



SEÇÃO: EPISTEMOLOGIA & FILOSOFIA DA LINGUAGEM

From Empirical Evidence to First Principles: Thomas Kuhn's Methodological Revolution

Das evidências empíricas aos primeiros princípios: a revolução metodológica de Thomas Kuhn

De las evidencias empíricas a los primeros principios: La revolución metodológica de Thomas Kuhn

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Abstract: *The Structure of Scientific Revolutions* represented a milestone in the attempt to understand scientific development based on empirical observations. However, in the next decades after the publication of his book, history, psychology, and sociology became increasingly marginal in Kuhn's discussions. In his last articles, Kuhn even suggested that philosophers should pay less attention to empirical data and focus more on "first principles." The purpose of this article is, first, to describe this radical transformation in Kuhn's methodological approach, from his initial naturalism to his later and more strict philosophical stance. Next, I present some of the alleged justifications for explaining this transition, such as his interest in problems more firmly attached to the philosophical tradition and a desire for greater acceptance within this community. Although these factors certainly played a role in explaining Kuhn's change, I also believe that an important theoretical component exerts a fundamental function in this transition: the idea that scientific development is a kind of evolutionary process, which is better understood through the use of abstract theoretical models, instead of sparse observations of scientific activity.

Keywords: Thomas Kuhn; History of Science; Naturalism; Evolutionary Epistemology.

Resumo: *A Estrutura das Revoluções Científicas* representou um marco na tentativa de compreender o desenvolvimento científico baseado a partir de observações empíricas. Entretanto, nas décadas seguintes após a publicação do livro, a história, a psicologia e a sociologia tornaram-se cada vez mais marginais nas discussões de Kuhn. Nos seus últimos artigos, Kuhn chegou mesmo a sugerir que os filósofos deveriam prestar menos atenção aos dados empíricos e concentrar-se mais em "primeiros princípios". O objetivo deste artigo é, em primeiro lugar, descrever esta transformação radical na abordagem metodológica de Kuhn, do seu naturalismo inicial até sua posterior e mais estrita posição filosófica. Em seguida, apresento algumas das alegadas justificações para explicar esta transição, tais como o seu interesse em problemas mais firmemente ligados à tradição filosófica e um desejo de maior aceitação dentro desta comunidade. Embora tais fatores tenham certamente desempenhado um papel na explicação da mudança de Kuhn, acredito também que um importante componente teórico desempenhou uma função fundamental nessa transição: a ideia de que o desenvolvimento científico é uma espécie de processo evolutivo que pode ser melhor compreendido mais com a utilização de modelos teóricos abstratos do que com observações esparsas da atividade científica.

Palavras-chave: Thomas Kuhn; História da Ciência; Naturalismo; Epistemologia Evolutiva.

Resumen: *La Estructura de las Revoluciones Científicas* representó un hito en el intento de comprender el desarrollo científico basado en observaciones empíricas. Sin embargo, en las décadas siguientes a la publicación del libro, la



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historia, la psicología y la sociología se volvieron cada vez más marginales en las discusiones de Kuhn. En sus últimos artículos, Kuhn incluso sugirió que los filósofos deberían prestar menos atención a los datos empíricos y centrarse más en los "primeros principios". El propósito de este artículo es, en primer lugar, describir esta transformación radical en el enfoque metodológico de Kuhn, desde su naturalismo inicial hasta su posterior y más estricta posición filosófica. A continuación, presento algunas de las supuestas justificaciones para explicar esta transición, como su interés por los problemas más vinculados a la tradición filosófica y el deseo de una mayor aceptación dentro de esta comunidad. Aunque estos factores tuvieron ciertamente un papel en la explicación del cambio de Kuhn, también creo que un importante componente teórico ejerció una función fundamental en esta transición: la idea de que el desarrollo científico es una especie de proceso evolutivo, que se comprende mejor mediante el uso de modelos teóricos abstractos, y no por medio de observaciones fragmentarias de la actividad científica.

Palabras clave: Thomas Kuhn; Historia de la Ciencia; Naturalismo; Epistemología Evolutiva

Introduction

Thomas Kuhn's *The Structure of Scientific Revolutions* (1962) played a prominent role in the historicist turn of the 1960s in the philosophy of science.² At the basis of this project was the proposal, a radical one at the time, that the empirical sciences, and in particular the history of science, should be the primary source of evidence for the elaboration of theoretical models of scientific development. Contrary to the prevailing view at the time—the "received view," as it also became known—, which considered empirical observations of science as limited to exemplifying and testing the different philosophical theories, Kuhn argued that empirical evidence should form the basis of any theoretical model of scientific development.³ In *Structure*, empirical observations held the methodological primacy in the constitution of a theoretical model about science.

Kuhn's image became permanently linked to this naturalistic approach. Interestingly, though, such a

characterization does not accurately depict his path over the following decades. After *Structure*, Kuhn's work in the history of science, once so abundant, almost disappeared. He wrote just two theoretical articles on the history of science (1968; 1971), and a single lengthy case study, *Black-body Theory and the Quantum Discontinuity, 1894-1912* (1987), in which he advanced a new interpretation of Planck's role in quantum physics. In addition, his work increasingly moved away from meta-historiographic investigations (Bird [2002] considers *Structure* as a work in "theoretical history of science"), turning to issues related to the language of scientific theories and its implications for the incommensurability thesis (1981; 1983; 1989; 1991; 1993).

Such a change in approach could simply indicate a change in interest and problems. There is an amount of truth in this. Kuhn's concern was more and more directed to problems such as rationality, relativism, truth, and, above all, to the thesis of the incommensurability of scientific theories, and away from issues such as the theory-ladenness of observation and the psychology of perception.⁴

However, this change also results from more profound issues. In the decades following the release of *Structure*, Kuhn's work suffers a radical *methodological paradigm shift*—to employ an expression that made him so widely known. Theorizing about history and scientific practice gives way to a more systematic conception of science. Kuhn's initial naturalism is, thus, replaced by a more strictly philosophical approach, one that requires no more than a glance at observations (KUHN, 1992, p. 116). Models of scientific development now ought to be based on first principles, and no longer on detailed case studies (KUHN, 1992, p. 112; see also 1991, p. 98).

My aim in this article is to understand Kuhn's methodological turn. The article starts with an

² The historicist turn was a broad and rather diffuse movement, a *Zeitgeist*, in Kuhn's own words (1991). Among its most well-known members were Feyerabend, Hanson, Hesse, Polanyi, and Toulmin.

³ For a long time, Kuhn was seen as responsible for the death of logical empiricism (widely constructed, including Popper). That was the standard interpretation until the 1990s, when Reisch (1991), Earman (1993), and Irzik and Grünberg (1995) pointed interesting similarities between *Structure* and some of the ideas that were developed by Carnap. This would explain, for example, why Carnap, the editor of the *International Encyclopaedia of Unified Science* was so receptive to Kuhn's work. Oliveira (2007), on the contrary, defends that these similarities are a sign that Carnap had already abandoned the main tenets of logical positivism. See also Uebel (2011), Oliveira (2015), and Tsou (2015).

⁴ In *Structure*, Kuhn was "unsure whether these psychological results showed how the mind worked in general, both in perceptual cases and in scientific thinking, or whether they merely provided an analogy for the operation of paradigms" (Bird, 2002, p. 448). Subsequently, he acknowledged another problem with the use of the *gestalt* theory: *gestalt* changes are fundamentally psychological processes, that is, individual phenomena, while scientific revolutions are events that affect whole communities (Kuhn, 1989, 1993).

exposition of the two different views found in Kuhn's work: the first, in *Structure*, derived from direct empirical evidence; the second, present in his final articles, in which science is understood from an abstract evolutionary conception. Next, I discuss the reasons that seem to have led to such a radical change in approach. I believe that the transition from a theory of science based on empirical evidence to a theory of science based on first principles is due to a deepening of the idea (initially metaphorical) of scientific development as a type of evolutionary process.

The Role of the Empirical Sciences in *Structure*

Right from the start, Kuhn sets out the methodological approach underpinning the project in *Structure*: "History, if viewed as a repository for more than anecdote or chronology, could produce a decisive transformation in the image of science by which we are now possessed" (KUHN, 1962, p. 1).

Kuhn's proposal is that history should have a more active role in molding our image of science. For him, it is essential to have a detailed knowledge of the history of science to understand its nature. But to better understand the originality of the Kuhnian project, it is necessary to clarify some aspects of his use of historical data.

First, Kuhn's methodology is based on a specific type of historiography. Historical data, by themselves, are unable to produce a consistent change in our image of science, if they are "sought and scrutinized mainly to answer questions posed by the unhistorical stereotype drawn from science texts" (KUHN, 1962, p. 1). In place of this presentist or Whig historiography, Kuhn advocates the use of a (by then) new sort of historiography of science, which had in the works of Koyré its utmost realization. Contrary to the traditional historiography, which sought "the permanent contributions of an older science to our present vantage," the new historiography of science attempted "to display the historical integrity of that science in its own time" (1962, p. 3). It considered older modes of thought from

their own perspective, giving "those opinions the maximum internal coherence and the closest possible fit to nature" (KUHN, 1962, p. 3).

The second aspect regarding Kuhn's use of historical data in *Structure* refers to the function attributed to it. To some extent, history was always present in philosophical considerations, even for those more inclined towards the tenets of logical positivism. Traditionally, though, history had been restricted to illustrating scientific procedures and to testing theoretical models of scientific development. For Kuhn, on the contrary, historical data should serve as the *ground* for elaborating theoretical models of science. History of science should be an active source of problems and insights, and not an episodic source for testing or exemplifying models of science. History, in other words, should function "as a source of empirical evidence" (KUHN, 1991, p. 95). Hence, for Kuhn, more important than the type of history employed, was the role attributed to it.

The image of science outlined in *Structure* is, for Kuhn, the direct result of his careful observations on scientific activity—an image that was suggested and implied by this new historiography. History of science, thus, functioned "as the source of data from which to develop a philosophy of science" (WRAY, 2011, p. 89).

To be more precise, although the explicit focus of *Structure* is on history, Kuhn's interest was not restricted to this discipline. In order to understand how knowledge is produced in the natural sciences, he also paid attention to other empirical sciences, such as sociology and psychology.

There are a few references, for example, to the social organization of scientific communities and the role of community for the resolution of controversies. Even more relevant is the role played by psychology in Kuhn's analyses; in particular, the *gestalt* theory of perception, which he employed to argue in favor of the theory-ladenness of observation.

Kuhn, therefore, relied heavily on the empirical sciences in order to develop his model of science. As Bird explains, "the evidence Kuhn adduces for his more philosophical claims is mostly not

philosophical in nature but comes instead from the empirical sciences, as well as from the history of science" (BIRD, 2002, p. 446).

Which disciplines were used to structure a model of scientific development—history, psychology or sociology—was, in fact, a matter of secondary importance to Kuhn. What mattered was only that they provided an adequate comprehension of *real science*; that they helped to understand how science works and how knowledge is produced. For that aim, contemporary science may be as useful as past science (WRAY, 2011).

Structure is, thus, full of a naturalistic flavor. For Shapin, this approach could only be formulated in a Cold War environment shaped by the "institutional, economic, and political circumstances of Big Science" (SHAPIN, 2015, p. 18). On a more personal level, Kuhn's naturalism could also be explained by his serendipitous path from physics to philosophy, which got him acquainted with disciplines and theories that were not usual in philosophy of science at the time (HUFBAUER, 2012; ANDRESEN, 1999).

In the end, the appeal to these various disciplines had a wide, and largely positive, reception in fields other than philosophy (KAISER, 2016; ABBOTT, 2016)—it was in the philosophy of science that they aroused less sympathy (see, for example, Shapere, 1964; Scheffler, 1982; and the articles in Lakatos & Musgrave, 1970). Comprehensively, Kuhn's naturalism was not well-received in an environment in which the distinction between normative and descriptive was still so solidly established.

First Principles

After *Structure*, two progressive but consistent changes could be seen in Kuhn's work. First a thematic shift: issues such as the transition to normal science and the resolution of scientific controversies lost relevance, whereas discussions concerning the nature of revolutionary changes and semantic incommensurability became preponderant. Kuhn also left aside his best known contribution, i.e., paradigms, turning back to the

previously dominant notion of "theory" (SHAN, 2018).

Another noticeable change is related to Kuhn's departure from the history of science, which took place on a couple of levels: Kuhn is not anymore dedicated to the history of science; and he stops justifying his theses on the grounds of carefully presented evidence in history of science.

This second feature is the one that most interests us here. That Kuhn was not as much worried about metahistory—the theories about scientific development over time—as before, and that he devoted himself instead to more traditional issues in philosophy of science and language, could be the result of Kuhn's willingness to enter the philosophical mainstream, as Bird (2002) believes. Though this explanation may have its fair share of truth, it is important to take into account that Kuhn also offers a theoretical justification for his increasingly less empirical approach.

In a couple of articles (1991; 1992), Kuhn defends that, more important than the explicit use of historical case studies, is the perspective that it provides to us. Observation is useful only to awake a new form of looking at the functioning of science. What is essential, in his view, "is not so much the details of historical cases as the perspective or the ideology that attention to historical cases brings with it" (KUHN, 1991, p. 95). This marks Kuhn's passage from a naturalized epistemology to an evolutionary one—or, as he also refers to it, the "developmental view" (KUHN, 1992).

Evolutionary perspective

The evolutionary or developmental view consists of three main tenets. First, scientists evaluate changes in beliefs, not beliefs themselves. This assessment is, moreover, comparative: it aims at selecting the best theory available at a given time. Finally, science is not a monolithic enterprise, but is instead formed by a complex and non-systematic net of specialties, each one of them responsible for dealing with a set of phenomena (1991; 1992).

Kuhn justifies the adoption of an evolutionary perspective by saying that the problem with the historical philosophy of science is that it is

merely based "upon observations of the historical record" (KUHN, 1992, p. 118). But why would that be a problem? In *Structure*, as discussed above, the empirical inspection of science was seen as constituting the privileged ground for any theoretical thinking.

Now, however, Kuhn considers that historical descriptions of scientific activity gives us only a *plausible* picture of science. They do not explain why science must be the way it is, and for this reason, we may be doubtful about how science produces knowledge, and if it actually does. An empirically grounded model of scientific development gives only some knowledge *that* science evolves thus and so, not *why* it evolves thus and so—i.e., propositional knowledge, and not knowledge-how.

To remedy this, Kuhn thinks it is essential to consider science through a more systematic lens—by a theoretical matrix that explains how science produces knowledge. Then, we can understand that the features pointed out in science "should not be seen simply as observed facts about its practice. Rather they are necessary characteristics of any developmental or evolutionary process" (KUHN, 1992, p. 119).

To a certain extent, *Structure* attempted to do just that. When discussing the role of crises, for instance, Kuhn argued that they were important in weakening the faith in a theory, thus giving opportunity for other approaches to be considered. He went as far as saying that "crises are a necessary precondition for the emergence of novel theories" (KUHN, 1962, p. 77).

Kuhn also believed that empirical evidence about how science worked was a valuable source not only for describing scientific development over time, but also for explaining such a development. Description, in that sense, was taken as a first step to normativity.

This is a theme explored by Kuhn (1970) in answering some of the criticisms directed to his book. There, he defends a strict, two-way relation between these two levels, insisting that description and normativity favor each other. Explaining his project in *Structure*, Kuhn claims that

My criterion for emphasizing any particular aspect of scientific behaviour is therefore not simply that it occurs, nor merely that it occurs frequently, but rather that it fits a theory of scientific knowledge. Conversely, my confidence in that theory derives from its ability to make coherent sense of many facts which, on an older view, had been either aberrant or irrelevant (KUHN, 1970, pp. 129-30).

Even though his descriptions intended to support a normative theory of scientific development—i.e., to explain why science had some specific traits and how these traits fostered the production of knowledge—, Kuhn was not satisfied with the role attributed to normativity in his work. Empirical evidence, he claimed, was not sufficient to explain how science is able to produce knowledge.

Instead, in his last articles, Kuhn thought more appropriate to consider science as an instance of evolutionary processes in general. For example, similarly to biological species, scientific research fields tend to split after some pressure is exerted on them. And as the number of species keeps growing, so does the number of research fields.

The subordination of scientific processes to evolutionary ones has many implications. First, extensive observation becomes unnecessary, since the main traits of science may be derived from evolutionary patterns: "little observation of its actual practice is required to reach conclusions of this sort" (KUHN, 1991, p. 95).

Further, the evolutionary ground of the features of scientific development, which were previously inferred from historical data, can now be the expected outcome of broad evolutionary processes. As Kuhn claims, "many of the most central conclusions [...] can be derived instead from first principles" (KUHN, 1992, p. 112).

As a consequence, the theoretical ground of evolutionary models of science permits to reduce "their apparent contingency, making them harder to dismiss as a product of muckraking investigation by those hostile to science" (KUHN, 1992, p. 112). Some features of science such as the lack of communicability among practitioners of different disciplines, can be simply discovered by unraveling recurring patterns of evolutionary processes, also

present in other areas, without the need for careful observation of actual scientific practice.

In summary, Kuhn appears to think that many of the properties of science, which *Structure* aimed at discovering through the amassing of empirical evidence, are actually "necessary characteristics of any developmental or evolutionary process" (KUHN, 1992, p. 119). They are "principles that govern all developmental processes, without, that is, needing to call upon actual examples of scientific behavior" (KUHN, 1992, p. 115).

Those evolutionary principles, it is important to say, are not *a priori*, but "must be suggested by observations" (KUHN, 1992, p. 112). Despite that, "one can reach many of the central conclusions we drew with scarcely a glance at the historical record itself" (KUHN, 1992, p. 111).

How Serious is Kuhn's Evolutionary Epistemology?

The connection between scientific development and biological evolution was already present in *Structure*. Particularly, Kuhn defended a reassessment of scientific progress inspired by Darwin's contribution to biology. For Kuhn, science should be seen as a process of increasing epistemic capacity that was not directed to any pre-fixed goal; much as biological species, for Darwinian biology, did not evolve towards any preconceived structure, but rather into more adapted solutions in response to environmental pressures.

The fact, though, is that the role of evolutionary theory grew immensely in Kuhn's later writings (KUUKKANEN, 2012). More than a fruitful analogy, Kuhn was now advancing an evolutionary notion of science.

The adoption of such an evolutionary perspective has various consequences. The first one, mentioned above, is that "scientific development must be seen as a process driven from behind, not pulled from ahead—as evolution from, rather than evolution toward" (KUHN, 1991, p. 96). Another consequence of the developmental view is the replacement of revolution for specialization as the engine of scientific progress.

Renzi (2009) and Renzi and Napolitano (2018) consider the approximation between Kuhn's scientific and biological development as not fully adequate. Kuhn's accounts of evolutionary analogies would be "either oversimplified and sketchy or based on inadequate evolutionary premises and concepts" (RENZI, 2009, p. 159). According to them, there would be a serious mismatch in the analogy that correlates biological and scientific development.

Reydon and Hoyningen-Huene (2010), on the other hand, believe that Kuhn refers to evolutionary processes for expository reasons only, with the intention of stressing the similarities between scientific and biological development, without arguing that both of these processes have a common nature. For this reason, any mismatch between scientific and biological evolution would be out of the scope of the analogy. Kuukkanen also agrees with them that "Kuhn meant the concept of evolution as an analogy or a metaphor, not to be taken literally" (KUUKKANEN, 2012, p. 149, n. 6).

I think this is a misinterpretation of Kuhn's real intention. Although his death prevented the continuation of his project, Kuhn planned to reinforce the evolutionary model of science. This can be seen both by the increase and deepening of evolutionary ideas in his latest articles, which appear with greater frequency and amplitude; and the indications he provided about the book he was writing, provisionally entitled *The Plurality of Worlds: An Evolutionary Theory of Scientific Development*, in which he intended to extend theories of evolutionary biology to other aspects of concept formation and scientific activity (HOYNINGEN-HUENE, 2015).

More importantly, Kuhn takes the application of evolutionary ideas to science as more than an analogy. Analogical thinking can help to comprehend aspects and relations in a new situation by bearing resemblance to another situation where the same relations are easily grasped. But the fact that scientific and biological development have some similarities is not sufficient to explain why science evolves the way it does. The only thing that can give us this kind of knowledge is

an understanding of the "principles that govern all developmental process" (KUHN, 1992, p. 115), of the "necessary characteristics of any developmental or evolutionary process" (KUHN, 1992, p. 119)—seeing scientific development as "a consequence of first principles" (KUHN, 1991, p. 98).

Biological and scientific development, for example, depend both on the limitation of contact with possible partners, which works as an isolating mechanism. This barrier guarantees an enduring unity for the group, permitting that more adapted tools for the specific challenges and circumstances arise. Successful adaptations then proliferate, whereas worse ones tend to disappear.

In both cases, the same general mechanism occurs in biology and science. The difference regards how these mechanisms are instantiated in each field. In biology, for example, species are separated by genetic differences that prevent interbreeding; in science, researchers belonging to different communities are unable to exchange ideas for their lack of a common taxonomy (1991). The general principles that command development in both cases are the same, though: isolation, adaptation, and proliferation.

This explicitly contradicts Reydon and Hoyningen-Huene thesis that "Kuhn only highlights a few specific parallels between scientific and biological evolution but nowhere claims that the two are instantiations of one and the same mechanism or even that they instantiate highly similar mechanisms" (REYDON; HOYNINGEN-HUENE, 2010, pp. 474-75). Instead, in the 1990s, Kuhn took the evolutionary perspective quite literally. For him, the mechanisms beneath biological and scientific development are examples of the same developmental mechanisms.⁵

To say that Kuhn took the evolutionary perspective literally does not mean to say that he took it "realistically."⁶ Evolutionary theory, as any other theory, is socially and historically-dependent, and does not represent a "true" or "approximately true" representation of how the

world is "in itself." What I mean is that, for Kuhn, scientific development and biological evolution are more than similar processes which share some resemblances—the underlying mechanisms which generate biological evolution are *the same* that produce scientific development.

Conclusion

Kuhn's trajectory gradually moves from a naturalistic approach into a more philosophical one. For Bird (2002), the consequence of this peculiar path explains Kuhn's ambiguous legacy for the philosophy of science. While his ideas had an enormous influence on the field, they did not result in the establishment of a Kuhnian school.

This paradoxical situation—the large impact of his ideas, without other authors having completely incorporated them—is explained by Bird through a mismatch between Kuhn's trajectory and the development of mainstream science philosophy in the 20th century. Kuhn started from a naturalistic approach, which then became less relevant in his work, until it was finally rejected. Philosophy of science, by turn, experienced an inverse general movement: the departure from *a priori* approaches to an increasing incorporation of naturalistic elements. For this reason, Bird considers that Kuhn made a "wrong turning." For Bird, "naturalism in epistemology is a development that took off just as Kuhn was abandoning his own naturalistic phase" (BIRD, 2002, p. 451).

In this paper, I intended to show that Kuhn's aprioristic turning was prompted, successfully or not, by an attempt to provide firmer grounds for theoretical thinking on scientific development. Although he was unable to develop this idea further, Kuhn indicated his belief that it was only through a general theory of development—in this case, an evolutionary theory inspired by biology—that it was possible to adequately understand what makes science develop as it does over time. Scientific development, he thought, was a type of evolutionary process, better understood

⁵ I agree with Reydon and Hoyningen-Huene (2010) that the role of the evolutionary analogy in *Structure* was mainly expository, as an attempt to facilitate the acceptance of a new image of scientific development as *development from some previous state*, in place of the most usual view of *development towards a goal*. My disagreement is regarding the function of evolutionary ideas in Kuhn's later articles.

⁶ I thank one of the referees of this paper for bringing this point to my attention.

through the use of abstract theoretical models, and not sparse observations of scientific activity.

According to Bird (2000), Kuhn's treatment of the history of science would have two main aspects: a *descriptive* side, in which Kuhn would detail "what he sees as pattern or regularity in the development of the various sciences" (BIRD, 2000, p. 29); and an explanatory side, in which he would try to indicate the underlying explanation for science's pattern of development.⁷ Although the precise relation between the descriptive and explanatory aspects in Kuhn's philosophy is complex and hard to define,⁸ Bird's remarks can enlighten Kuhn's methodological path.

After *Structure*, Kuhn gave increasingly less importance to historical studies in his investigations, and later, attempted to advance an *a priori*, evolutionary perspective on science. In summary, the descriptive side of science became less and less relevant for Kuhn, whereas the explanatory side of his project grew in significance.

Despite that, Kuhn's evolutionary epistemology still has some naturalistic background, since the developmental model is ultimately based on empirical evidence—having, thus, a descriptive counterpart. The evolutionary perspective must explain the actual development of science; it is not intended to work only as an abstract model of how science could have evolved or how knowledge could be produced.

Nonetheless, it is important to note a substantial difference: observational data are not constitutive of the developmental view of science as they were of the theoretical model in *Structure*, in which the image of science was thought to be derived from the careful scrutiny of the historiographical material. The developmental view, instead, is much more loosely grounded on the history of science and actual scientific practice. Empirical evidence, in this case, has mainly the goal of

bringing to our attention the general evolutionary principles involved in the development of science. And for that task, observations can be acquired not only from science, but also from the various fields that exhibit a similar evolutionary behavior. As Kuhn says, in the developmental view observations are not "restricted to the sciences and they require, in any case, no more than a glance" (KUHN, 1992, p. 116).

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⁷ It should be noted that not all scholars consider that Kuhn, and in particular *Structure*, intended to give a descriptive (i.e., empirical) theory of the history of science. Sharrock & Read (2002), in their highly Wittgensteinian reading of Kuhn, see *Structure* as a sort of therapy against the positivist, folk image of science. Kuhn's approach, for this, should not be understood as an empirical description of science. According to Kindi (2005), Kuhn's project would be a transcendental one, stipulating the conditions of possibility of science, and, therefore, it would not rely on history. Mladenović (2007) understands Kuhn's project as offering a sort of Weberian explanatory theory, in order to replace the image bequeathed by the received view; the categories in *Structure* should not be taken as implicated by the history of science, but as explanatory tools used with the goal of understanding "scientific change without attempting to describe it in detail" (p. 273).

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