. In general terms, its objective was to represent the natural relationships between the "three independent fundamental conceptions, namely, those of time, space, and mass" (Hertz, 1956, 24), exempting from the foundations of mechanics postulations about the things in itself and avoiding the use of pseudo concepts such as "force" and "energy" within it. To this end, he tries to establish the measurement of a system without reference to any other, only measuring them in relation to each other through coordinate systems: "It is mathematically possible to write down any finite or differential equation between coordinates and to require that it shall be satisfied" (Hertz, 1956, 11). The concept of "mass", for example, comes to be understood from the association of particles in a kind of coordinate system – "The number of material particles in any space, compared with the number of material particles in some chosen space at a fixed time, is called the *mass* contained in the first space" (Hertz, 1956, 46). Interpreted as a definition of mass *a priori*, it can be said that one can choose a certain area of points in space, defined by a set of coordinates, and use this as a unit of measurement in order to define the mass of some other set of points in the space. Even the introduction of the "hidden masses" from which, presumably, a connotation of the ontological thesis would emerge in the Hertzian system, serves him much more as a methodological requirement, namely, "to predetermine the motions of the visible masses of the system, or the changes of its visible *coordinates*, notwithstanding our ignorance of the position of the concealed masses" (Hertz, 1956, 224 – emphasis added). Therefore, we see that Hertz's mechanics

works as a kind of geometric coordinate system[8] where the locations are defined by means of a plane that allows the measurement of one system to be established *without reference to any other*. This is very similar to the Tractarian "method" for defining a configuration, describing it completely by means of a certain net of meshes of a certain fineness (TLP, 6,342).

> Let us imagine a white surface with irregular black spots on it. We then say that whatever kind of picture these make, I can always approximate as closely as I wish to the description of it by covering the surface with a sufficiently fine square mesh, and then saying of every square whether it is black or white. In this way, I shall have imposed a unified form on the description of the surface [...]. (TLP 6.341)

"The net, however, is *purely geometrical*; all its properties can be given a priori" (TLP, 6.35). And what is right a priori is purely logical (TLP, 6.3211).

We see that Novalis' old notion that "hypotheses are nets: only he who casts will catch", used by Karl Popper as an epigraph of his book *The Logic of Scientific Discovery*, was also used by Wittgenstein to illustrate the different representations of the natural sciences. Wittgenstein uses the image of a metaphorical net in order to compare the description of a specific theory offered with a net being traversed by the facts. This net could be more or less thin and, thus, describe facts more or less accurately. "For example, the mechanics of Newton's *Principia* would represent one net of a certain fineness. Later, with the development of Lagrange's analytical mechanics, this description would represent a finer net" (Kjaergaard, 2002, 132). This image of the spot on a white surface is the projection of the distribution of simple material points in space. There are points in space, matching shapes of spots. To describe this surface, we could cover it with a grid, for example. If the meshes of the net were thin enough, we would be able to say whether each square of the net is white or black. In that case, we would have a description of the surface in the unit form. This shape, however, is arbitrary, as the net could consist of triangular or hexagonal meshes or others, including combinations of geometric figures, such as triangles and hexagons. The net itself is the coordinated system by which the distribution of the spots is defined and each net would correspond to a different system of description of the world, a different mechanic (TLP 6.341). And here, as we have seen, there is a striking parallel with Hertz and his holistic conception of Fundamental Law: a scientific law, like the image of this net, is not to make descriptions, not even very general descriptions, but to provide representation techniques by which it is possible to make descriptions. A remarkable example of what we are talking about is the comparison of the notion of *logical space* in the *Tractatus* with the metaphorical net: the essence of metaphor is the comparison of a proposition as a point in a coordinated system and names with coordinated singular numbers. In a given coordinate system, putting two numbers together defines a point; in a given language, joining two names makes a statement. In this way, languages are a kind of coordinated logical system. And just as there are different systems as a result of choosing different points of origin, different scales, and so on, so there are also different forms of representation in the language (Griffin, 1998).

Wittgenstein's fundamental notion regarding science, for example, is that there is no privileged theory in science, but that there are different points of view. If physical theories are figures of reality and, therefore, only have a descriptive relationship with nature, this leads to the possibility that the natural sciences integrate multiple models of explanation. In other words, there is no privileged *physical theory*.

[8] "A coordinate system is undoubtedly an important piece of symbolism in the sciences. Here it is used to describe the movement of a body. It can also hypothetically describe the relationship between mass and volume. On one-dimensional scales, temperatures can also be exposed in this way ". (Griffin, 1998, 148)

> Similarly, the possibility of describing the world by means of Newtonian mechanics tells us nothing about the world: but what does tell us something about it is the precise way in which it is possible to describe it by these means.
> We are also told something about the world by the fact that it can be described more simply with one system of mechanics than with another. (TLP, 6.342)

If there is no privileged theory, there are certainly several possible ways of representing facts. None is more correct than the others are, but one could be more appropriate to give a more detailed or helpful picture of that part of nature that a specific physical theory should describe. According to Wittgenstein (1980, 18), "the real achievement of a Copernicus or a Darwin was not the discovery of a true theory but of a fertile new point of view". Drawing attention to two of the most celebrated scientists in the historical construction of the view of the modern world, Wittgenstein at the same time demonstrates the general character of his argument and deconstructs the false conceptions of truth spread by the theories of science that were nurtured by the tremendous success of natural science. On the other hand, Wittgenstein also proposes to give a correct interpretation of the infamous *law of causality*.

We see that the reflections on causality presented in the *Tractatus* and discussed in aphorisms about science are also a consequence of the influence of Hertz's mode of representation and are directly involved with the representation of the metaphorical net. Says Wittgenstein: "Laws like the principle of sufficient reason, etc. are about the net and not about what the net describes" (TLP, 6.35). What he means is that the law of causality, or the principle of sufficient reason, on the other hand, was not conceived as a proposition saying something about the world, but as belonging to the image representing the facts of the world, just like the Hertz's Fundamental Law.[9] Causality is instrumental in the integrated information about the facts of the world, thus being a *form* of the law instead of the true law of nature; the "connection" is not a relationship in itself, but only a way of showing the existence of the relationship. To affirm the contrary, that is, that causality is, in fact, an explanation of the phenomena of nature, constitutes the illusion that founded the modern worldview – "The whole modern conception of the world is founded on the illusion that the so-called laws of nature are the explanations of natural phenomena" (TLP, 6.371).

> Thus, people today stop at the laws of nature, treating them as something inviolable, just as God and Fate were treated in past ages.
> And in fact, both are right and both wrong: though the view of the ancients is clearer in so far as they have a clear and acknowledged terminus, while the modern system tries to make it look as if everything were explained. (TLP, 6.372)

This means that causality is not a law of logic, nor an empirical generalization, nor a synthetic proposition *a priori*. In fact, it is not even a proposition since it tries to say what can only be shown. What it indicates is a certain form of description that is crucial for scientific theorization (TLP 6.321 et seq.). In this sense, the law of causality as it is conceived by the natural sciences (as a relationship between event and cause), is something superfluous, that lacks sense and represents nothing – "It is a hypothesis that the sun will rise tomorrow: and this means that we do not *know* whether it will rise" (TLP, 6.36311, 6.37).

> Nothing can logically guarantee that the events to be known in the future will continue to exemplify the regularity described by the simplest set of laws compatible with past

[9] "Our Fundamental Law allows us to survey the whole domain of mechanics, it shows us what are the limits of this domain" (Hertz, 1956, 38).

> and present experience. Like Hume, the *Tractatus* concludes: the induction procedure has no logical basis, but only psychological. There is no logical reason that we can claim as the basis for our belief that the sun will rise tomorrow; in fact, we do not know if he will actually rise. We act as if we know because we have nothing better to do. (Santos, 2001, 98-99)

The principle of causality is itself a formal concept; it does not describe reality, but as the corresponding "net" to *one* way of *representing reality* that, in fact, is optional. As Wittgenstein says: "'Law of causality' – that is a general name. And just as in mechanics, for example, there are 'minimum principles', such as the law of least action, so too in physics there are causal laws, laws of the causal *form*" (TLP, 6.321 – emphasis added). The law of causality would be nothing more than the methodological prescription that the propositions of science take the form of hypothetical laws: all its relevance to the propositional representation of the world is concentrated in its prescriptive nucleus, "everything has a cause".

In the aphorism 6.36 of the *Tractatus*, Wittgenstein states that "if there were a law of causality, it might be put in the following way: 'There are laws of nature'. But of course, that cannot be said: it makes itself manifest". And it shows itself precisely because, being form and not content, it is to be understood as an image representing facts of the world, that is, strictly as representation and not as law. The laws of mechanics, for example, are the laws of our method for representing mechanical phenomena, and since we have effectively chosen a method of representation when describing the world, it is impossible for the laws of our method to say anything about the world – they represent the world. As Wittgenstein says: "One might say, using Hertz's terminology, that only connections that are *subject to law are thinkable*" (TLP, 6.361). To think connections that conform to the laws is to think of a coordinated system that represents the fact without mentioning it, that is, without saying anything about it. Thus, from this notion, we can establish a relationship between mechanics and logic. We know that the fact that a white surface, covered with black spots, can be described by a given net does not *say* anything about the surface specifically, but the complete description of the surface by the net somehow characterizes the surface. Saying and characterizing (showing) frequent different fields. The various systems of mechanics, with their varied axiomatic languages, represent any facts, however, without saying anything about them. Even so, that a given system is capable of describing such facts, or that a given system describes them more simply than another, *shows* the essence of these facts. And this is very similar to the discussion about the logical form of the proposition where the doctrine of showing and saying of the *Tractatus* arises, says Wittgenstein: "Propositions cannot represent logical form: it is mirrored in them. Propositions show the logical form of reality. They display it" (TLP, 4.121). The synthesis of this doctrine would be this: the language is not confined to saying that this or that happens; it *shows*. What can be said in the language is that this object does have, in fact, this property or is, in fact, in this relationship with this other object; however, nothing can be said about the formal properties of objects or states of affairs; formal properties and relationships are shown. In this way, solutions like those of Russell's paradox, which attributed external measures to determine the validity of self-referring formal systems, creating a kind of metalanguage to deal with language problems, could not do anything for the system when they tried to say what could only be shown in logical notation. Once again we see a notion emerging in the *Tractatus* whose foundations go back to Hertz's mechanics: the analysis of the functionality of a system does not allow us to say anything about the system itself or even the facts of the world; all of that, it shows – "Our Fundamental Law allows us to survey the whole domain of mechanics, it *shows* us what are the limits of this domain" (Hertz, 1956, 38)".

Final Considerations

Due to the fact that it was ignored by the majority of *Tractatus* interpreters that Physics, here especially Hertz's mechanics, had substantial importance in the constitution not only of that work but of all Wittgenstein's thought, we proposed this article. We demonstrate the presence of the Hertzian spirit, going from the *Tractatus* object conception to the formalized world scheme (ontology) presented in this work. This scheme had a direct impact on his conception of science, the only one capable of providing the language with meaningful propositions since its propositions are the ultimate representatives of the contingency of objects in states of affairs. The coordinate system of Hertz mechanics not only provided the *Tractatus* with the notions represented above but also was a source of inspiration for the doctrine of saying and showing presented in that work. But the Hertzian influence on the *Tractatus* may have gone further. Baker (1988), for example, deals with the strong inspiration of Hertz's methodology on Wittgenstein's thinking to address the clarification of thought and the dissolution of problems. For him, the Hertzian method has become a way to expose the lack of sense of issues that make a true proposition *a priori*. Likewise, Kjaergaard (2002) states that the physicist H. Hertz played a decisive role in the use of Wittgenstein's only philosophical method. And that Wittgenstein successfully applied this method to the critique of problems in logic and mathematics throughout his life, including to solve problems concerning logical paradoxes and foundational problems, including those of mathematics – all of which would have been seen by Wittgenstein as pseudo-problems requiring clarity, instead of a solution.

Thus, we restricted our analysis by dealing only with the influence of Hertz's mechanics on the *Tractatus*, but we found that the reflexes of Hertz's philosophy of science on Wittgenstein's philosophy persist throughout his work, for example the notion of "sleeping partners" used by Wittgenstein in *Philosophical Grammar* (as well as in *Philosophical Remarks* and *Philosophical Investigations*) is the same used by Hertz in *Principles* (Hertz, 1956, 11-12). Likewise, the method of resolving language misunderstandings dealt with by *Philosophical Investigations* (IF, § 90) is the same critical method of analyzing philosophical problems within physical theories used by Hertz: a method of philosophical clarification with which it is possible to identify and dissolve (not solve) philosophical problems within scientific debates, because, such concepts "(...) have no additional value for us besides being abbreviations" (Hertz, 1956, 25). This Hertzian inspiration of the need to dissolve pseudo-problems in the realm of science endures throughout Wittgenstein's late philosophy; he assumes it, for example, in *The Big Typescript* (2005, 310e): "As I do philosophy, its entire task is to shape expression in such a way that certain worries disappear (Hertz)". These problems are generated by "misunderstandings regarding the use of language". For conceptual confusions, providing the content offered by Frege and Russell's philosophies was a great asset for Wittgenstein, but what helped him to resolve these same confusions was *the form* offered by Hertz. After all, as we have said, one of the most important parts of the method of doing philosophy for Wittgenstein, in almost his entire career of thought, was the concern with the form of an argument and not with the content. Therefore, it is necessary to understand the importance of *the form* in order to understand the *Tractatus* method and appreciate the continuity of Wittgenstein's thought.

References

Baker, G. *Wittgenstein, Frege and the Vienna Circle*. Oxford: Basil Blackwell, 1988.
Graβhoff, G. *Wittgenstein's World of Mechanics*. New York: Springer Wien New York, 2006.

Griffin, James. *O Atomismo Lógico de Wittgenstein*. Porto: Editora do Porto, 1998.
Hertz, Heinrich. *The principles of mechanics*: presented in a new form. Preface by Hermann von Helmholtz. Authorized English translation by D. E. Jones e J. T. Walley. With a new introduction by R. S. Cohen. New York: Dover Publication, 1956.
Janik, Allan; Toulmin, Stephen. *Wittgenstein's Vienna*. New York: Touchstone, 1973.
Kjaergaard, Peter C. Hertz and Wittgenstein's Philosophy of Science. *Journal for General Philosophy of Science*. Netherlands: Kluwer Academic Publishers, nº 33, p. 121-149, 2002.
Margutti Pinto, P. R. *Iniciação ao Silêncio:* Análise do Tractatus de Wittgenstein. São Paulo: Loyola, 1998.
Monk, Ray. *Wittgenstein*: o dever do gênio. Trad. Carlos Afonso Malferrari. São Paulo: Cia das Letras, 1995.
Santos, L. H. L. *A Essência da Proposição e a Essência do Mundo*. Ensaio introdutório à tradução do *Tractatus Logico-Philosophicus*. São Paulo: Edusp, 2001.
Wittgenstein, Ludwig. *Culture and Value*. Oxford: Basil Blackwell, 1980.
Wittgenstein, Ludwig. *Gramática Filosófica*. Trad. Luís Carlos Borges. São Paulo: Loyola, 2003.
Wittgenstein, Ludwig. *Letters to C. K. Ogden with Comments on the English Translation of the Tractatus Logico-Philosophicus*. Oxford: Blackwell, 1983.
Wittgenstein, Ludwig. *Notebooks 1914-1916*. Ed. by G. H. von Wright, G. E. M. Anscombe. New York: 1961.
Wittgenstein, Ludwig. *Prototractatus*: An Early Version of Tractatus Logico-Philosophicus. London: Routledge & Kegan Paul, 1971.
Wittgenstein, Ludwig. *The Big Typescript, TS 213*. Edited and translated by C. Grant Luckhardt and Maximilian A. E. - German–English scholars' ed. Oxford: Blackwell Publishing, 2005.
Wittgenstein, Ludwig. *Tractatus Logico-Philosophicus.* Translated by D. F. Pears and B. F. McGuinness with Introduction by Bertrand Russell. Routledge & Kegan Paul, London & Henley, 1961 b.