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## Special Issue

### Wittgenstein and the Sciences: History and Philosophy of Science and Science Education

#### Science and its Grammar: Writing the History of Science through the Lens of the Later Wittgenstein

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#### Abstract:

The article aims to demonstrate the possibility of writing the history of science from the later Wittgenstein viewpoint. To accomplish this purpose, it exposes the “theory of history” of Wittgensteinian inspiration, called “grammar of history”. Then it discusses the idea of a Wittgensteinian-inspired “theory of science”, here called “grammar of science”. Finally, based on the interconnections between the grammar of history and the grammar of science previously exposed, some guidelines for writing the history of science from a Wittgensteinian perspective are outlined.

**Keywords:** Wittgenstein; Grammar of science; Grammar of history; History of science

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## Introduction

Wittgenstein’s work has been used for the understanding of science, its epistemology, and history. The Austrian-British philosopher’s reflections on science were already presented in the *Tractatus Logico-Philosophicus*,<sup>2</sup> though in a very synthetic manner. Besides his significant presence in the Vienna Circle, influential authors such as Kuhn, Shapin, and Schaffer were

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<sup>2</sup> From this point on, I will refer to Wittgenstein’s books worked as follows: The *Tractatus Logico-Philosophicus*, only *Tractatus*, and in quotations, *Tract.*, followed by the number of the aphorism to which it refers. The *Philosophical Investigations*, in the citations, *PI*, followed by the number of the paragraph to which it refers. The *On Certainty*, in quotations, *OC*, followed by the number of the paragraph to which it refers. The *Remarks on the Foundations of Mathematics*, in the citations, *FM*, followed by the paragraph number to which it refers.

inspired by Wittgenstein to understand science and its historical insertion.<sup>3</sup> In giving sequence to these appropriations of the Wittgensteinian work to understand science, even though not necessarily in the same direction of these authors, this article aims to understand the uses of the later Wittgenstein's philosophy<sup>4</sup> as a robust reference for the understanding of science and its history. Namely, Wittgensteinian philosophy can supply us with some significant guidelines to orient our writing of the history of science.

Whether starting from the assumption that the philosophy of the later Wittgenstein, especially his notion of grammar, can be understood as a model of scientific rationality, we can take it as a reference for elaborating the writing of the history of science. With this purpose, in the first moment, I will discuss the notion of grammar in the later Wittgenstein. In the sequence, I will try to show how to understand history from a Wittgensteinian perspective, even though our author has not explored this theme. I will try to explain what I call here a "grammar of history". In a third moment, I will try to demonstrate, always based on the Wittgensteinian notion of grammar, how we can conceive a theory of science or what I call "grammar of science". Finally, in the last part, based on the ideas discussed (theory of history and theory of science), I will try to demonstrate how Wittgensteinian thought allows us to establish guidelines for understanding the history of science and the elaboration of its writing. In other words, I will try to explain the "grammar of the history of science".

Due to Wittgenstein's work complexity and the extensive historical and philosophical aspects concerning science, of course, the approach of these issues cannot fit in all its depth in this article. Although having a vital presence in contemporary philosophy, the author of the *Philosophical Investigations* has not yet been fully taken as a philosopher who could establish a "theory of science" that would appropriately understand the history of science. In this sense, I hope to be contributing by pointing out Wittgenstein's philosophy as a valuable way to think about science in its epistemological and historical aspects. From conversations with colleagues and graduate students who are historians of science, I realized the need to synthesize in a single text two previous articles (Condé 2004a, 2018) about this topic. Thus, I reworked and expanded them substantially to make more evident the beneficial use of Wittgenstein's philosophy as a reference for writing the history of science.

## The Notion of Grammar

As I tried to demonstrate in previous work (Condé 2004), language in Wittgenstein can be thought of as a model of rationality that opposes modern reason to overcome it in its dichotomies and paradoxes. The Wittgensteinian notion of grammar is central to this formulation. The idea of using the Wittgensteinian grammar as a model for analyzing the history of science is based on the conception that Wittgenstein's work offers us a model of rationality beyond a philosophy of language. Based on this model of rationality, we can understand science, among other forms of human knowledge (art, politics, religion, etc.).

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<sup>3</sup> Although Wittgenstein was not precisely a philosopher of science, his philosophy has already greatly propitiated the philosophical and historical reflection about science. According to Ryle, Wittgenstein was an unknown but important philosopher of science (see Ryle, 1957). Authors like Thomas Kuhn (Kuhn 1970 [1962] and 2000) acknowledge the influence they received from Wittgenstein's work. As far as a philosophy of social science is concerned, Peter Winch's well-known book, *The Idea of a Social Science and its Relation to Philosophy*, was perhaps the most striking influence, becoming a reference for philosophers and social scientists (Winch 1958). Wittgenstein's contribution to the sociology of science was mainly in the so-called "strong program" of David Bloor's sociology of scientific knowledge (Bloor 1973; 1991 [1976]) (Shapin and Schaffer, 1985). Not to mention, of course, all the decisive influence of the author of the *Tractatus* on the Vienna Circle.

<sup>4</sup> It has become common the expression "later Wittgenstein" to designate the second philosophy of the Austrian-British thinker, present above all in the *Philosophical Investigations*.



This model of scientific rationality, which Wittgenstein inspired, especially from his notions of grammar and pragmatics of language, is configured as a particular type of system. As one of its main aspects, this system has a holistic perspective while not a totalizing one.

Thinking particularly about science, we notice that the Wittgensteinian model of rationality, unlike the modern totalizing scientific rationality, is not constituted from an a priori and hierarchical order. It is not similar to the Cartesian *Mathesis Universalis*, but, in contrast, it is a flexible multidirectional network that extends itself through “family resemblances” (*Familienähnlichkeiten*) (PI §§ 67, 77, 108). The Wittgensteinian’ rationality is not totalizing because it does not claim to provide a “unique” and complete worldview based on an ultimate foundation. However, it is holistic because it presents a panoramic dimension (*Übersichtlichkeit*) (PI § 122) constituting an open and decentralized system in which rationality is not incrustated in any privileged place but configured from the multiple relations within the system (Grammar). Although this Wittgensteinian model of rationality is an autonomous system, it is not closed in extreme relativism as it is open to other systems.

In approaching the conception of grammar in the later Wittgenstein, at first two essential observations must be made. First of all, it is necessary to point out that, in Wittgenstein’s uses, the expression grammar should not be confused with the normative grammar of any particular language. In using the expression grammar, Wittgenstein is essentially concerned with the philosophical aspect of language. Second, we have much more a “notion” of grammar than a closed “concept” with well-defined limits.

Although my aim is not to reconstruct the later Wittgenstein’s philosophy of language, to understand the notion of grammar in the *Philosophical Investigations*, it is necessary to understand the concepts of “use”, “language-games”, “family resemblances”, and “rules”. For Wittgenstein, the use of language in different situations and occurrences enable the meaning of an expression, that is, “(...) the meaning of a word is its use in the language” (PI § 43). In the philosophical tradition, or even in the *Tractatus*’ perspective, an object determined the meaning of a word. According to the later Wittgenstein, the meaning of a word comes from its use in a given context. These contexts are not exclusively linguistic but involve a whole pragmatic dimension: a set of words, objects, actions, behaviors, etc. Wittgenstein calls this set “language-games” (PI § 7). The Austrian-British thinker exemplifies several language-games as:

- Giving orders, and acting on them –
- Describing an object by its appearance, or by its measurements –
- Constructing an object from a description (a drawing) –
- Reporting an event –
- Speculating about the event –
- Forming and testing a hypothesis –
- Presenting the results of an experiment in tables and diagrams –
- Making up a story; and reading one –
- Acting in a play –
- Singing rounds –
- Guessing riddles –
- Cracking a joke; telling one –
- Solving a problem in applied arithmetic –
- Translating from one language into another –
- Requesting, thanking, cursing, greeting, praying. (PI § 23)

However, there is no common foundation for all games. They are simply similar to each other, like the members of a family. Some specific features belong to certain games but are absent in others. Thus, particular features appear and disappear from one game to another, and in several language games, characteristic traits appear and disappear. According to

Wittgenstein, the only connections in these multiple and varied language-games are like the similarities between family members. Language-games are related to each other in many ways, like “family resemblances”. Thus, family resemblances are the similarities between aspects belonging to the various compared elements but in a way that similar features are distributed randomly across these elements, without repeating themselves uniformly. The author of *Philosophical Investigations* proposes the end of a search for the essence of language that characterized the traditional philosophy of language. According to him, there is no something as a property common to all languages.

For Wittgenstein, the use within a language-game is not an indiscriminate practice. Although relatively free, language uses are governed by rules that distinguish the correct and incorrect use of words in different contexts. These rules are linguistic and pragmatic; namely, they involve actions, objects, and behaviors. Moreover, it is the set of these rules, which have a dynamic aspect and are in a continuous flow, which makes up grammar. To the extent that grammar, more than the syntactic-semantic dimension, incorporates pragmatics, it is inserted in social practice. A grammatical rule can only effectively constitute itself as such through social praxis. Grammar is a social product. It remains to be noted that just as the use of a word conditions the rule, the rule, in turn, will determine whether the use of this word is correct or not. However, as grammar is an open-ended set of rules, new rules may be added, old rules changed.

The later Wittgenstein’s conception of grammar keeps, thus, some essential characteristics. Possibly the most important one is the precise that the rule is a product of social praxis. From this conception, it follows that the rule is a social convention (therefore, a collective agreement) which arises from this praxis and could be different if this praxis were different (or even could change from one society – “form of life” (PI § 19) – to another). As an “invention”, the rule is a social creation that does not reflect any metaphysical essence. It is an “arbitrary” creation which means it is an “invention”. However, the rule cannot be completely arbitrary, since it must maintain its coherence with the set of other rules, practices, and behaviors, that is, with grammar. “[...] if rule became exception, and exception rule; or if both became phenomena of roughly equal frequency – our normal language-games would thereby lose their point” (PI § 142). Thus, rules arise in our “patterns of behavior”, usages, practices, customs, and institutions (PI §§ 142, 199, 202, 337).

When we understand the rule as a product of a language-game, we conclude by the operative character of the rule. Following a rule is an operation – that is the pragmatic character of the rule. “To understand a language means to be master of a technique” (PI § 199). It is not an isolated mental process. “That’s why ‘following a rule’ is a practice. And to think one is following a rule is not to follow a rule. And that’s why it’s not possible to follow a rule ‘privately’; otherwise, thinking one was following a rule would be the same thing as following it” (PI § 202). Following the rule in the language-game is a practice that involves expressions, objects, actions, behaviors, and attitudes.

In his *Philosophical Investigations*, Wittgenstein distinguishes two levels of grammar. The “surface grammar” (*Oberflächengrammatik*) and the “depth grammar” (*Tiefengrammatik*) (PI § 664). Surface grammar deals with the evident characteristics of the expressions without considering the global grammatical context in which those expressions are generated. In contrast, in the depth grammar (panoramic grammar),<sup>5</sup> the rules of the use of language are engendered. Within the depth grammar, like a game, the production of

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<sup>5</sup> The expression “depth grammar” does not seek to affirm the “essential structures of reality”, as the metaphysical tradition has claimed. There is nothing hidden beyond our grammar. As H. Glock points out, “depth grammar” may not be a good expression since it is not a contrast between the surface and the “geology” of expressions, but between local uses and global geography (See Glock 1996, 154-155). Thus, I think it would be better to use the expression “panoramic grammar”.

different linguistic expressions is generated, and in the same way, rationality. Thus, depth grammar, more than peculiar aspects of a specific language-game, considers everything involved in the whole praxis of language, such as its uses, production of rules, etc. Perhaps, the general meaning of the later Wittgenstein's notion of grammar could be expressed as follows: logic is expressed in grammar rules. Every logical possibility is grammatical. In the *Philosophical Investigations*, grammar, more than making logic possible, is logic itself. Consequently, grammar tells us what is logical, what is inside and outside the limits of meaning. "So does what is, and what is not, called (logically) possible depend wholly on our grammar" (PI § 520). As a more immediate consequence, rationality is, first of all, grammatical. Grammar is, therefore, the set of rules erected from the interaction between language and actions in its regularity. This regularity establishes the standard norm, which also establishes the understanding of exceptions (PI § 142). In effect, a grammar of history, a grammar of science, and, consequently, a grammar of the history of science would follow the same processes described in the philosophy of the later Wittgenstein. I will address the "grammar of history" in the next section.

## The Grammar of History

In his *Philosophical Investigations*, Wittgenstein comments on a passage by St. Augustine about the issue of time – "What, then, is time? If no one asks me, I know; if I want to explain it to those who ask me, I no longer know" (PI § 89) – to conclude that our understanding about time resides, essentially, in a philosophical aspect. Thus, as Augustine's passage might suggest, our understanding is not based exclusively on an empirical perspective that tries to establish considerations about the nature of time in its duration: past, present, and future. For Wittgenstein, we do not reflect on the phenomenon of time itself. We reflect on the "possibilities" of the phenomenon of time, that is, about the way we qualify it from our language and social insertion (Grammar).

We feel as if we had to *see right into* phenomena: yet our investigation is directed not towards *phenomena*, but rather, as one might say, towards the '*possibilities*' of phenomena. What that means is that we call to mind the *kinds of statement* that we make about phenomena. (PI § 90)

In effect, thinking about temporality is not limited to only think about the physical phenomenon of time. First and foremost, a "grammar of time" is a "grammar of history".

However, doing this exercise of analyzing the interpretative possibilities of history from the work of the Austrian-British thinker was not something that historians and philosophers of history considered a very fruitful task. As we know, Wittgenstein was not a philosopher of history and influenced relatively little or almost nothing about the science of history.<sup>6</sup> Wittgenstein was not even a philosopher of a dialectical tradition. Still, perhaps the highest representative of an analytic tradition consolidated in the British world. To some extent, the later Wittgensteinian philosophy flourished as a counter position to the dialectical, hermeneutic, or phenomenological tradition. Wittgenstein did not discuss the temporality phenomenon (historicity) properly. However, it is possible to think about history from his later work. This section aims to explain what this temporality is.

A first point to highlight the use of Wittgenstein's philosophy of language to understand history imposes on us a minimalist and dynamic ontology. One can say a "deflated" ontology that opposes traditional philosophical theses about history (*à la* Kant, Hegel, Marx, Comte, etc.) – currently no longer practiced by historians and philosophers of

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<sup>6</sup> As pointed out, Wittgenstein's influence on history has been in the specific field of the history of science in such major authors as Kuhn (1970 [1962], 2000) and Shapin and Schaffer (1985).

history. This minimalist ontology displays the contingency of a given historical time through its complex pragmatic and grammatical networks and ramifications, not very fond of grand metaphysical syntheses or the affirmation of metanarratives.

However, on the other hand, even if Wittgenstein's work can allow us to understand the rationality of the singularity of a given historical time from the analysis of such intricate pragmatic and grammatical interactions of a contingent historical time, this does not necessarily imply in assuming a historical relativism. Relativism would be if this historical time were closed in on itself, that is, relative to itself, without connections to its past, present, and future horizons or any contact with other cultures and societies. Nevertheless, the first analysis of any history is enough to see that there are always continuities and ruptures in any historical time. These continuities connect us not only with our past but open the door to relate with other histories and societies. Most of the time, we find, in a Wittgensteinian perspective, "family resemblances" of a historical time with itself in its past, present, and future. It is also entirely possible to confront this particular culture with other historical times or other cultures and societies. In short, historicity is not synonymous with historical relativism. I will return to this point later on when dealing with relativism in science.

Faced with the constant danger imposed by the metaphysics embedded in traditional philosophies of history, it would be possible to use Wittgensteinian's grammar for an adequate understanding of historical processes. In other words, it is possible to build a type of methodology allowing us to understand historical processes. We do not need to construct a strong "thesis" about history.

Thus, in a Wittgensteinian perspective, it is not a matter of capturing the metaphysical essence of a historical time but understanding its grammatical scope or extension (habits, traditions, and costumes). Historical processes are related in a long and comprehensive chain of interactions of their multiple events. Faced with such complex phenomena, we lack "an overview" (*Übersichtlichkeit*) (PI § 122), as explained by Wittgenstein. Moreover, it is, in this sense, that in analyzing the grammar of history, it is not precisely a matter of establishing a depth, of searching for an essence that is far from the surface. It is about understanding a complex network of interactions that extends too far for us to grasp it immediately. We are swallowed by the complexity of the historical process, for we lack "an overview" to reach every corner of our historical experiences and memories. However, to articulate these multiple experiences and historical memories, it is possible to use the Wittgensteinian notion of grammar; that is, it is possible to establish a "grammar of history" that provides us with the conductor thread of our understanding of the historical process.

First of all, grammar is already something eminently historical because its constitution in the form of life – with its multiple social and cultural interactions – is a process in time. In sum, grammar is essentially historical (since, as a dynamic and open mechanism, it is constantly changing). Because grammar is a historical and social system that constitutes a particular kind of "holistic" system (although, as noted, it is not a "totalizing" metaphysical system),<sup>7</sup> it stands in opposition to traditional conceptions of history. In other terms, contrary to the idea of a positivist and neutral narrative, a Wittgensteinian-inspired theory of history is not constituted from a hierarchical structure or an a priori metaphysical order. On the contrary, the grammar of history is constituted by the network of family resemblances and their different language-games distributed in time. Like the Wittgensteinian notion of grammar, a grammar of history cannot be something totalizing because it has no ultimate

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<sup>7</sup> The 18<sup>th</sup> and 19<sup>th</sup> centuries philosophies of history had this totalizing character as if all rules were valid for all members of society. We see this claim, for example, in authors like Kant, Hegel, Comte, and even Marx and Engels in the famous *Communist Manifesto* that ends with the statement: "Proletarians of all lands. Unite!" (Marx; Engels 1998, 69), without considering that even proletarians constitute different subclasses with distinct interests. In Wittgensteinian terms, we would say that they established different grammars in different forms of life.

foundation, nor does it seek a metaphysical or positivist intelligibility. The grammar of history must be holistic; that is, it must seek a panoramic view of historical processes. In effect, it constitutes an open and decentralized system in which rationality is not based in any special privileged place but instead is configured out of the multiple relations within the social and historical system it configures. Extending Wittgenstein's conception of linguistic (grammatical) rationality to our understanding of historical processes, we realize that the science of history, in its *modus operandi*, is also a kind of grammar. This "grammar of history" can be conceived as a theory of history.

In effect, contrary to theories of history that affirmed the description of facts or metaphysical worldviews, the grammar of history does not seek the narratives of a historical fact, essentially, from its description or positivity, or even from metaphysical foundations. Above all, it seeks the intelligibility of its grammatical dynamics. As observed, it is not a matter of approaching the (historical) phenomenon *per se*, but the grammatical "possibilities" of the (historical) phenomenon. These grammatical possibilities are not metaphysical presuppositions but the result of social and historical interactions.

The grammar of history follows a basic assumption of any theory of history. Although history refers to the past, it does not prevent us from understanding the weaving of history in the present. Of course, it is not a matter of glimpsing the telos of the event for the grammar of history. The most important is to understand the meaning of the historical experience. To understand how this temporality constituted its historical values in the plot of its events. In other words, how history established its grammatical rules erected through social behaviors over time.

In other words, if understood as grammar, the science of history allows us to establish intelligibility in the historical processes. It allows us to understand the grammatical rules that marked the events, even though we can never inexorably predetermine the flow of events. In this sense, the grammar of history is an "understanding" and not an "explanation", as established by Dilthey's hermeneutics.

Although it is an autonomous system, the grammar of history is not closed as in a system of extreme relativism since it remains open to other systems of thought and behavior (other grammars). It is through the possibility of using the concept of grammar in many areas – the grammar of colors, grammar of uses, etc. –, the association of grammar with the notion of institutions – money (PI § 584), writing and reading (PI § 156), the system of measures (PI § 50) – that we can think of the institution of history as grammar. In other words, we can think of history as an institution as a set of rules and practices that encapsulate its rationality within itself, even if it is opened to connecting with other grammars. Like grammar, history has its values in itself and, in this sense, its autonomy. A historical grammar always describes a peculiar process even if it has "family resemblances" with other grammars. Even if the grammar of history is contingent on its own rules, it can go beyond this contingency by presenting family resemblances among its institutions and even potentially with the institutions of other grammars (cultures and societies).

Indeed, the grammar of history is the historical device or the "system of reference" (*Bezugssystem*) (PI § 206) that situates us historically. Social and linguistic behaviors structure our cognitive practices in the particular context of what Wittgenstein called a "form of life" (PI § 19). So, in this form of life, we deal with social and natural events constituting that process of our historicity. Thus, the grammar in space and time is analogous to a form of life. However, differently from some interpretations of Wittgenstein's work, a form of life is not closed to others.

On the contrary, as already pointed out, it interacts with other possibilities of social practices or other forms of life, with more or fewer connections. We can establish approximations, comparisons, confrontations, etc., with other historical grammars or forms of life through the grammar of history. From our form of life, we establish our "system of reference" for understanding other forms of life, and we share family resemblances in many

of our practices and institutions. From our historical grammar, we thus find a possibility of understanding other historical grammar. Of course, historical grammars are peculiar. Thus, we cannot expect from our historical grammar to understand the totality of other grammars anachronistically. Even though if we can establish through family resemblances some intelligibility about them.

There are ruptures and continuities between different historical times, such as between feudalism and capitalism. Several institutions present in feudalism have “family resemblances” to capitalism (money, writing, reading, religion). However, it is only within the emerging capitalist relations or the historical grammar of capital that we find new institutions or new social values like “individualism”, “competition”, “profit”, “social mobility”. And, as a whole, the new mode of production with its new division of labor. However, a grammar of history does not necessarily lead us to know “why” capitalism came into being – however much we enumerate the necessary conditions for this – but only to infer “how” its grammatical rules of operation and its various language-games were instituted. In conceiving a grammar of history, it is not a matter of seeking the telos of history but to imagine its mode of evolution in terms of Darwin established with his idea of evolution. Not a process toward somewhere but coming from somewhere. We can understand the grammar of history a posteriori, but we cannot explain its development teleologically or a priori.

An expressive part of the questions posed by traditional philosophies of history since St. Augustine is, in fact, questions that sought a metaphysical and teleological why of history and not a grammatical “how”. This “why”, although it may have its hermeneutical legitimacy, turned out to be, most of the time, an empty metaphysics without a practical explanatory commitment to historical processes. A grammar of history does not seek a why. It seeks to know “how” the grammatical rules of such a historical process were constituted in its political, social, economic, etc., circumstances, in short, in the context in which the events occurred.

However, to understand history, one must create the institutions and mechanisms of that historical consciousness. Just as Wittgenstein points out that one cannot play chess without the institution of the game of chess (PI §§ 337) – or measure without the institution of measurement –, it would also be impossible to understand history without some mechanisms. These mechanisms allow us to understand the institutionalization of our social practices, habits, and customs. Thus, they allow us to construct our historicity. Historical mechanisms are the different configurations, explanatory models, and theories ranging from myth to the most advanced and complex possible theory of history. Whether the interpreters are aware of it or not, the different explanations of history (regardless of their degree of complexity) are only possible as grammatical institutions.

When trying to understand the historical process, the traditional philosophy of history and the Wittgenstein-inspired grammar of history answer, in a way, the same questions, but from different perspectives: one based on the metaphysics of “why” historical facts happened and the other based on the grammatical “how” these same facts happened. In other words, the grammar of history shows us the way “how” knowledge and practices are institutionalized within a certain historical context (or form of life) but has little to say about the motivations or the random events that led to these facts. Although this grammar of history has these limits, perhaps no theory of history can ever give us definite answers to these “whys” (other than mere teleological and metaphysical speculations). So, we have to be content to know “how” a specific set of grammatical rules helped shape a historical moment.

According to Wittgenstein, language and social practices are processed and organized through language-games and their grammar from where we see the world. Grammar tells us what the world is. “Grammar tells what kind of object anything is” (PI § 373). Finally, if there is any possible essence, “essence is expressed in grammar” (PI § 371). Grammar circumscribes

the “essence” of historical understanding. It is in this sense a convention and never a metaphysical essence. For Wittgenstein, the search for essence is always searching for the convention stipulated by grammar and its pragmatics or social practices.

From the above, taking our author’s ideas to the last consequences to establish the basis of a theory of history, we can affirm that our actions are social acts. While they take place in time, they are necessarily historical. Therefore, by providing the parameters of our practices and our knowledge, grammar situates us historically. Its function is precisely to construct in a given historical time the specificity of the different values that we attribute to the world as a historically situated society.

Although exposed here in a synthetic way, we can perceive some of the fruitful possibilities of understanding history from Wittgenstein’s later philosophy. In the last section, I will resume some aspects of the grammar of history to think about the history of science. For now, explained the grammar of history, I will move on to the grammar of science.

## The Grammar of Science

In its *modus operandi*, science also constitutes a specific grammar.<sup>8</sup> This “grammar of science”,<sup>9</sup> insofar as it characterizes scientific rationality, allows us to think of it as a “theory of science”. Consequently, in this section, I will try to explain the notion of the grammar of science. As already pointed out, it is by the possibility of the use of the notion of grammar in many domains (grammar of colors, of uses, etc.) and the association with institutions (money; writing and reading; system of measures, etc.) is that we can also think of the institution of science as a grammar. In other terms, as an institution with a set of rules and practices, habits and customs that enclose its rationality in itself, that is, as a grammar, science has its values in itself. In this sense, the grammar of science is autonomous, although not independent from society, since it is in society that the grammar of science finds its “rough ground” (PI § 107) on which it is built.

In a Wittgensteinian viewpoint, what circumscribes something as scientific, such as what separates medicine from witchcraft or establishes the distinction between scientific

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<sup>8</sup> The idea of science as grammar was embryonically postulated by physicist Heinrich Hertz in his book *Principles of Mechanics*, published posthumously in 1892. However, Hertz referred to the normalizing grammar of any given language and not to grammar in the philosophical sense stipulated by Wittgenstein. Hertz formulates the idea that science, mainly mechanics, operates similarly to the grammar of a given language (Hertz [1892] 1956, 40). Although the young Wittgenstein received a significant influence from Hertz (Tract. 4.04, 6.361), his inspiration was not explicitly from the analogy between science and grammar. This influence possibly came from the concept of the model (*Bilder*) in Hertz’s physics and was used to elaborate the notion of logical grammar in the *Tractatus* (Tract. 3.325).

<sup>9</sup> It is also worth noting that the expression “grammar of science” is the title of Karl Pearson’s book (Pearson, [1892] 1943), coincidentally published in 1892, the same year that Hertz’s *Principles of Mechanics* appeared. Pearson was not explicitly inspired by Hertz. Although he does make some brief references to him (Pearson [1892] 1943, 30, 31 and 153); these concern Hertz’s scientific contributions and not the philosophical ones present mainly in the introduction of the *Principles of Mechanics*. In his book, Pearson tries to balance the sciences until the end of the 19<sup>th</sup> century, but he does not explicitly explain his title. With some effort – and to some extent already influenced by a Wittgensteinian *Gestalt* – we are led to conclude that science’s methodological and operational aspects resemble grammar for Pearson. However, although Pearson’s book brings some innovative philosophical aspects for its time – such as the critique of metaphysics from the new scientific ideas –, his epistemology still finds limitations to address what the sciences from the late nineteenth century onwards present. In fact, except for the title of Pearson’s book, what is set as grammar here is a model of scientific rationality centered on the later Wittgenstein and is not developed either from Hertz’s work or Pearson’s book. Despite this coincidence, the expression “grammar of science” is justified from the later Wittgenstein’s philosophy.

and nonscientific, is the set of rules, practices, and scientific results. In short, the elements of the “grammar of science”. Considering scientific grammar is an open system of interactions and juxtapositions of practices, rules, and values, it is even possible to say that there are family resemblances between science, witchcraft, religion, and politics. These resemblances may, in different manners, influence the final product of scientific knowledge, but the justification of scientific rationality is found in its grammar. Finally, as an institution, science has specific rules and practices, its particular grammar – remembering that, for Wittgenstein, every rule can be applied only in an institution (PI §§ 380, 540). Of course, the grammar of science can be permeated by other values of the society in which it is inserted. Insofar as these criteria of scientific rationality are social, public, pragmatic, and intersubjective (neither transcendental nor merely positive), they allow us to have access to the different “system of references” (grammars). They enable us to make choices among different grammars.

The necessity of choosing between the grammar of science and that of witchcraft, for example, among the public criteria, will be the rules of behavior of each group and the efficacy in reaching the intended goals, i.e., nature’s response. Therefore, even if our grammar is not reduced to the positivity of facts, if these facts were different, our language-games would also be different, and, consequently, our grammar: as Wittgenstein points out, “If we imagine the facts otherwise than as they are, certain language-games lose some of their importance, while others become important” (OC § 63). In other words, language-games constitute their “regularities” (PI § 208), so to speak, also from a kind of “order of things”. The language-game of understanding nature is part of science, although it is not necessarily part of other grammars such as art, religion, or witchcraft.

This Wittgensteinian grammatical perspective opens – like the networks made possible by family resemblances – a fruitful way to investigate epistemological issues highlighted by contemporary sciences. Some traditional epistemological problems would thus find a rich possibility of an equation in the perspective of Wittgensteinian grammar. Some related problems to scientific knowledge are objectivity, subjectivity, intersubjectivity, certainty, validity, relativism, internalism, externalism, the foundation of knowledge, etc. Of course, these problems are related in a complex net in a theory of science, which makes it challenging to address them in isolation. However, I will indicate how to approach two of these problems from a Wittgensteinian perspective for illustrative purposes. Albeit briefly, I will address the problems of (1) the foundation of knowledge and (2) relativism. The purpose is to outline one possibility of approaching such problems from the grammar of science.

Modern epistemology had as its central point the issue of the foundation of science. Although this issue is an inheritance from Greek thought, it seems justified in the rise of modern science since it stands on the debris of the foundations of the Greek episteme. On this new ground, it became necessary to construct the “new science”. For both Cartesian rationalism and Baconian empiricism, although from different perspectives, the primary role of philosophy was to provide the foundation of science. For Wittgenstein, there is no ultimate foundation. The value of a particular statement, for example, is not due to the positivity of facts or metaphysical essence but just given by the pragmatic set which makes up our system of reference, our grammar of rules, uses, and actions present in our different language-games. It is from this pragmatic perspective that “our knowledge forms an enormous system. And only within this system has a particular bit the value we give it” (OC § 410).

The search for the foundation as an ultimate essence from which we structure our knowledge is the fruit of a grammatical illusion. For Wittgenstein, “to the depth of the essence there corresponds to the deep need for the agreement (*Übereinkunft*)” (FM § 64). He places the end of the chain of reasons not in a metaphysical ground (truth) but the pragmatics of our language-games, habits, and institutions where we established agreements. The grounding (*Begründung*), the justification of evidence, has an end – but the end is not the fact that certain propositions immediately present themselves to us as being

true. It is not a matter of seeing (*Sehen*) on our part, but of our acting (*Handeln*), which is at the bottom of the language-game (OC§ 204). Therefore, there is no ultimate foundation as modern science has claimed, but a grammatical “system of reference” established by our different language-games.

This position opens the question to the second epistemological problem to be addressed here by the grammar of science, namely, scientific relativism. Is it knowledge relative? In other words, does knowledge produced by different forms of life lead to relativism? It could be argued that Wittgenstein’s position ends up enclosing knowledge in relativism. Science would be lost in its grammar by establishing the criteria of our knowledge and judgment in grammar and language-games. However, this was perhaps the greatest misconception attributed to Wittgenstein’s philosophy. If grammar were impervious to other grammars, we would have relativism because each grammar would be closed in on itself. However, to the extent that grammar is an open system, we can mitigate relativism. From our grammar, we can establish relations with other grammars and create criteria to understand them based on the family resemblances. Moreover, above all, we share resemblances in the way we act in the world. Although grammar is where I construct my criteria for judgment, it is possible to understand other grammars through it.

Suppose you came as an explorer to an unknown country with a language quite unknown to you. In what circumstances would you say that the people there gave orders, understood them, obeyed them, rebelled against them, and so on? Shared human behaviour is the system of reference by means of which we interpret an unknown language (*Die gemeinsame menschliche Handlungsweise ist das Bezugssystem, mittels welches wir uns eine fremde Sprache deuten*). (PI § 206)

The reference for understanding a foreign grammar is its performance and our performance that we share – family resemblances – with foreign culture. There is no common ground between different forms of life because there is a common foundation, but simply behaviors, practices, interactions, institutions. In short, ways of acting can be shared as family resemblances, sometimes to a greater, sometimes to a lesser degree. The grammar of science is open knowledge. For example, as the criteria of objectivity emerge from a pragmatic perspective, they are public and thus can be assimilated with greater or lesser precision by different grammars.

In the same way, different scientific theories and practices are not necessarily incommensurable, which does not imply that they find in the positivity of facts or the transcendental essence the absolute reference of convergence or refutation of knowledge. Unlike, the dialogue between alternative scientific approaches or different group choices within science is based on the public criteria of the pragmatics of language and understood through its grammar. In this grammatical perspective, language and facts are “balanced” in language-games, thus allowing the constitution of our rationality and of our way of organizing the world scientifically. In the next section, when addressing specificities of the history of science, I will return to some of these points. Finally, we can see that it is possible to glimpse a fruitful way to constitute a Wittgensteinian epistemology which allows us to understand science in its various philosophical problems.

## The Grammar of the History of Science

Considering that, inspired by Wittgenstein, it is possible to conceive history and science as grammars; then, one can conclude that it is possible to establish a grammar of the history of science. In other words, conceiving the grammar of history (theory of history) in tune with the grammar of science (theory of science) enables us to understand science and its history

and, consequently, understand some guidelines for fruitful writing of the history of science. In the broadest sense, the history of science follows similar parameters to the theory of history in the Wittgensteinian perspective presented above. However, the history of science presents specificities better understood with the help of a theory of science. In other words, a theory of science teaches us how to approach nature, and we must attentively observe the importance of facts when writing the history of science. To sum up, the “grammar of history” teaches us how to understand the historical process, and the “grammar of science” helps us understand the issue of the facts in the construction of science.

Unlike when we deal only with the history of human social, political, artistic or religious plots, nature plays a central role in the history of science. Perhaps, we could, for example, interpret a revolutionary political movement in different ways and eventually relativize the figure of the “hero” of the revolution in this process. We could speculate whether or not there were heroes or even that, who is considered a hero, will depend on which side of the contention triumphed. Here it seems that the hermeneutic criteria are much more elastic. In turn, although we can elaborate on different interpretations of a scientific fact in the history of science, we cannot disregard the unique weight of empirical in this fact. We can have various theories explaining why the stone falls (to occupy its natural place, by the force of gravitational attraction), yet to compose our scientific knowledge, we cannot ignore the fall of stone. Nature is undeniably there, and although interpretations of a scientific fact can be contested, we have to deal with the empirical facts in a much more emphatic way in science. A fact is a construction, but it is not a construction out of nothing. It has a firm reference to empirical. To understand the interpretation of empirical facts in science, the help of a theory of science becomes very relevant. In what follows, I will initially seek to understand the specificities of the history of science *vis-à-vis* the theory of history and then how a theory of science complements our understanding of the history of science. These theoretical references (history and science) are the presuppositions for writing the history of science from a Wittgensteinian perspective.

Two points are essential to understand the role of the theory of history in science – of course, they should be present in any historical approach. The first one consists of the affirmation that there is no “telos” of grammar. Although there is the inevitable evolution of natural, social, and linguistic phenomena in (historical) time, we cannot consider that historical grammar has a telos. Although it may allow us to understand this process retrospectively, grammar does not have a pre-established direction towards the future. It merely reflects the synchrony of social interactions. Even if it can be seen retroactively as a kind of backward diachrony, it can never guarantee the precise direction of future events. It is important to stress this point because the idea of progress has often been influential in the history of science. There is an expectation that science will always triumph. However, a vaccine will not necessarily be discovered. A theorem will not necessarily be “demonstrated as it should be” (*quod erat demonstrandum*). Science and its history are subject to the same indeterminacy about the future. Therefore, a Wittgensteinian history of science can never be teleological. Well, history is the history of the past. No past guarantees future, no matter how science can make reasonable predictions about the behavior of nature and how much this has deceived triumphalist or positivist historians. One cannot reconstruct the chain of events based on an idea of telos from the past to the future. As seen above, the existing nexuses in this chain are grammatical and not teleological. There is no inexorability of the arrow of historical time, only an unfolding of the grammar of science.

A second critical point for the history of science from the idea of a grammar of history is that we cannot construct “metanarratives” – what we should not do in any historical approach. We cannot narrate history with the presupposition of one who watches it “from the outside”. We have to assume the grammatical contingency of history and run away from totalizing metaphysical approaches. At most, one grammar shares family resemblances with others, but there is no meta-grammar from which to look at the others. Nevertheless, even

so, grammar constitutes a “system of reference” which allows us to understand the whole (holism of the grammar),<sup>10</sup> even if it is permeated by other grammars (family resemblances). This system of reference gives us the basis to construct the meaning of the grammar to which we belong, while it provides us with the parameters for understanding other grammars. In the present, the historian of science can look at the past grammar of science and understand its rules. Naturally, it is necessary to respect the rules of the grammar of the past, under penalty of committing anachronisms.

In effect, we can only see nature (or society), that is, do science, from our grammatical contingency. We construct a holistic perspective from our partial grammatical view of the object nature (and the object society), allowing us to do science. There is no privileged place in the history of science in which it could make a kind of metanarrative, however much nature weighs in this process. It is not the positivity of the facts themselves but the grammatical interactions that give us the map for understanding our scientific objects. Positivist stances believed that the empirical data would be the crucial reference in the understanding of science. Hence one of the solid reasons for the failure of positivism.

Considering that we cannot construct metanarratives, how do we suppose to understand the historical phenomenon of science in depth? In other words, how to overcome the lack of “an overview” (*Übersichtlichkeit*) (PI § 122) of the complex networks of interactions that are lost in time? To navigate this deep historical sea, it is up to the historian to establish what Wittgenstein called “intermediate links” (*Zwischengliedern*) (PI § 122) for understanding this panoramic network of the grammar of science. Comparisons (family resemblances) and intermediate links are all we have to understand the intricate map of the flow of historical processes. We have of history just that: language-games, rules, grammar, institutions that form and fall apart in the process of time. To understand the grammar and its language-game is necessary to contrast them and find the intermediate links that connect them.

In the same way that the historical process of the development of science is prepared by women and men inserted in concrete social relations, or the “rough ground” of pragmatic relations, the historian of science cannot put himself in a privileged place to elaborate narrative. His or her historical approach is equally made under the same conditions. It is always built through the analysis of a specific grammar. Thus, the task of the historian of science is to analyze the grammar of science risen in its “form of life” to understand how it is institutionally located. Since, as pointed out, it is in the institutions, habits, and customs that the language-games governed by its grammar take place. Different cultures and societies, in general, share institutions (money, marriage, numbers) and, even if such cultures are not identical in their different institutions, they have in them an air of family.

We will only know the historical meaning of science – the intentions of the scientists’ behaviors governed by the grammar of their language-games – by identifying their pragmatic procedures in their form of life. Only by identifying these language-games and their rules will the historian understand the grammar of a historical time. In this analysis of the historian of science, it is necessary to understand the grammar of science both “internally”, in its ideas, concepts, theories, and connections with nature, and “externally” in its social relations or family resemblances that it establishes with other grammars (politics, religion, art). Only by this analysis can the historian identify the goals and strategies followed in the historical flow of science and thus understand the grammar of science and its history, but without ever giving in to the illusion of a metanarrative. One must see the grammar of science always from its contingency. Thus, the grammar of history does not seek a “why” but the “how”. In other words, how are constructed the grammatical rules of such a historical process? How did a specific set of grammatical rules come about that helped to shape a historical moment?

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<sup>10</sup> Unlike a totalizing perspective based on metaphysical assumptions, holism is a possible summation of the parts of grammar in their interactions (family resemblances) with others.

Finally, the grammar of history provides us with a more profound (panoramic) understanding of the transformations of linguistic and social processes not only within science but in its relations with other grammars. By analyzing the grammar of science, we can distinguish the dialogue it establishes with nature. This dialogue is understood as something specific and different from mere political and economic aspects, although the latter may affect the grammar of science. The historian of science has to be aware that such economic or political aspects – even considering their weight at the end of the process – are not at the root of the production of scientific knowledge. Political and economic conditions are, to a large extent, “necessary conditions” for the production of scientific knowledge, but they are not “sufficient conditions”.

As we know, it is possible to have societies with economic and political institutions but without science. The sufficient conditions for doing science arise from the social and linguistic constitution of specific practices in the form of life, that is, from the way the grammar of knowledge is engendered. In other words, the grammar of the history of science shows us that knowledge is based on the two sides of the same coin that make up grammar, that is, the social aspect and the linguistic aspect. These aspects establish the rules (grammar) that guide the meaning of our knowledge. Science is not something essentially political or economic, as stressed by some authors, although it can be stimulated (or eliminated) by politics or economics. These are factors that enter into its recipe but do not make up its central decision-making core. The grammars of politics or economics affect science or even share family resemblances (a science policy of an institution or government, for example). However, science is a specific and autonomous device, although not independent from other grammars. The generating matrix of scientific knowledge is not in politics but the autonomy of the grammar of science with its own rules.

Now, to think about the place of nature in the history of science, I will analyze the “theory of science”, that is, the “grammar of science”. A theory of science has its main focus on the specificity of science in its relation to nature. In the first place, it is necessary to recognize that science has internal and external aspects. As mentioned, science institutions go far beyond ideas, theories, academies, laboratories, research groups, specialized journals, scientific associations, and congresses, branching out into society through the different contacts and uses that non-scientist establish with science. Science is constituted as a scientific culture or a scientific “form of life”. This scientific form of life is constituted as an institution in its technical and scientific apparatus (theories, laboratories, etc.) and its purposes, values, imaginary and uses of science. So, we should understand the idea of a scientific institution in this broader perspective that considers both the ideas, theories, and more abstract aspects of science (traditionally as internal aspects of science) and the material and social aspects (traditionally as external features). Internalism and externalism are different aspects of the grammar of science or the institution of science.<sup>11</sup>

Another critical point to highlight the relation between grammar and nature, or facts in science, is to recall the expression “language-games”. In the direction this article, “language-games” does not mean a distancing from facts. Sometimes, those who read about Wittgenstein’s philosophy understand that “language-games” deal only with words that construct an empty discourse. If this were so, anything could be said, and even if an empty discourse eventually made sense, it would not refer to anything concrete in the world. They would have no materiality or no ballast in the empirical. Language-games would be mere fiction. However, when we look at the theory of science or the Wittgensteinian-inspired grammar of science, we realize that this is not the case. Nature is an essential point in the

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<sup>11</sup> By considering both the social aspects of science and its abstract theories and ideas, the notion of grammar allows us to “dissolve” the old internalism/externalism problem. For those who argue that science has a development by itself, independent of social aspects, the notion of grammar shows us that scientific ideas are shaped in society’s dialogue with nature.

makeup of the grammar of science. The language-games of science are not simple linguistic and social constructions. Therefore, no matter how much we may develop those social and linguistic apparatuses with which we analyze nature, the empirical data is equally relevant. As Wittgenstein pointed out, our language-games would also be different if the facts were different (OC § 63). Not because the facts are determinant, but because this change would force us to reposition our language-games. Thus, it is up to the historian of science to analyze how a scientific community constructs its grammar in dialogue with nature. How it established the understanding of what a scientific fact is. How were theories formulated and revised? How were agreements sanctioned? Etc.

From the grammatical viewpoint, it is not a matter of establishing the description of the fact since any description is already a grammatical formulation. The interpretation of nature is made from different grammatical “possibilities” (PI § 90) that allow understanding a phenomenon or fact. Thus, this interpretation is a grammatical analysis and not an apprehension of the phenomenon itself. One concludes that the value of the fact is relative to the context of grammar. We can change our understanding of the fact by modifying our grammatical perception, changing our language-games, or even inserting new phenomena in a language-game.

Thus, we see that the social and linguistic (grammatical) aspects are vital in forming the “grammar of science”, even though they are conditioned up to a significant extent by facts. Indeed, any history of science is a social (grammatical) history. Ultimately, even scientific ideas and theories are the fruit of grammar. No matter how abstract an idea could be, even if it is highly relevant to our understanding of nature, such an idea is the product of a social constitution (grammar). Theories and ideas lay down on the complexity of the scientific culture. They lay down in a grammar of a form of life. Even the ideas of a theoretical scientist – like Einstein – are based on the grammar’s natural, social, institutional, and theoretical complexity.

For the Austrian-British philosopher, the meanings of words in a language-game also involve the empirical aspects connected to the interaction between speakers and the world (OC §§ 98, 145, 319, 401, 455). To understand how we make these assertions about phenomena (PI § 90), Wittgenstein differentiates an “empirical proposition” (*Erfahrungssatz*) from a “grammatical proposition” (*grammatischer Satz*) (PI §§ 251, 295, 458). The empirical propositions refer directly to phenomena, and the grammatical ones establish the rules of language uses. However, there is not such a simple division. In a language-game, it is not always easy to distinguish between a grammatical and an empirical proposition, for “there is not a sharp division of the one from the other” (OC § 97). This difficulty in distinguishing between these two types of propositions is because this division is not of nature but function. Thus, the same proposition can perform both functions (empirical and grammatical).

Although the empirical propositions have the purpose of describing the empirical aspects, in some way, they are constituted by usage, rules, in short, by grammar, which is the set of rules. On the other hand, even though they may contain some “description” of the empirical dimension of the world, grammatical propositions constitute explanations of the uses we make of words and the rules we obey to signify. Therefore, there is not a distinction of nature but function. Some propositions have the function of describing. In others, this function is not relevant. For Wittgenstein, “the same proposition may get treated at one time as something to test by experience, at another as a rule of testing” (OC § 98). Thus, in analyzing nature, we do not directly address phenomena but the “possibilities” of phenomena. Either when we construct empirical propositions or elaborate grammatical propositions with our rules of use in understanding these phenomena. Scientific theories make use of both of these types of propositions.

Indeed, not only do grammatical propositions form the basis of our understanding of the world, but empirical propositions also play a decisive role. “The truth of certain empirical

propositions belongs to our system of reference (*Bezugssystem*)” (OC § 83). To realize our grammatical understanding, more than activities, acts, behaviors, and interactions, we also rely strongly on the facts and phenomena we perceive by empirical propositions. “I want to say: propositions of the form of empirical propositions, and not only propositions of logic, form the foundation of all operating with thoughts (with language)” (OC § 401). In other words, our judgments about the world depend not only on what our grammatical (logical) propositions tell us but also on what our empirical propositions inform us. Both types of propositions make up the grammar which we realize our “surveyable representation” (*übersichtlichen Darstellung*) (PI § 122) of the world. They thus become the basis of our judgment. They configure themselves as “paradigms” (PI § 50) in our language-games to establish our “world view” (*Weltanschauung*) (PI § 122).

We say we know that water boils and does not freeze under such-and-such circumstances. Is it conceivable that we are wrong? Wouldn't a mistake topple all judgment with it? More: what could stand if that were to fall? Might someone discover something that made us say “It was a mistake”? Whatever may happen in the future, however water may behave in the future, – we know that up to now it has behaved thus in innumerable instances. This fact is fused into the foundations of our language-game. (OC § 558)

Finally, within the framework of a “theory of science”, it is up to the historian of science to analyze – considering empirical and grammatical propositions in grammar and its language-games –, how theories refer to facts. This analysis shows us the structuring of scientific knowledge in its internal aspects in tune with its external aspects. In other words, by understanding how the relationship between grammar and empirical is established, we can see the harmony between the internal and external aspects of science. By distinguishing between empirical and grammatical propositions, the history of science can solve the internalism versus externalism problem. Moreover, Wittgenstein provides us with a parameter to seek a balance between the two positions. Thus, avoiding radicalisms that emphasize only one side, such as, for example, the statement that closes the eminent book by Shapin and Schaffer, *Leviathan and the Air-Pump*, according to which “the solution to the problem of knowledge is political” (Shapin and Schaffer 1985, 342). Consequently, for them, “it is ourselves and not reality that is responsible for what we know” (Shapin and Schaffer 1985, 344). However, from Wittgenstein's later philosophy, we can see that this responsibility is shared between man and nature.<sup>12</sup> By understanding grammar with its grammatical and empirical propositions, we can see our perception of nature is changed by the facts and grammatical networks. There is a tendency to balance this relationship, but only through grammar analysis can we evaluate how this process is established.

As we can see from a “theory of history” and a “theory of science” inspired by Wittgenstein, we have fruitful ways to guide the writing of the history of science. The later Wittgenstein's philosophy opens rich possibilities of overcoming epistemological and historical problems in which other approaches look like they have encountered severe difficulties.

## Conclusion

In this article, we have seen that the later Wittgenstein, particularly with the notion of grammar, offers excellent tools to help us to write the history of science. A “theory of

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<sup>12</sup> This was the central point of Kuhn's criticism of the strong program, that is, disregarding the role of nature in formulating our knowledge about it (Kuhn 2000, 105-120).

history”, here called “grammar of history”, was discussed in the first moment. Then, a conception of a “theory of science” was developed and called “grammar of science”. Finally, from the interconnections between these two theories, some significant guidelines for writing the history of science were outlined in the last part of the article. Although, for reasons of space, the theme could not be developed to its full extent, I hope to have demonstrated how fruitful the later Wittgenstein’s work can be to understand science and its history.

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