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Scientific Representation, Causality and Induction in Ludwig Wittgenstein's *Tractatus*

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Abstract:

The purpose of this article is to demonstrate how the Wittgenstein *Tractatus* deals with themes related to the laws of nature, as well as with the metatheoretical principles of science. More specifically, our intention is to expose the notions of scientific representation linked to principles such as those of causality and induction. As a starting point, we propose that the notion of non-precedence of one scientific theory over another is Hertzian inspiration, which argues that "one image may be more suitable for one purpose, another for another" (Hertz 1956, 3). As an unfolding of this notion, the systems of the geometric representation of Hertz and Boltzmann will serve the *Tractatus* in order to demonstrate that laws, like the law of causality, as form and not content, only represent the network (any method) that, after all, is optional. On the other hand, metatheoretical principles such as induction have no logical basis and their effect, in the wake of what Hume thought, is only psychological. Like the other themes of the *Tractatus*, its Philosophy of Science cannot be understood outside a broader context, which is the proper context to the criticism of language. Therefore, what is presented here intends not to be divorced from the relationship between logic, language and science. Since, in our view, these are the three pillars of support of the *Tractatus*.

Keywords: Scientific representation; Causality; Induction: *Tractatus*; Wittgenstein

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Introduction

On Wittgenstein *Tractatus*, starting with aphorism 6.3, we find comments about the natural sciences. For those who follow the systematic of the "growing" development of the items explored in the work, it is believed that those aphorisms, placed at the end, are the unfolding from the reflections that were being made on logic and mathematics. However, it must be

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noted that propositions concerning the natural sciences (natural laws and metatheoretical principles) are an integral part of the *Tractatus* project. From the time of studying Mechanical Engineering in 1906, until he went to study with Russell in 1911, Wittgenstein became interested in logic and mathematics due to his personal interest in the philosophical foundation of natural science, motivated by reading Hertz's works (*The Principles of Mechanics*) and Boltzmann (*Populäre Schriften*) (Monk 1995, 38). In this way, the natural sciences theme, or the non-priority of a system of scientific representation in relation to the others, is ingrained in his thinking and follows him from *Notebooks* (1914-1916) to *On Certainty*. In this brief article, we will make a foray into some points concerning this subject, which appear specifically in the *Tractatus Logico-Philosophicus*, namely: on the question of scientific representation (*Darstellung*) and how this notion, circumscribed in the works of Boltzmann and Hertz, was appropriated by Wittgenstein in the *Tractatus*. In this sense, notions such as causality, as a metatheoretical principle and not a law of nature, cannot be conceived as a proposition saying something about the world, but belonging to the image that represents the facts of the world. In this same line of thought, we will also deal with the relationship between the causal nexus and the determination of the propositional sense and, finally, about the psychological foundation of the inductive method, trying to understand why, with all restrictive positioning of Wittgenstein to the metatheoretical principles, even so, he admits the anteriority of the propositions of science in the *Tractatus* to the detriment of the propositions of ethics, aesthetics and religion, for example. We hope that these few lines of thought can urge Wittgenstein's readers to enter into this interesting world that reveals Wittgenstein's strong commitment to thinking about science since the most remote times of his philosophy.

The Scientific Representation in the *Tractatus*

The picture theory of language was 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 realism vs. anti-realism dispute within a scientific theory. That his conception of scientific theory, treated as the only field subject to meaningful propositions, was successful, it was what was desired – although it came as an unfortunate consequence to inspire an ontological interpretation. A way to "deviate" from such an interpretation was to emphasize in its system the purely representational character such as that of physical theory, demonstrating its independence from external foundations through a clear and simple representation[2] and, thus, avoiding confusion about the status of the formal elements of the built system. That is why the *Tractatus'* absolutely simple object[3] is also 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" (*Notebooks,* 06/12/1914); and in the same sense it says: "Just as with the number-system we must be able to write down

[2] "But how 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)

[3] The tractarian "object" is the ultimate constituent of reality. The one on whose basis all linguistic terms, endowed with meaning, would be connected, in a space called by Wittgenstein as "logical space". In short, it is about the ontological counterface of linguistic representation. That is where the language terms point.

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).[4]

According to Wittgenstein's understanding of the *Tractatus*, the Hertz system made a coherent representation of mechanics. Its mechanics function as a kind of geometric coordinate system,[5] in which the locations are defined using a plane that allows the measurement of a system to be established without reference to any other.

Wittgenstein then seems to use this procedure to design a "method" and define a configuration, describing it entirely by means of a given mesh of a certain fineness (TLP 6.342). This is where the affinity of his notion of scientific theories with images or systems that, as constituents of language through their propositions, also picture the world occurs:

> 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).

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. He uses the image of a metaphorical network, intending that the description of a specific theory offered would be compared to a network being traversed by the facts. This network 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, one can, for example, cover it with a square network. If the network's meshes were thin enough, there would be conditions to determine whether each square of the network is white or black. In that case, there would be a description of the surface in a unit form. This shape, however, is arbitrary, as the network could consist of triangular, hexagonal, or other meshes, including combinations of geometric figures, such as triangles and hexagons. The network itself is the coordinate system by which the distribution of the spots is defined, and each network would correspond to a different system of description of the world, a different mechanic – "Just as it must be possible to write down any arbitrary number by means of a system of numbers, so it must be possible to write down any arbitrary proposition of physics by means of the system of mechanics" (TLP 6.341).

An example is made possible by comparing what occurs in the logical space of the *Tractatus* with the metaphorical network. It is known that the logical space is a measurement space. According to Fraassen (2008, 165), "*The act of measurement is an act – performed in accordance with certain operational rules – of locating an item in a logical space*". Wittgenstein did not give a concise definition of "logical space", nor did he present a concrete construction of the meaning of logical coordinates. However, it is clear that the logical space refers to the

[4] Here the work *Tractatus Logico-Philosophicus* will be abbreviated to TLP and the number that follows the acronym refers to its respective aphorism.

[5] "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).

total set of logical possibilities, possibilities that form a "logical scaffolding" (TLP 3.42), a systematic aggregate similar to a coordinate system. Each elementary proposition corresponds to two possibilities of truth (TLP 4.31). The truth or falsity of "molecular" propositions, treated as truth-function, occurs by determining the truth-value of these elementary propositions (TLP 5.234). The completeness of the logical space ensures that each meaningful proposition is localizable and, for this location, is linked to a possible state of affair (*Sachverhalt*).

According to Lugg (2019, 212), "Wittgenstein placed Boltzmann and Hertz first and second in a list of influences he drew up in 1931 (VB 1998: 16), and when discussing scientific theories, he follows in their footsteps". Regarding Boltzmann's influence on Wittgenstein, he further states that:

> It is a safe bet that he was acquainted with Boltzmann's *Populäre Schriften* (if not his more technical work) and was aware that Boltzmann identified the properties of a physical system with coordinates that jointly define a 'space' of possible states. He too took spaces of possibilities to be allied to systems of coordinates as a matter of course, an alliance he exploited in his late as well as his early writings. Given his scientific training, he would not have needed to be reminded that mathematical physicists identify time with points on a one-dimensional line, correlate the positions of particles with points in a three-dimensional (Cartesian) coordinate space and associate the positions and momenta of N particles with points in an 6N-dimensional (phase) space (Lugg 2019, 212).

The Boltzmann statistical mechanics program aims to associate a weight or probability of occurrence to the different microstates and to predict the average result of a large set of measures of observable data. In this case, statistical mechanics functions as a probabilistic theory that establishes the connection between the two levels of description – the macroscopic (Thermodynamics) and the microscopic (Mechanical) – within a phase space. The general formula that synthesizes its functioning is Boltzmann's own equation. This equation, like the guiding principle for the construction of diverse representations of the "logical space" taken from the combinatorial scheme of the theory of truth-functions[6], also proposes to calculate what happens in a system with distribution-function of particles, which gives the number of particles per unit volume in a phase space. The phase space, in this case, allows us, through the attribution of numerical values to the various random dynamic states in which the elementary and discrete components of the system are at a given moment in time, to distribute the temporal evolution of the instantaneous variables of the various states alongside a period of time, that is, the trajectory of each macrostate related to all its associated microstates. As all points that fill the space have the same contour parameter, that is, they are in the same space, under the same temperature and pressure; the relevant variables in the entire space are the same and share the same Domain and Image set. The dimensions of the phase space are the relevant variables observed themselves. The system's behavior is established according to the particles' behavior, in numerical values, within the contour parameters (limits) and represented in the phase space. What the phase space does is a distribution of the microstates of each particle of the system at the moment of observation.

[6] I also believe that the technique of truth-functional analysis of descriptive language is a generalization of the familiar Helmholtz-Boltzmann idea of phase-space, the geometrical representation of all the states that a system could take up, all the configurations that are possible for it (Harré 2001, 213).

To understand how this happens, think about a given material system with a set of variable attributes. A convenient example could be a planetary system like our solar system. For such a system, there are some possible configurations and others not. The term "phase space" in Physics refers to an imaginary volume that contains all possible configurations of these variables. It is basically a mathematical idea that allows us to trace the history of the system. The real history of the system is a set of points in the phase space. These sets of points constitute a line, that is, the number of dimensions of the phase space. The number of relevant variables to be observed will be as many as are necessary so that the trajectory of the points has a linear characteristic. The real history of the system, therefore, corresponds to a trajectory of a point in the phase space. The introduction of the statistical method allows the understanding of the functioning of the accessible microstates of the system (set called *statistical ensemble*) as being possible events within the so-called *Sample Space* (S), and assumes that, *a priori*, all events of this *Sample Space* are equiprobable, that is, they present the same probabilities of occurrence. It is precisely this so-called "sample space" that is argued to be a model of logical space as proclaimed by the *Tractatus*.

The essence of the network metaphor, on the other hand, is the comparison of a *proposition* as a *point* in a system of coordinates 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. 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). Here an influence is established on Wittgenstein's thought that is Hertzian expressed in his conception of Fundamental Law.[7] Because it is a local variational principle, which its explanation is general, it applies, of course, to any other representation characterized by a set of fundamental principles or laws. A scientific law, like the image of the metaphorical network, is not to make descriptions, not even very general descriptions, but to provide representation techniques by which it is possible to make descriptions.

> Scientific theories – Newtonian mechanics serves as a concrete example – function as systems of concepts for speaking about natural phenomena and "the relative position of logic and mechanics" (TLP 6.342) is determined by the fact that they supply different resources for describing the world, not by the fact that they say different things about it. Newtonian mechanics is a "form of description" but more restricted in scope than logic. While circumscribing what is possible rather than what is actual, it treats solely of matter and motion. (Lugg 2019, 214)

Or, in the words of Wittgenstein:

> [Newtonian] mechanics determines one form of description of the world by saying that all propositions used in the description of the world must be obtained in a given way from a given set of propositions – the axioms of mechanics. It thus supplies the bricks for building the edifice of science, and it says, 'Any building that you want to erect, whatever it may be, must somehow be constructed with these bricks, and with these alone'. (TLP 6.341 – our addition)

[7] "309. Fundamental Law. Every free system persists in its state of rest or of uniform motion in a straightest path" (Hertz 1956, 144).

Newtonian mechanics, therefore, puts the description of the world in a unitary form. "[…] Newtonian mechanics is as silent about the forces on bodies as the network of squares is silent about the configurations of black spots on white surfaces" (Lugg 2019, 215).

Wittgenstein's fundamental notion about science is that there is no such thing as a privileged theory, but different points of view. If physical theories are figures of reality and thus have only 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.

> 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. One is not 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 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" or "Darwin's theory has no more to do with philosophy than any other hypothesis in natural science" (TLP 4.1122). 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, nurtured by the tremendous success of natural science. And, thereby, it also intends to give a correct interpretation to the notorious law of causality.

The Determination of the Propositional Sense and the Foundations of the Law of Causality

From this point on, one can discuss the affinity of the model conception as an image and bring it closer to Wittgenstein's approach to scientific theories. In the models produced in science, the various principles, laws, theorems, axioms and definitions are instilled. Here we intend to analyze how Wittgenstein evaluated them, as well as his restrictive attitude towards them, starting with the law of causality. As for the reflections on causality, presented in the *Tractatus*, it can be said that there are two possible interpretations: the first of them linked to a supposed influence of Hertz, who had anticipated that an image does not describe nature but represents it through differential equations and coordinate system – or, in Wittgensteinian terms, through the metaphorical network: What he means is that the law of causality 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 Hertz's Fundamental Law. Causality is instrumental in integrated information about the facts of the world, so it is a *form* of the law rather than the true law of nature - "The law of causality is not a law but the form of a law" (TLP 6.32). It is a generic name that covers a range of principles of representation.

> Such principles, which I call metatheoretical principles, have historically been included in the list of "laws of nature". The principle of sufficient reason, the principle of Occam's razor, the principle of least effort and the principle of continuity of nature are some of these principles. According to Wittgenstein, it is wrong to call these principles

> "laws of nature" because they say nothing about natural phenomena, they do not describe reality. They say nothing about the spot, but about the net (Barroso 2017, 53).

Alternatively, as stated by Lugg (2019, 216-217):

> Just as there are in mechanics "minimum-laws, such as the law of least action", so there are in physics "causal laws, laws of the causality form", each of which is presupposed when the world is represented and like everything "a priori certain proves to be purely logical" (ibid.: 6.3211). To Wittgenstein's way of thinking, "[a]ll propositions, such as the law of causation, the law of continuity in nature, the law of least expenditure in nature, etc. etc., [...] are a priori intuitions of the possible forms of the propositions of science" (ibid.: 6.34). Which is to say they are principles of representation, not representations that record "accidents". Like all principles of representation (and laws of logic), they do not convey information and can only be displayed.

The "connection" in causality is not a relationship in itself but only a means of showing the existence of the relationship. To affirm the opposite, 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, meaningless and represents nothing.

The principle of causality is in itself a formal concept; it does not describe reality, but, as a "network", corresponding 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 core, "everything has a cause". "Causal laws are instructions that circumscribe what counts as a senseful proposition of the causal form (i.e., of the form '*p* causes *q*') within an optional system" (SANDIS; TEJEDOR, 2017, p. 579).

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". It shows itself precisely why, 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 to represent mechanical phenomena, and [...] once we effectively choose a method

of representation when describing the world, it is impossible that the laws of our method say something about the world" (Watson 1938, 52) – they represent, they show the world.

Once again, a notion appears in the *Tractatus* whose foundations date back to Hertz's mechanics: the analysis of a system's functionality does not allow 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).

Another interpretation that can be given to the question of causality is directly related to the propositional logic of the *Tractatus;* more specifically to the question of the determinability of the propositional sense, which also has a Hertzian background, in the sense that a scientific theory cannot be a *description* of needs implicit in nature, it has to be determined; it is up to it the function of being only an image, independent of natural phenomena – "images produced by our mind and necessarily affected by the characteristics of its mode of portrayal" (Hertz 1956, 2).

There are three basic principles that support the fabric of the *Tractatus*: the idea that the proposition is essentially i) bipolar, ii) complex and iii) fully determined (Prado Neto, 2003, 46). Which is to say that: i) they can be true or false from their comparison with the real, ii) they are formed from the combination of a complex of names; finally, iii) they are fully determined because there is no possibility that one proposition is inserted in another – except as a truth-function of a complex proposition. This means that the meaning of elementary propositions does not depend on meanings that are more elementary of which it would be composed (unlike the meaning of the complex proposition, which is determined by the meaning of elementary ones), as well as, it is independent of the meanings of other propositions. "One elementary proposition cannot be deduced from another" (TLP 5.134).

We know that in the *Tractatus*, the world is defined as the totality of compound facts and atomic facts (or elementary), the states of affairs. The latter are made up of simple objects, each of which can be given a name. The combination of such names results in an elementary proposition that is *independent* of its similar. Each of these propositions is positive and describes a *possible* state of affairs, which constitutes its *meaning*. However, nothing prevents thinking about the independence of the propositional sense in relation to its truth-value, or better saying; nothing prevents using a meaningful proposition, although it does not correspond to any fact or that it is false. In Wittgenstein's words, nothing prevents the proposition from representing a negative fact – "We also call the existence of states of affairs a positive fact, and their non-existence a negative fact" (TLF 2.06). It is in this project that Wittgenstein dives: to safeguard the legitimacy of the false sense and the autonomy of the propositional sense in relation to its truth-value. This will only be possible due to the development of the conceptions of the *object* and the *elementary proposition*.

In the *Tractatus*, the proposition is a picture of reality by virtue of names (TLP 2.1515). Even if a proposition does not correspond to any existing state of affairs, their names have references (this solution will only work if the names are the genuine names required by the *Tractatus*, which take the place of absolutely simple objects, therefore, indestructible, also required by the *Tractatus*). In this way, the proposition has an *independent* sense from the facts (TLP 4.061), that is, the sense is previous to the affirmation or denial of the proposition (TLP 4.064). Understanding the propositional meaning is in the existence of what is logically simple, the object – which is replaced by the name that has no sense, only reference. Through the concatenation of names, propositions come into contact with the fact, and the language touches the world. The elementary proposition expresses its meaning by picturing a fact, that is, its meaning is the expression of the contact between it and the fact. Therefore, it must be fully determined.

Due to what has been said, Wittgenstein justifies the impossibility of representing the needs of nature (for example, the causal nexus) when he asserts that the meaning of the proposition must be completely independent. As Wittgenstein says:

> One elementary proposition cannot be deduced from another.
> There is no possible way of making an inference from the existence of one situation to the existence of another, entirely different situation.
> There is no causal nexus to justify such an inference.
> We *cannot* infer the events of the future from those of the present.
> *Superstition* is nothing but belief in the causal nexus. (TLP 5.134-5.1361)

"One elementary proposition cannot be deduced from another" (TLP, 5.134), that is, elementary propositions have to be fully determined; it is not possible for one proposition to be inserted in another – except as a truth-function of a complex proposition. This means that the meaning of elementary propositions does not depend on meanings that are more elementary of which it would be composed (unlike the meaning of the complex proposition which is determined by the meaning of elementary ones), as well as it is independent of the meanings of other propositions. Each of these propositions is positive and describes a *possible* state of affairs, which constitutes its *meaning*. Thus, the proposition has an *independent* meaning from the facts (TLP 4.061), that is, the meaning is prior to the affirmation or denial of the proposition (TLP 4.064):

> This thesis [...], means that if elementary propositions were logically dependent, then it would be possible to deduce one elementary proposition from another. This consequence, if accepted, in turn, would imply the possibility of inferring the very states of affairs that the elementary propositions appear, i.e., it would be possible to apply the logical calculation *a priori* to the states of affairs, thus attributing to the empirical relationship of causality, the status of logical necessity. Now, as it is not possible to calculate *a priori* the occurrence of states of affairs, since there is only need in Logic [...] then the elementary propositions that affirm the subsistence (*das Bestehen*) of states of affairs must be logically independent. (Moreno 1995, 203-204)

Since there is no elementary proposition that can be deduced from another, the belief in the existence of a causal nexus cannot be logically justified since one cannot deduce the existence of a situation from the existence of another situation. Such refusal of the existence of the causal nexus, however, does not have the same grounds for which Hume also rejected it. What Hume refuses is the notion of an associative principle that makes it possible to make inferences about facts and events that are not presented to the senses. Such inferences are made possible by habit, which underlies the feeling that there is a regularity in nature. This regularity, however, would have a psychological basis since it is an expression of beliefs; his study is about "irrelevant investigations" (Hume 2001, 28). In Wittgenstein, however, the rejection of the causal nexus does not originate in the subject's psychological expressions, which make him believe that in nature things happen like this and so, but in logical inferences that prescribe that the propositional sense must be independent of others senses, because "there is no causal nexus to justify such an inference" (TLP 5.136). If the propositional sense is supposed to be fully determined, the conception of a causal nexus is superstition.

The Inductive Method and the Anteriority of Science Propositions in the *Tractatus*

These reflections on the causal nexus obviously extend to the principle or method of induction. If the law of causality is based on principles such as, for example, Newton's third law, according to which "for every action, there is an equal and opposite reaction", the principle of induction is aimed at making generalizations from the observation of particular cases, since it is not possible to carry out concrete experiments in all cases – "The procedure of induction consists in accepting as true the *simplest* law that can be reconciled with our experiences" (TLP 6.363). In this case, it is a psychological process[8] by which it is hypothetically assumed that there is reason to affirm the possibility of a future event based on a set of events in the past. "It is a hypothesis that the sun will rise tomorrow: and this means that we do not *know* whether it will rise. There is no compulsion making one thing happen because another has happened. The only necessity that exists is logical necessity" (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 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).

This notion is only maintained by the coercion of the "modern view of the world is founded on the illusion that the so-called natural laws are the explanations of natural phenomena" (TLP 6.371).

> "Nature is uniform" not provide us with an instruction that circumscribes our use of signs: it does not rule in certain senses and rules others out in the way that causal laws do. When we observe our first black swan, having in the past only ever observed white ones, no law relating to the uniformity of nature *instructs us* to find a new name for this creature. Upon inspection of the animal, *we may or may not* end up calling it a *swan* – but that we *may* indeed end up opting for this term simply goes to show that there is *no instruction circumscribing our use of signs in place here*, no instruction relating to the uniformity of nature. (Sandis; Tejedor 2017, 580).

If the inductive method that is based on so-called scientific propositions does not sustain itself, why is Wittgenstein electing the propositions of science that are the only ones liable to truth-values?

According to the *Tractatus*, there are three types of propositions: the propositions of philosophy, those of logic and the significant ones (propositions of science). As for the propositions of philosophy, these are not false, but "nonsensical".

> Most of the propositions and questions to be found in philosophical works are not false but nonsensical. Consequently, we cannot give any answer to questions of this kind, but can only point out that they are nonsensical. Most of the propositions and questions of philosophers arise from our failure to understand the logic of our language. (TLP 4.003)

[8] "This procedure, however, has no logical justification but only a psychological one" (TLP 6.3631).

The reason for the philosopher's "failure to understand" concerning the logic of language lies in the fact that "language disguises thought" (TLP 4.002). That is why "the correct method in philosophy would really be the following: to say nothing except what can be said, i.e., propositions of natural science – i.e., something that has nothing to do with philosophy – and then, whenever someone else wanted to say something metaphysical, to demonstrate to him that he had failed to give a meaning to certain signs in his propositions" (TLP 6.53). Thus, "the word 'philosophy' must mean something whose place is above or below the natural sciences, not beside them" (TLP 4.111) and would have no other role than that of "logical clarification of thoughts" (TLP 4.112).[9] It is clear, at the outset, that the *Tractatus* favors factual discourse to the detriment of others, such as ethical, aesthetic, religious, etc.

As for the propositions of logic, these are not representations, as they are meaningless propositions and do not say anything about the world. The propositions of logic are necessarily true (tautologies) or necessarily false (contradictions), that is, they do not have truth-conditions, they are not "proposals" of agreement with the world, because the bipolarity of the meaning (T/F), characteristic indelible from significant propositions, does not underlie them. Its function is to show the limit cases of the signal connection, that is, its dissolution as significant signals - "Tautology and contradiction are the limiting cases – indeed the disintegration – of the combination of signs" (TLP 4.466). Truth-values cancel each other both in tautology and in contradiction. "A tautology leaves open to reality the whole – the infinite whole – of logical space: a contradiction fills the whole of logical space, leaving no point of it for reality. Thus neither of them can determine reality in any way" (TLP 4.463). The truth of a logic proposition is recognized only by looking at the sign:

> It is the peculiar mark of logical propositions that one can recognize that they are true from the symbol alone, and this fact contains in itself the whole philosophy of logic. And so too it is a very important fact that the truth or falsity of non-logical propositions *cannot* be recognized from the propositions alone. (TLP 6.113)

Given the characteristics of the propositions of logic, it is seen that "the so-called law of induction cannot possibly be a law of logic, since it is obviously a proposition with sense. – Nor, therefore, can it be an *a priori* law" (TLP 6.31). "Logic is *prior* to every experience – that something *is so*" (TLP 5.552).

If the law of induction is not a logical law, then it is a proposition of science, as it is "endowed with meaning". As for the truth of this type of proposition (non-logical, or significant, or science propositions), it can only be recognized through comparison with reality – "Reality is compared with propositions" (TLP, 4.05). Only the propositions of science can be chosen as a figure since only they are capable of representing the contingency of the concatenations of objects in the logical space. Only they are figures, because only they maintain the condition of internal identity (due to their combinatorial possibilities) and external (due to the fact that they are combined) with thought and reality, and this does not happen even with nonsensical (with the propositions of philosophy, for example) nor with the propositions of logic, as it turned out.

[9] As long as there is a verb "to be" that seems to work like "to eat" and "to drink"; as long as the adjectives "identical", "true", "false", "possible" exist, as long as people talk about the passage of time and the extension of space etc., they will continue to encounter the same difficulties that leave them perplexed (Wittgenstein, L. *Manuscript 111*. pp. 133-134 *apud* Spaniol 1989, 94).

Final considerations

In this article, a brief presentation of scientific representation questions, causality and induction in Ludwig Wittgenstein's *Tractatus* was proposed. It is known that the *Tractatus*' conception of science, as well as the notion of geometric representation, is a tributary of both Hertz's mechanical system,[10] and Boltzmann's mechanical and thermodynamic systems. From Hertz's notion, it is possible to have several images of nature and that systems can be represented through systems of coordinates of material points that the meaning of the metaphor of the Wittgenstein network can be deduced. On the other hand, this notion is also a Boltzmannian notion and, "perhaps recalling Boltzmann's use of the phrase 'geometric representation' (Boltzmann 1974, 9), he likens mechanics to a 'square network [*quadratischen Netzwerk*]' (TB 35; TLP 6.341)" (Lugg 2019, 214). Just as the coordinate system represents a reality of nature through its fundamental coordinates, the Tractarian metaphorical network allows facts to be described from its configuration and its meshes' fineness. The metaphorical network symbolizes the possibility that different reference systems (metatheoretical principles) or different scientific theories say something about the world, preventing the advance of one theory over the other – all are legitimate modes of representation, each working in their own way. Such conception is part of Hertz's notion that scientific theories are forms of representation, or images of the world, each, in its own way, plays a role in elucidating the order of nature. Some of the images are more suitable for a particular purpose, others for other purposes, with no precedence for one over another – "One image may be more suitable for one purpose, another for another; only by gradually testing many images can we finally succeed in obtaining the most appropriate" (Hertz 1956, 3). The fundamental requirement is that such representations do not infringe the principles of logic permissibility (*Zulaessigkeit*), correction (*Richtigkeit*) and adequacy (*Zwegmaessigkeit*) (Hertz 1956, 2). The notion of logical permissibility is connected to the notion of determinability of the Tractarian propositional meaning, which advocates that the meaning of the proposition must be fully determined and, still, it must not be contradictory. This notion directly reflects his assessment of the causal nexus and the principle of induction, which deceive us into believing that there are designs in nature. The law of causality, as a metatheoretical principle, that is, as a form of law and not a law itself, is neither a law of logic, nor an empirical generalization, nor a synthetic proposition *a priori*. As a form, it cannot say anything about the world, only show – "What can be shown, cannot be said" (TLP 4.1212). What it indicates is a particular form of description that is crucial for scientific theorization (TLP 6.321). In this sense, the law of causality reveals itself to be superfluous, meaningless and represents nothing. Whether the proposition is to be fully determined and cannot depend on other propositions' meaning, then the causal nexus is a superstition.

On the other hand, the support of other principles that advocate the chaining of particular events, in order to justify a general inference regarding the behavior of nature, is only made possible by psychological issues: by the belief that, if an event occurs several times in a certain way, this must be how it will happen the next time. Thus, the inductive method, according to Wittgenstein, "has no logical justification but only a psychological one" (TLP 6.3631). It is not because the sun has always risen in the morning that it will be guaranteed that it will rise the next day. These Wittgensteinian notions about scientific representation, causality and induction seem clear when understood in the light of the Hertzian image of mechanics, as well as Boltzmann's physics and philosophy of science, and everything proposed here was to show how this is possible to be understood.

[10] See, for example, (SIMÕES 2020, 93-107).

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