

IS KUHN'S "WORLD CHANGE THROUGH REVOLUTIONS" COMPREHENSIBLE?

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Kuhn's talk of "world change through revolutions" has mostly been met with perplexity. What is it really that Kuhn wants to express in this strange way? I will first review what Kuhn exactly says on this topic. Next, I show that the world change talk is at least not inconsistent and has some initial plausibility. Then I will discuss whether "world change through revolutions" should be replaced by "change of world view". This will show that "world change through revolutions" is motivated by a strictly non-presentist historiographic stance. However, Kuhn's intended message can also be expressed in a philosophically much less provocative way.

Keywords: Thomas Kuhn, world change, scientific revolutions, world view change, non-presentist historiography, hypotheses becoming facts

ПОЗНАВАЕМО ЛИ КУНОВСКОЕ «ИЗМЕНЕНИЕ МИРА ЧЕРЕЗ РЕВОЛЮЦИИ»?

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Разговор Куна об «изменении мира посредством революций» в основном был встречен с недоумением. Что же на самом деле Кун хотел выразить таким странным образом? В начале статьи я анализирую, что конкретно говорит Кун по этой теме. Далее я покажу, что разговоры об изменении мира, по крайней мере, непротиворечивы и имеют некоторое правдоподобие. Затем я рассмотрю вопрос о том, следует ли заменить «изменение мира посредством революций» на «изменение взгляда на мир». Это покажет, что «изменение мира посредством революций» мотивировано строгой непрезентистской историографической позицией. Тем не менее предполагаемое послание Куна также может быть выражено в гораздо менее провокативной, с философской точки зрения, манере.

Ключевые слова: Томас Кун, изменение мира, научные революции, изменение взгляда на мир, непрезентистская историография, гипотезы, становящиеся фактами

1. Introduction

For many philosophers, Kuhn's talk about "world change through revolutions" has been the most repulsive part of his reflections on the development of the basic natural sciences, which he presented in his famous 1962 book *The Structure of Scientific Revolutions* [Kuhn, 1970 (1962)], *Structure* for short. In comparison to this topic, the controversies about the



concept of paradigm¹ and the nature and existence of normal science² appear to be minor. Because Kuhn's world change thesis is the "most fundamental" ingredient of his incommensurability thesis,³ also incommensurability has been indigestible for those philosophers. A fairly early negative reaction came from Israel Scheffler who stated that he cannot "believe that this bleak picture, representing an extravagant idealism, is true" [Scheffler, 1967, p. 19]. More recently, Peter Godfrey-Smith stated that "Chapter X [of *Structure*] is the worst material in Kuhn's great book. It would have been better if he had left this chapter in a taxi" [Godfrey-Smith, 2003, p. 96]. On a scale of damnation of writings by other philosophers, this statement undoubtedly scores rather high.

However, I have never been deterred by statements like these. I have tried in several attempts to make sense of Kuhn's talk of "world change through revolutions."⁴ In this paper, I will connect several strands of my research and develop them further. To this end, I will first review what Kuhn exactly says about world change through revolutions (Section 2). I will then investigate whether this world change talk is logically or conceptually inconsistent (Section 3). Because it is not, I can then ask whether there is some initial plausibility for the world change talk (Section 4). Then I will discuss whether the strange "world change through revolutions" talk should be replaced by "change of world view" talk (Section 5). We can then see that "world change through revolutions" talk is motivated by a strictly non-presentist historiographic stance. Nevertheless, it can be avoided without giving up this stance (Section 6).

2. What Does Kuhn Say about World Change Through Revolutions?

In this section, I shall collect the most important quotes from Kuhn about world change through revolutions. First, the most relevant quotes from *Structure*:

"[T]he historian of science may be tempted to exclaim that when paradigms change, the world itself changes with them." [Kuhn, 1970 (1962), p. 111]. Note Kuhn's triple hesitation in this sentence on the historian's

¹ See exemplarily [Mastermann, 1970].

² See exemplarily [Popper, 1970] and [Watkins, 1970].

³ The "third and most fundamental aspect of the incommensurability of competing paradigms" is that "the proponents of competing paradigms practice their trades in different worlds", [Kuhn, 1970 (1962), p. 150].

⁴ See [Hoyningen-Huene, 1989; 1990; 1993; 2005; Hoyningen-Huene, Oberheim, and Andersen, 1996; Oberheim and Hoyningen-Huene, 1997; 2018; Hoyningen-Huene and Oberheim, 2009; Hoyningen-Huene, 2021; 2022 (in press)].



part: “*may be tempted to exclaim*”. An “exclamation”, not just a “statement”, and perhaps an exclamation of despair?

“[T]he principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world” [Kuhn, 1970 (1962), p. 118]. Note that a “principle of economy” (which falls from heaven at this point, totally unexplained) *urges* Kuhn and his fellow like-minded historians of science to speak that way, in other words, they are hesitant and don’t do that voluntarily.⁵

“Is there any legitimate sense in which we can say that they pursued their research in different worlds?” [Ibid., p. 120]. Note that Kuhn often uses rhetorical questions to lead over to some topic.

“[T]hough the world does not change with a change of paradigm, the scientist afterward works in a different world” [Ibid., p. 121]. This sentence may be read either as a clear indicator of Kuhn’s stupidity, by not noting the glaring inconsistency of the sentence, or as an indicator that there are probably two different concepts of world in play. I chose very early on the second alternative [Hoyningen-Huene, 1993, Chapter 2].

“The data themselves had changed. That is the last of the senses in which we may want to say that after a revolution scientists work in a different world” [Kuhn, 1970 (1962), p. 135]. This shows that Kuhn’s world change talk is even internally somehow complicated because it admittedly has several different senses.

“[T]heories [...] do not evolve piecemeal to fit facts that were there all the time. Rather, they emerge together with the facts they fit from a revolutionary reformulation of the preceding scientific tradition” [Ibid., p. 141]. In other words, a scientific revolution is a process in which, at the same time and in substantive conjunction, new theories emerge with new facts.

“In a sense that I am unable to explicate further, the proponents of competing paradigms practice their trade in different worlds” [Ibid., p. 150]. Note Kuhn’s admission that he is not fully understanding what his own world change talk means.

In the Postscript – 1969 to *Structure*, Kuhn tries to understand his own world change talk better: “Notice now that two groups, the members of which have systematically different sensations on receipt of the same stimuli, do in some sense live in different worlds” [Ibid., p. 193]. Now we really have two worlds, a world of stimuli that is invariant against revolutions, and a world of sensations that may vary with revolutions. The latter is a phenomenal world.⁶

Ten years later, Kuhn adds that his envisaged position has substantial parallels with Kant: “The view towards which I grope would also be

⁵ For some discussion of this passage, see [Hoyningen-Huene, 2022 (in press), Section 4].

⁶ For interpretation of the “stimulus ontology” contained in this passage, see [Hoyningen-Huene, 1993, pp. 42–60].



Kantian but without ‘things in themselves’ and with categories of the mind which could change with time as the accommodation of language and experience proceeded” [Kuhn, 1979, pp. 418–419]. It remains entirely open in this statement what could play the role of the stimuli that Kuhn found necessary to refer to ten years earlier.

There are very important passages regarding world change in works of Kuhn from the 1980s, especially in his Thalheimer Lectures, which he held in 1984.⁷

“When I first used [the locution that the world changes with the lexicon, “lexicon” having a similar role as “paradigm”, P.H.-H.] more than twenty years ago, I thought my remark metaphorical and the metaphor eliminable. Now I am not so sure” [Kuhn, 1984, unpublished-b, pp. 97–98].

And more to the point:

“I shall then suggest that reiterated assertion that the world changes with the structure of the lexicon used to describe it ought not be heard simply as metaphor.” [Ibid., unpublished-a, p. 3]. Many people had understood Kuhn in this way: world change through revolutions must be metaphorical or psychological.⁸

Kuhn, however, insists on the opposite:

“I see no alternative to taking literally my repeated locution that the world changes with the lexicon” [Ibid., unpublished-b, p. 120], “change with the lexicon” meaning a scientific revolution.

Given these quotes, it is clear what Kuhn intends to say. However, it is less clear whether this is really comprehensible, let alone plausible. In the next section, I will take the first step in the direction of potential comprehensibility, namely, to find out whether this talk of world change through revolutions is at least not logically or conceptually inconsistent. Further steps will follow in later sections.

3. “World Change through Revolutions” Is Not Inconsistent

The question of the logical and conceptual consistency of the “world change through revolutions” talk arises in a realist framework that many philosophers and scientists take as conceptually unavoidable. In this realist framework, which is also our everyday view of reality, the real consists of the things that stand opposite to us and are completely independent of us. Of course, the background of this persuasion is the equally elementary and

⁷ Unfortunately, these lectures are not published in English and they will not be contained in [Mladenovic, 2022, in press]. A Spanish translation of the Thalheimer Lectures appeared in [Melogno, Miguel, and Giri, 2017].

⁸ See, e.g., [Sankey, 1994, pp. 152–153; Bird, 2012, p. 869].



fundamental difference between things *being* such-and-such and *imagining* or *dreaming* or *wishing* or *fearing* things being such-and-such. In this view, the real has no components that have their origin on the subject side, or as I shall call them for short “genetically subject-sided components” (“genetically” does not refer to “genetics,” but to “genesis”).⁹ Thus, in our common (and, for some, also philosophical) understanding we speak very naturally of reality as “mind-independent.” In this view, the following equation holds:

$$\text{real} = \text{objective} = \text{purely object-sided} = \\ \text{without genetically subject-sided components.}$$

Given this view of what reality is, it is completely intelligible and plausible that most forms of “idealism” in metaphysics, which posit genetically subject-sided contributions to reality, appear to be conceptually incoherent and thus not even worth discussing. Most generally, any form of idealism seems to claim that something genetically subject-sided is at least part of, or even fully constitutes, reality.¹⁰ To someone committed to the above view of reality, this is incoherent, because by “reality” we just *mean* the completely object-sided, to which the epistemic subject does not and cannot contribute anything whatsoever.

However, ever since Kant philosophers have made a distinction between a world of appearances and a domain of “things” completely independent of human beings.¹¹ The claim is that the world of appearances is the *real* world of *real* things we deal with both in everyday life and in science, and *vice versa*: the real things we are dealing with are appearances (in the specific terminological sense). The point that “appearances” in the desired sense do not refer to a purely psychological phenomenon has often not been understood in the literature.¹² However, it seems to me that the distinction between these two domains is indeed intelligible, it is not inconsistent, even if some philosophers find the distinction highly implausible and based on an utterly false philosophical theory.¹³ Even

⁹ I have introduced and used the terms “subject-sided” and “object-sided” earlier in [Hoyningen-Huene, 1993, pp. 33–36, 45–47, 62–66, 122 fn. 283, 125, 267–271; Hoyningen-Huene, Oberheim, and Andersen, 1996, p. 139; Hoyningen-Huene and Oberheim, 2009, p. 208].

¹⁰ This holds, of course, only for (kinds of) “subjective” idealism that for many analytic philosophers appears to be the only form of idealism known to them.

¹¹ I am using this clumsy expression “a domain of ‘things’ completely independent of human beings”, even with scare quotes around “things”. If we assume that this domain is completely inaccessible to us, then the term “world” as well as the term “things” is already misleading, because they are taken from the *accessible* world around us. It is the domain of the purely object-sided.

¹² See, for instance, [Bird, 2012, p. 869].

¹³ It should be noted, however, that shortly after the introduction of the distinction between appearances and things-in-themselves by Kant in the *Critique of Pure Reason*,



Kuhn's already mentioned, harsh critic Israel Scheffler, who cannot believe that Kuhn's "bleak picture, representing an extravagant idealism, is true" [Scheffler, 1967, p. 19], speaks about a "picture" that "represents" something, which he believes is not true. This concedes that this "picture" is up for truth or falsity, which does not apply to something inconsistent that is *necessarily* false.

The intermediate result is this. One cannot get rid of the "world change through revolutions" idea by dismissing it as inconsistent. It is not. One should rather conceive of it as a possible consequence of an "error theory of realism", in analogy to the "error theory of ethics". The error theory in ethics claims that "[m]oral judgments are never true because the properties that would be necessary to render them true – properties like moral wrongness, moral goodness, virtue, evil, etc. – simply don't exist, or at least are not instantiated" [Joyce, 2021, Section 3.2]. The error theory of realism claims that all judgements about something real being purely object-sided are never true because we do not have access to the purely object-sided. Instead, everything that we indeed and justifiably call real has always also genetically subject-sided components. It belongs to the domain of appearances, in the specific sense as something real that does not only consist of purely object-sided elements but features also subject-sided contributions. If the real world is a world of appearances, then world change through revolutions is conceptually possible. It is conceivable that in a scientific revolution, the genetically subject-sided contributions to reality may change and this results in a world change.

However, conceivability is not very much, although it is not nothing. Notwithstanding conceivability, the "world change through revolutions" idea may still be rejected as being utterly implausible. Let us see whether this is the case or whether this strange idea has at least some initial plausibility.

4. "World Change through Revolutions" Has Some Initial Plausibility

Ever since Laudan's pathbreaking paper [Laudan, 1984 (1981)], philosophers of science have intensively discussed the consequences of the existence of once empirically extremely successful but now discarded theories upon the doctrine of realism. The gist of Laudan's argument is that

Friedrich Heinrich Jacobi launched the incisive critique that "that I could not enter into the system [of the *Critique of Pure Reason*] without that assumption [of the thing-in-itself] and, on the other hand, I could not remain in it with this assumption" [Jacobi, 1787, p. 223, my translation]. At least in the 1960s and 1970s, Kuhn was completely unaware of the underlying problem, see [Hoyningen-Huene, 1993, pp. 50–55].



there is a list of once empirically successful, but now discarded theories that had been realistically interpreted at the time. In all these cases, the theoretical entities that had once been taken to be real turned later out not to exist. Extrapolating this finding into the future results in the “pes-simistic meta-induction”: those theories that we interpret realistically to-day because of their empirical successes may turn out in the future to be seriously false. The seriousness of their falsity would consist in the non-existence of the theoretical entities that these theories postulate as existent.

Of course, Laudan's argument did not go unchallenged. Some people thought that the logical set-up of the argument has to be refined.¹⁴ Other people challenged every single example that Laudan presented, because just empirical success (and later failure) is not enough for the argument to go through.¹⁵ Others postulated a continuity of reference through scientific revolutions.¹⁶ Still others invented “structural realism” that posited a continuity of mathematical structures, thereby saving a realism of theories' structures, but giving up scientific realism (the reality of theoretical entities postulated by highly confirmed, “mature” theories).¹⁷ And still others doubted the validity of Laudan's inductive step because of a putative deep historical change in the overall confirmatory situation since the most recent of Laudan's examples.¹⁸

The controversy about scientific (and structural) realism still persists, no consensus has been reached. However, the existence of this controversy demonstrates that “world change through revolutions” talk (a potential consequence of anti-realism) is not *just* a logical possibility, as demonstrated in the previous section. It is a serious philosophical candidate in a long-lasting dispute.

However, there is an indicator that the whole problem of the “world change through revolutions” talk can possibly be completely circumvented. Ironically, it derives directly from Kuhn's *Structure* itself. Let us go to Chapter X of *Structure*. Its title is “Revolutions as Changes of World View”. However, the first sentence in this chapter reads:

Examining the record of past research from the vantage of contemporary historiography, the historian of science may be tempted to exclaim that when paradigms change, the world itself changes with them.

There is a blatant contradiction between the title and this first sentence (which is not explicitly resolved in the course of the chapter). It is one thing to say that in a scientific revolution, the world view changes,

¹⁴ [Lyons, 2002; 2015].

¹⁵ See [Vickers, 2013] for a summary and for an updated list of 20 putative cases.

¹⁶ Even long before Laudan, [Scheffler, 1967, pp. 54–66]; later, for instance, [Sankey, 1994, Chapter 2].

¹⁷ Beginning in our times with the path-breaking paper [Worrall, 1996 (1989)].

¹⁸ [Fahrbach, 2009].



and quite another one to say that in a scientific revolution, the world itself changes. To illustrate, it makes quite a difference whether you may say in a relationship that during the last 10 years your spouse has changed tremendously, or whether your view of your spouse has changed tremendously. In the example of the couple, both cases are possible (and perhaps equally plausible), but in the case of worlds, world view change through revolutions sounds plausible, whereas world change through revolutions sounds incomprehensible, at least at first sight. Had Kuhn stuck to the title of Chapter X and had he only talked about world view change instead of world change, he could have saved a lot of trouble for himself. What was Kuhn's motivation to talk about world change through revolutions? And why did he somewhat identify world view change with world change? I shall deal with these questions in the following section.

5. Shouldn't "World Change through Revolutions" Be Replaced by "Change of World View" Talk?

Let us first investigate the arguments in favor of a description of scientific revolutions as changes of worldview.¹⁹ The main argument is that from our perspective, earlier scientists falsely assumed the existence of some entities or falsely described the properties of existing entities. For instance, earlier scientists falsely assumed the existence of a substance (or a "principle") "phlogiston" that is, among other things, responsible for the processes of combustion, respiration, and calcination. Or earlier scientists assumed that water is an element and not a compound. One may legitimately say that these scientists viewed the world as containing phlogiston, or as containing an element water, respectively. We may say from our perspective that later scientists gained the insight that these views were false. Their correction led, by a scientific revolution, to the later, more appropriate world views. Thus, a change of world view occurred (not a change of the world). This way of describing the change has the additional invaluable advantage of not challenging plausible metaphysical and epistemological convictions: that our worldview may change due to new data, theories, assumptions, etc. is highly plausible, and that the underlying world is not affected by this change, too. This plausibility is based on the view that epistemology and metaphysics are strictly separated: an epistemic change, happening on the side of the epistemic subjects, cannot possibly influence metaphysics, i.e., the purely object-sided phenomena that are the subject matter of our epistemic enterprise.

However, here is a counter-objection to this view. In phases of well-established scientific knowledge, scientists believe that they *know* what

¹⁹ An earlier version of this section is contained in [Hoyningen-Huene, 2022, in press].



the (specific part of the) world is like and behave accordingly. For instance, Aristotelians thought they knew that they live in a two-sphere universe with different kinds of matter and dynamics in the sublunar and the supralunar sphere. By contrast, Newtonians thought they knew that they live in a uniform universe of material particles that move on well-defined trajectories due to the influence of forces. Clearly, Newtonians thought of the earlier Aristotelian view, where it differed from their own, as being erroneous. This is why Kuhn often expresses the effect of a scientific revolution by saying that after the revolution, scientists *worked* or *practiced science* in a different world.²⁰ The relevant difference of “working in a different world” from “having a different world view” is rooted in the immediateness of the former in contrast to the latter. The statement that scientists experiment with the chemical compound water expresses that these scientists take for granted that water *is* a chemical compound, they just *know* it. There is no reflection on the part of the scientist involved having the content “I am experimenting with water and according to my scientific world view, water is a chemical compound”. Kuhn wants to express that the effect of a revolution on scientists is that the objects of research *are* what the new paradigms says: immediately and without reflective distance.²¹ This change of immediate commitments to entities and their nature, as it happens in revolutions, is not properly expressed by “a change of world view”, but it is expressed more adequately – however oddly – by “a change of the world”. In order to realize how also we today take many claims of science without the slightest reflection or hesitation for granted, both in science and in everyday life, just consider how we express something like “the dinosaurs went extinct some 65 million years ago” or “the Sun is a star similar to many others”. We do not qualify such statements by “according to our current world view” or something similar,

²⁰ [Kuhn, 1970 (1962), pp. 4, 6, 111, 112, 118, 120, 121, 135, 141, 147, 150].

²¹ For Kuhn, such a sense of epistemic security is part and parcel of a paradigm: “Normal science [...] is predicated on the assumption that the scientific community knows what the world is like”, [Kuhn, 1970 (1962), p. 5]. However, this is overgeneralized. There are scientists who always have a critical, reflective distance to whatever paradigm, and do not take any theoretical statements for granted. Steven Hawking, who is a radical instrumentalist, is a case in point. He does not believe that physical theories refer to reality, “it is meaningless to ask whether [a physical theory] corresponds to reality” and therefore, they are neither true nor false [Hawking and Penrose, 1996, pp. 3–4], see also [Hawking and Mlodinow, 2010, especially pp. 53–78]. Already Niels Bohr held a similar view that he characterizes as an “old truth”: “in our description of nature the purpose is not to disclose the real essence of the phenomena but only to track down, so far as it is possible, relations between the manifold aspects of our experience” [Bohr, 1934, p. 18]. Nevertheless, with respect to their scientific practice such scientists cannot be distinguished from scientists with a deeply realist stance, who take the ontological assumptions of the reigning paradigm for true and granted, see [Hoyningen-Huene, 2018, p. 5].



because we believe that these statements express facts, not beliefs. Thus, it is the immediateness of scientists' reference to existing things and their nature that somehow licenses, or at least makes understandable the motive for, Kuhn's odd talk of world change.

This may also lead us to an answer to the second question: what is Kuhn doing when implicitly equating "world change" and "worldview change"? Under normal circumstances, a thing and an image of that thing are very different, and there seems to be no way to equate the two. However, in the course of scientific revolutions, a kind of blurring of the boundaries between "world" and "worldview" may occur. Clearly, when any of our contemporary views first came up, it was a (perhaps crazy) hypothesis whose truth was yet undecided. For instance, the heliocentric planetary system could have been seen first as a literally false theory of the planetary system (perhaps useful as an instrument for predictions). Only later, in the course of further empirical confirmation and the overcoming of external obstacles, it began to be believed to be an adequate description of the world. Once it was believed to be true, it just described the world as it is. Every astronomer then "worked in this world" by presupposing that planets circle the Sun, that the Moon is a satellite of Earth etc. To describe their new stance as a new world view is, of course, correct, but as explained before, slightly too weak. The reason is that the concept of "worldview" implies potential multiplicity, that is the existence of other worldviews. It also implies the possibility of falsity (of a worldview). By contrast, the concept of "world" implies absolute uniqueness and a categorical exclusion of falsity: the world is what it is; there is no conceptual space for something like "a false world".²²

Thus, if one describes the attitude of scientists in a situation of an undisputed paradigm, to say that their worldview was such-and-such, is too weak a description. "Worldview" implies the real possibility of reflexive distance taking by, for instance, contemplating alternative worldviews. This, however, does not take place when scientists are in the firm grip of a paradigm. The famous evolutionary biologist and historian of biology Ernst Mayr described this process nicely with respect to evolution: "biologists no longer speak of evolution as a theory but consider it a fact – as well-established as the fact [...] that the earth is round and not flat".²³ Or consider a more recent example, dark matter. Dark matter was hypothetically introduced in order to explain, among other things, galaxy rotation curves and gravitational lensing. The inference to dark matter is

²² This holds, of course, only for the literal sense of "world". There are metaphorical variants of the world concept like "he lives in his own world", indicating that the pertinent person has somehow lost contact to reality, to the "real world".

²³ [Mayr, 1997, p. 178], similarly on p. 61. – In conversation, Mayr often deplored that he was not aware that philosophers of science have investigated this transition from theory to fact.



abductive: dark matter is a (hypothetical) entity whose existence is postulated because of its enormous potential to explain a variety of observable effects. As noted cosmologist Lisa Randall recently put it in *Nature*, cosmologists “believe that [dark matter] *is out there* because of its manifold gravitational influences. [...] *We know it exists*, but we do not yet know what it is at a fundamental level”.²⁴ Or take a more mundane example: dinosaurs. Most people, including paleontologists, other biologists, and children would agree to the statement that until roughly 65 million years ago, dinosaurs existed on the surface of the Earth. It would sound very strange to say, “in my world-view, dinosaurs once existed on Earth”, because this utterance has the implication that in other people’s world views that are not entirely illegitimate, there were no dinosaurs.

Still, this argument will not be persuasive for many, especially for scientists, to speak about scientific revolutions as changes of the world, instead of changes of world view. The argument would go as follows. It may be entirely correct that earlier scientists firmly believed in the existence of some entity, for instance phlogiston, and they may have been subjectively absolutely certain. Nevertheless, today we know better, we *know* that phlogiston does not exist. Therefore, the only correct way to describe what happened is that they believed in phlogiston, and they were wrong, as we know today. The world was *wrongly conceptualized* as containing phlogiston. We conceptualize the world much better, especially as not containing phlogiston. Therefore, the only thing that has changed is the conceptualization of the world, in other words the world-view, and the world itself that does not care a bit about our conceptualizations of it, remained the same. Therefore, change of world-view: yes, change of world: no.

I am certain that Kuhn was aware of this line of argument that is utterly convincing to scientists and to many, if not most philosophers, and to any lay person. However, a *historian of science* may have a different attitude here, and this is what I am going to discuss in the following section.

6. Is “World Change through Revolution” Talk a Necessary Consequence of a Strictly Non-Presentist Historiographic Stance?

Note what Kuhn says when he seriously talks about world change for the first time: “[T]he *historian of science* may be tempted to exclaim that when paradigms change, the world itself changes with them.” [Kuhn,

²⁴ [Randall, 2018, pp. S6–S7], my italics; for a survey of dark matter’s history, see [Bertone and Hooper, 2018] and [Peebles, 2020].



1970 (1962), p. 111, my italics]. I already noted in Section 2 the triple hesitation contained in this sentence. I shall now direct our attention to the fact that Kuhn explicitly speaks about the *historian* of science. Is this more or less coincidental or does Kuhn consciously exclude other people, like scientists, philosophers, or lay people? I suggest that this is the case. The temptation to exclaim that the world changes with a paradigm change is a temptation exclusively for historians of science, and there only for a sub-class of them. It is those historians of science who practice the “new internal historiography of science”.²⁵ Kuhn was an early member of this group and he was instrumental in its institutionalisation in the United States in the 1960s and 1970s.²⁶ The main thrust of this kind of historiography of science is to strictly avoid “presentism”, that is to avoid in a historical narrative elements from the present that the historical actors could not know and that would therefore distort our description of what happened at the historic time. In other words, the historical process should be conceptualized exclusively in the “actors’ perspective”, otherwise one would not understand what the actors were doing, because they only had their point of view (and not ours).²⁷ The whole aim of *Structure* is to present the consequences of this new historiography on our understanding of what science and its development is: “This essay aims to delineate that [new] image [of science] by making explicit some of the new historiography’s implications” [Kuhn, 1970 (1962), p. 3]. Let us investigate what the implications of the new historiography are for the descriptions of scientific episodes with revolutionary ontological consequences. I am choosing the example of dark matter today, together with a fictitious but not impossible situation in 20 years from now.

As explained above, the hypotheses of dark matter began to be broadly discussed in the 1970s in order to explain a number of strange astrophysical and cosmological observations, among them gravitational lensing and surprising rotation curves in galaxies [Bertone and Hooper, 2018]. In the meantime, for most cosmologists and astrophysicists the existence of dark matter has changed its status from hypothesis to fact, although dark matter’s nature is completely unknown, as cosmologist Linda Randall’s 2018 quote attests that cosmologists “believe that [dark matter] *is out there* because of its manifold gravitational influences. [...] *We know it exists*, but we do not yet know what it is at a fundamental

²⁵ For a more extensive presentation of this kind of historiography and its contrast to the “old internal historiography of science”, see [Hoyningen-Huene, 1993, pp. 12–24].

²⁶ For Kuhn’s role in this institutionalization process, see [Hoyningen-Huene, 2001] (unfortunately only available in German).

²⁷ This is not strictly true. Heuristically, also elements from today’s science may be used, for instance in order to identify a specific experiment or observation and its outcome. Or, after having reconstructed the historical process in actors’ categories, one may fit it into a larger historical process that was unknown to the actors.



level.” Thus, most cosmologists today would agree with the following statement about the universe:

Statement (2022): “We live in a universe that contains the Earth, the Moon, the Sun, our galaxy, many other galaxies, and dark matter.”

Note that this is a statement about facts and it is meant as such. It is not a statement *about* our epistemic state like our belief or knowledge although, of course, it articulates our knowledge about certain facts.

As I said above, *most* cosmologists today would agree with Statement (2022), but not all of them. For instance, there is noted astrophysicist Pavel Kroupa who claims that there is convincing evidence that dark matter does *not* exist: “The standard dark-matter based cosmological model is the most falsified model which the very vast majority of scientists have ever believed in.”²⁸ The background of this statement is an alternative theory of gravitation that is a modification of Newton’s gravitational theory, appropriately called MOND, for “Modified Newtonian Dynamics”; it was introduced in the early 1980s by physicist Mordehai Milgrom.²⁹ The motivation for MOND was to modify the gravitational force in such a way that the hypothesis of dark matter, introduced to explain the rotation pattern of galaxies, becomes superfluous. In other words, what traditional gravitational theory explains by gravitational force *plus* dark matter, MOND explains by a modified gravitational force – this is at least the idea.

As I said, most astrophysicists endorse the standard model of cosmology called the Λ CDM model, where “CDM” denotes its essential Cold Dark Matter component (“ Λ ” denotes the dark energy component). Nevertheless, imagine that Kroupa and colleagues convince the astrophysical/cosmological community within the next twenty years of the falsity of Λ CDM and the correctness of MOND (at least as an effective theory). Then, in 2042, it would be a consensus among astrophysicists and cosmologists that dark matter does not exist. Instead of agreeing with Statement (2022), they would agree with

Statement (2042): “We live in a universe that contains the Earth, the Moon, the Sun, our galaxy, many other galaxies, and no dark matter.”

Now compare the 2022 and the 2042 authoritative statements about the universe:

2022: “We live in a universe that contains... dark matter.”

2042: “We live in a universe that contains... no dark matter.”

²⁸ Golden Webinar in Astrophysics, April 9th, 2021, Santiago de Chile, “On the Non-Existence of Dark Matter”, <https://www.youtube.com/watch?v=PVgwLWVETIM> (accessed Dec 21, 2021).

²⁹ [Milgrom, 1983a; 1983b; 1983c]. For a contemporary introduction to MOND and further analysis, see [Merritt, 2020].



Note again that these are statements about the universe and not about epistemic states. If you asked the *astrophysicists* about Statement (2022) in 2042, they would say something like “Yes, in 2022, we believed that dark matter existed, but we were wrong. Our view of the universe has changed.”

However, a non-presentist historian would not be allowed to speak about the difference between 2022 and 2042 in this way, because it involves a *reinterpretation* of Statement 2022 in the light of Statement 2042. This is exactly what is strictly forbidden for non-presentist historians: to reinterpret statements of historical actors in the light of later developments. For instance, for the non-presentist historian it is forbidden to say “when chemists referred to dephlogisticated air in 1785, what they really meant was oxygen.” No, what they meant was really dephlogisticated air with all the connotations that this expression has, and these connotations are part and parcel of the research practice of the scientists at the time. Even if oxygen refers to the same thing as dephlogisticated air, one cannot fully understand the historical actors if one strips their concepts of the connotations that these concepts bear. By the same token, a non-presentist historian is apparently not allowed to rephrase the authentic Statement 2022 *which is about the content of the universe* as a statement about the beliefs of astrophysicists, as a 2042 astrophysicist would quite naturally do.

Therefore, when the non-presentist historian tells the story of cosmology in the 21st century in 2045, she has to compare the authentic historical sources

Statement (2022): “We live in a universe that contains... dark matter”.

And

Statement (2042): “We live in a universe that contains... no dark matter.”

Of course, comparing these historical sources she may be “tempted” to “exclaim” that “the universe” had changed between 2022 and 2042 due to the supposed underlying paradigm change induced by Kroupa [Kuhn, 1970 (1962), p. 111]. But does she have to succumb to this temptation, as Kuhn did? Does the canon of non-presentist historiography *force* her to do so? I think that this is not the case. The historian can legitimately describe the situation as follows:

“In 2022, almost all cosmologists took it as fact that dark matter exists.”

And:

“In 2042, almost all cosmologists took it as fact that dark matter does not exist.”

And she may even say, to come even closer to Kuhn’s phrasing:

“In 2022, almost all cosmologists behaved as if they lived and worked in a universe that contained dark matter (which is, according to our present 2045 knowledge, not the case).”



The huge advantage of this sort of phrasing is that the historian of science does not force herself into controversial philosophical pronouncements that are not really necessary to get her historical message across. It seems to be a wise suggestion to scientists and humanists of all kinds not to get involved in philosophical disputes unless absolutely necessary (*"disputationes metaphysicae non sunt multiplicanda praeter necessitatem"*; one may call this HH's razor).

7. Conclusion

In this essay, I have tried to make Kuhn's strange "world change through revolutions" talk comprehensible. This way of speaking is motivated by two factors. First, there are situations in the history of science in which the conviction of scientists about a certain hypothesis is so strong that they treat it as fact. Nevertheless, this hypothesis may be abandoned at later times. Second, consciously non-presentist historians may be tempted to describe such a situation as a world change through revolutions. However, it seems wise for historians not to yield to this temptation because they can express their non-presentist message in other ways that are much less provocative because they are much more philosophically neutral.

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