



Deconstructing the Phantom: Duhem and the Scientific Realism Debate

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Abstract

For many decades, Duhem has been considered a paradigmatic instrumentalist, and while some commentators have argued against classifying him in this way, it still seems prevalent as an interpretation of his philosophy of science. Yet such a construal bears scant resemblance to the views presented in his own works—so little, indeed, that it might be said to constitute no more than a mere phantom with respect to his actual thought. In this article, we aim to deconstruct this phantom, tracing the sources of the misconceptions surrounding his ideas and pinpointing the sources and/or causes of its proliferation. We subsequently point out and discuss those elements of his philosophy that, taken together, support the view of him as a scientific realist of a sophisticated kind. Finally, we defend our own interpretation of his thought against suggestions to the effect that it is oriented towards neither instrumentalism nor scientific realism.

Keywords Pierre Duhem · Scientific realism · Instrumentalism · Antirealism · Conventionalism · Philosophy of science · French philosophy · History of philosophy of science

The question of how Pierre Duhem’s philosophical and methodological reflections regarding the epistemic status of physical theories are to be construed has proved a subject of unending dispute. As Brenner (2011) points out, subsequent generations of philosophers of science have found inspiration in his philosophical works, but for the greater part of the last century they read them selectively with their own purposes in mind. Those varied approaches gave rise to, and perpetuated, divergent accounts of his philosophy of science. Where Duhem’s position on the epistemic relation between physical theories and the mind-independent world is concerned, those accounts tend to fall into one or other of three groups:

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- (1) those ascribing a version of instrumentalism (antirealism) to him—e.g., Mach (1906/1976), Rey (1907), Popper (1956/1963), Giedymin (1976/1982) and Austin (1976);
- (2) those claiming to discern some inconsistency or indecisiveness on Duhem's part (typically by pointing out that while some of his philosophical remarks are indicative of instrumentalism (antirealism), others suggest realism, with a variation of this approach claiming that rather than inconsistent, he was searching for a third way between realism and antirealism while endorsing none of these general views)—e.g., McMullin (1990), Psillos (1999) and Darling (2003);
- (3) those attributing to him some form of scientific realism—e.g., Jaki (1969), Maiocchi (1985), Lugg (1990), and Bordoni (2017).¹

Of these, interpretations of the first kind have, in the past, tended to be dominant—to the extent that Duhem has come to be regarded as a paradigmatic instrumentalist. Moreover, though it would seem that several authors have made quite compelling cases for the untenability of interpreting his philosophy as a form of instrumentalism (at least in the latter's properly construed sense), such readings are still commonplace amongst contemporary philosophers, with those who do see problems there being prompted to then exhibit more enthusiasm for interpretations of the second sort, which have recently become more fashionable. Meanwhile, the principal aim of the present article is to show that despite being the least popular stance, the third of the above accounts of Duhem's philosophy is in fact the right one. In other words, we ourselves shall be advocating a view according to which he was neither an antirealist about physical theories, nor inconsistent in this respect, but instead a fully conscious, historically aware, highly consistent and sophisticated scientific realist.²

Before proceeding with our argument for thinking of Duhem as a scientific realist (about the physical sciences—as he himself repeatedly emphasized, he was specifically concerned with the epistemology of physics), we wish to point out and elaborate on what we think are the main sources of the misunderstandings surrounding his philosophy. We shall also make some suggestions as to why it is that some of the interpretations based on those misunderstandings achieved the popularity they did and continued to be influential over quite a number of decades.

1 The Phantom of Duhem's Philosophy of Science

The first difficulty one encounters when trying to comment on different interpretations of Duhem's philosophy of science is that over the course of an extended period of time certain authors have tended to ascribe to him a set of views he in fact *never* advocated. Moreover, we are not just dealing here with a simplification of his stance by commentators. Schematizing the views of a well-known thinker in order to simplify some complex theoretical construction or other is, of course, a fairly standard practice, often amenable to justification.

¹ There are, as would be the case with any classification, accounts of Duhem's philosophy that do not fall readily into one or other of the groupings proposed here. Thus, for example, the account presented in Stoffel (2002), as we understand it, takes itself to be located somewhere between (2) and (3).

² Of course, the very expression "scientific realism" did not enter into usage until after Duhem's death, so we are applying it here retroactively. We shall offer some comments aimed at clarifying our own understanding of the scientific realism controversy in due course.

Yet the discrepancy between what sometimes passes for Duhem's philosophy and the ideas presented in his works is so great that it cannot, strictly speaking, even be classed as a caricature. In something of the latter kind, one is able to identify the original because, in spite of all the simplifications and deformations, one can still readily identify its distinctive features. However, to label Duhem an instrumentalist or an antirealist is to misrepresent his views on such a vast scale that any resemblance to his actual claims is lost. As far as taking him to be an instrumentalist is concerned, our figurative characterization of this as generating nothing more than a *phantom* of his philosophy of science will be meant to serve as indicative of just such a situation.³

1.1 Phantom-Creating Mechanisms

The emergence of the above-mentioned phantom has, we believe, been a product of a somewhat complex cultural mechanism. As we see it, this latter has consisted in the following crucial elements:

- (a) effects issuing from the deep crisis affecting the modern ideal of science and the emergence of a new ideal of science in Western philosophy, one of the outcomes of which has been a decades-long period of disorientation within philosophical circles as to whom should be considered "enemies", and whom "apologists", with respect to the new science;
- (b) a common tendency on the part of commentators to consider Duhem's philosophy the intellectual fruit of his religious involvement;
- (c) a shift in the meaning of several terms commonly used in the philosophy of science—and also in how the actual theoretical contours of debates are mapped out—that took place directly after Duhem's death and thus came to exert a direct influence on the reception of his thought (in that it rendered many of his claims highly context-dependent);
- (d) the high degree of effectiveness with which views about Duhem have been disseminated by certain influential figures in contemporary philosophy.

The phantom, then, has not been a product of any kind of mere intellectual weakness or complacency on the part of Duhem's commentators.⁴ It is, rather, largely a collateral consequence of important changes occurring in our philosophical views regarding the empirical

³ Though certainly not wishing to defend a radical position to the effect that there are methods within the humanities that would enable one to determine conclusively which interpretation of an author's thought is the right one, we nevertheless think that the following claim is defensible: that in his works in the philosophy and methodology of science, as well as in his research into the history of science, Duhem maintained essentially the same mode of exposition as in his work in physics and chemistry, where this amounted to a lucid—one might even say "Cartesian"—style of presenting theses and arguments. The language utilized aims at successful communication, it being both clear and free of unnecessary stylistic embellishment (though at the same time lively, flexible and marked by a skilful use of metaphor). Even the arrangement of the texts with respect to structure, formal apparatuses, etc., testifies to a high level of concern for successful communication. Duhem was straightforward about, and did not seek to mask, his epistemological views. His intentions are transparent, with no underhand implications. Therefore, in what follows we shall not be seeking to defend our thesis about the phantom of Duhem's philosophy by excavating any hidden senses concealed in his works. Instead, we shall be taking them at face value.

⁴ We stress that we have no wish to pass judgement on those responsible for creating or disseminating the phantom, and are not seeking to suggest that they were somehow lacking in critical perspicuity; indeed, in most cases these are individuals for whom we retain the highest esteem.

sciences and their relations with other areas of culture, and concerning the limits of human knowledge. So let us now inspect these elements more closely.

1.2 Duhem's Philosophy and the Dawn of the New Ideal of Science

Duhem's life, and the first phase of his philosophy's reception, unfolded alongside important changes in our thinking about science. His was a time when two processes were culminating: on the one hand, the unfolding crisis affecting the modern ideal of science, and on the other, the emergence of our contemporary ideal, which manifested something new in this regard. Duhem, moreover, as a critic of positivist accounts of science, stood at the forefront of the movement responsible for shaping the course of these developments.

Amsterdamski invokes the expression "ideal of science" to refer to "a set of views about the goals of scientific activity and of views defining both the method and the ethos of science at a given period" (1983/1992, p. 14). For Amsterdamski, "the history of science constitutes the realization of a certain series of socially accepted ideals of science which, though genetically linked, were distinct from one another" (ibid., p. 14, emphasis omitted). In the context of our analysis, two functions pertaining to such ideals of science are of crucial importance. Firstly, they provide "a filter which determines that some research problems will be seen as available for investigation at a given time and are thus classified as worthwhile, interesting or important, while others will either pass unnoticed or be ignored as unimportant or even unscientific" (ibid., p. 21, emphasis omitted). Secondly, "ideals of science co-determine the methodological rules of research" (ibid., p. 22, emphasis omitted).

Thus, one of the consequences of embracing a particular ideal of science—of taking it for granted, so to speak—is the dismissal of those methodological solutions and philosophical accounts of science that cannot be reconciled with it. Much of the initial confusion surrounding how Duhem's philosophy of science is to be read stems from the fact that it was one of the first expressions of our *contemporary ideal of science* (i.e. the ideal that emerged from the crisis largely caused by the problematization of 19th-century physics, which paved the way for the emergence of the theory of relativity and quantum mechanics), but was often evaluated from positions rooted in the old, declining and disintegrating *modern ideal of science* (i.e. the ideal that developed from the 16th century on and culminated in 19th-century scientism). Accusations to the effect that he was guilty of betraying the spirit and ethos of science, were, as we see it, expressions of an admirable concern for the integrity of science and its proper place in the system of culture; nevertheless, they reflect a failure to realize that what was being defended was not science *per se*, but just one particular philosophical account of it—namely, the one manifested in the modern ideal of science.

It is also worth noting that although the modern ideal of science was beginning to disintegrate during the last decades of the 19th century, it is still commonly accepted over a hundred years on. The elements of this ideal constitute the positivistic conception of science that later came to be known as "the received view". Hence, one should hardly be shocked to discover that this kind of rejection of Duhem's philosophy of science can be witnessed recurrently throughout the 20th century. As we have indicated, for many authors, Duhem was one of those engaged in disrupting the accounts of science familiar to people then: one of those dangerous thinkers who—to paraphrase Carnap's comment on the situation in logic—were trying to cast the ship of philosophy and the methodology of the sciences off from the *terra firma* of the classical forms.

Duhem contested the ideal of science still prevalent during his lifetime when he argued that developed, mathematized sciences do not deal with “bare facts”, and that “scientific facts” are not given, but constructed—and, as such, (to some extent) negotiable. He rejected the “inductionist” account of theory construction (the “Newtonian method”, as he called it), and described various oversimplifications in the accepted account of the procedures involved in selecting a theory (including the viability of crucial experiments); he emphasized the role of tradition in scientific research, and its communally collective character, dismissing the model of the scientist as a fully autonomous cognitive agent as a kind of literary fiction. All these and many other points of his critique of the modern ideal of science have gradually come to be accepted, and even taken for granted, within contemporary philosophy of science (and thus, also, within the contemporary ideal of science), but many of the commentators rooted in or influenced by the old ideal saw them as being both radical and anti-scientific, and so were ill-positioned to arrive at any fair and proper assessment.

1.3 An Aggravating Circumstance: Religious Engagement

Another obstacle to a sound understanding of Duhem’s position relates to the common tendency of interpreting his philosophy of science as an artificial, sophistic theoretical facade actually promoting some quite different ends—ones supposedly connected with his involvement in religion. As Eastern European marxists were wont to put it during the Stalinist era, the philosophy of authors such as Duhem, Poincaré and Le Roy

[...] aims its criticism primarily at science: by reducing science to a nominalist fiction, it wants to prevent scientists from invading the territory monopolized by the Church and to deprive them, to the benefit of the Church, of any theoretical power. It is an agent of obscurantism in the bosom of science, disguised as a mediator between science and obscurantism (Kołakowski 1953, pp. 354–355).

[...] Conventionalism is, in its entirety, only a means to facilitate the ideological work of the servants of the Church. In his *Physique de croyant*, Duhem exhibits this all too clearly. He has already proven that physics tells us nothing about reality. Hence, as we are now supposed to see, it follows that it cannot be in contradiction with religion (ibid., p. 351).

This way of accounting for Duhem’s philosophy of science as driven by some “hidden agenda” was by no means only typical of the more doctrinaire figures of the time. Niiniluoto, for example, includes Duhem amongst those whose instrumentalist view of science “served [...] as a conservative reaction to defend religious doctrines from the advances of science” (1999, p. 282). Meanwhile, for Freudenthal, Duhem’s “instrumentalist philosophy of science was to undermine the menace which a realistically interpreted science exerted on the doctrinal positions of the Catholic Church” (2009, p. 271). In some cases—and especially for authors sympathetic to either scientism or, more generally, the Enlightenment cult of science and of critical stances towards religion—the fact of Duhem’s strong ties to Catholicism (which we ourselves take to be incidental to this⁵) was seen as confirming the

⁵ Our point is that Duhem’s religious views had no bearing on his justification of his positions regarding the epistemic capabilities of science. We are not claiming that his religious engagement and ties to Catholicism had nothing to do with his having arrived at these views, as quite the opposite was the case. On the shaping and evolution of Duhem’s views, see J.-F. Stoffel (2002).

initial diagnosis of his being involved in deliberate and sophisticated attempts to disparage scientific knowledge. It was seen as an important factor—one that explained the character of his philosophy of science and his critical remarks concerning modern, and especially positivistic, models of knowledge.

Nevertheless, even in regard to this aspect of his philosophy's reception we can say that this was a symptom of broader social and political processes and changes of worldview. For instance, in Duhem's France the process of laicisation of public institutions (including education at all levels) was at a high point, with many circles associated with the intelligentsia actively turning away from the Church.

To sum up, then, we regard Duhem's religious involvement as having no bearing whatsoever on the validity of his work in the methodology and philosophy of the physical sciences.⁶ More importantly, however, even if one were to produce a compelling argument for thinking that his philosophy was motivated by his religious beliefs, this would not change the fact that his diagnoses concerning the methods of science and their limits possess whatever claim they have to validity and soundness on their own merits.

1.4 Shifts in Meaning

After the First World War, the language of the philosophy of science underwent a fairly rapid process of evolution. Some terms altered their meanings, and other new ones were introduced. This, of course, was a natural manifestation of cultural life, but where the reception of Duhem's philosophy of science was concerned it contributed significantly to the emergence and perpetuation of a number of misunderstandings.

A good example of this would be the change to the meaning of the term "explanation" when employed to refer to what physical theories are meant to achieve. For Duhem, and for many of his contemporaries, to "explain" meant to provide an ultimate and literally true description of the causes of certain empirical facts or regularities—or, as he himself once put it, "to strip reality of the appearances covering it like a veil, in order to see the bare reality itself" (1906, 1914/1954, p. 7).⁷ Such a notion is related to essentialist or naïve-realist accounts of science. With those accounts being rejected in the context of the contemporary ideal of science the notion of scientific explanation also changes, and while no single account of scientific explanation has since come to monopolize contemporary philosophical language, most contemporary philosophers of science—including those seeking to defend scientific realism—would concur that it is inappropriate to attribute to science an ability to furnish explanations of an *ultimate* or *metaphysical* kind.

It is obvious how this particular shift in meaning could have led many commentators on Duhem's philosophy astray, in that they tended to read remarks of his concerning explanation—such as "A physical theory is not an explanation" (Duhem 1906, 1914/1954, p. 19), or "[...] a true theory is not a theory which gives an explanation of physical appearances in conformity with reality" (ibid., pp. 20–21)—as expressions of instrumentalism, whereas

⁶ It should be noted that we are not referring here to Duhem's work in the history of science. Some authors have argued that Duhem's account of the history of science was influenced by his religious beliefs (cf. e.g. Martin 1991). While we believe this not to be the case, and hold that a careful reading of his historical works would allow one to at the very least distinguish the diagnoses of Duhem-the-historian from the views of Duhem-the-religiously-engaged thinker, we accept that this issue remains open to debate.

⁷ We shall elaborate on Duhem's views about explanation in science in the second part of the article.

these should really be read as rejections of the essentialist or naïve-realist account of science by a precursor of the contemporary ideal of science. (Such a misreading was most likely one of the sources of Popper's reading of Duhem's philosophy, which we discuss in the next subsection below). Similar misunderstandings may arise when the reader draws attention to certain isolated claims of Duhem without paying due attention to the context that shapes their meaning. Take, for example, the concluding remark of *ΣΩΖΕΙΝ ΤΑ ΦΑΙΝΟΜΕΝΑ*:

Despite Kepler and Galileo, we believe today, with Oslander and Bellarmine, that the hypotheses of physics are mere mathematical contrivances devised for the purpose of saving the phenomena. But thanks to Kepler and Galileo, we now require that they save *all the phenomena* of the inanimate universe *together* (Duhem 1908/1969, p. 117).

This may quite easily be taken as a declaration of instrumentalist intentions. However, the context of the essay suggests a rather different reading, as it was issued in the specific context of a polemic against Galileo's essentialism. It should thus be read as rejecting the view that regards theories as potentially capturing ultimate truths about things, but not as endorsing a conception of them as mere instruments of prediction.

Other examples of similarly misleading shifts in meaning include the case of "cosmology", which, in the decades following Duhem's death, ceased to refer to non-empirical speculations and started to be used instead to describe a scientific discipline yielding theories with observable consequences, and the somewhat anomalous substitution of "instrumentalism" for what had earlier been referred to as "nominalism".⁸ Moreover, Duhem used certain terms (like "truth" and "metaphysics") in a highly rigorous fashion—one that cannot be said to have been widely maintained in the decades since his death. All these points contribute to the fact that when we read Duhem's works having no regard to their original context, we are liable to interpret them according to a conceptual framework alien to their author, and in a way contrary to his intentions.

A different kind of conceptual problem relating to the interpretation of Duhem's philosophy of science as a position in the realism–antirealism debate pertains to the fact that the very terms responsible for defining this opposition appeared quite some time after his death, and in the context of different debates. Moreover, since these expressions entered the philosophical vocabulary, they themselves have been subject to semantic evolution. As a result, using these and related terms to label views actually formulated in a different historical context is something that should only be done with great caution and self-reflection. Unfortunately, some commentators, recognising certain (superficial) resemblances between Duhem's claims and those typical of positions familiar from our own day, have been over-hasty in applying contemporary classifications to his thought.

⁸ Nominalism and instrumentalism were never equivalent terms, and there is no necessary connection between the positions to which they refer. However, in discussions involving the French conventionalists the term "nominalism" was in standard use in various contexts, including those where, later on, "instrumentalism" would perhaps be considered more appropriate (cf., e.g., the discussions of Le Roy's philosophy in Couturat (1900) and Poincaré (1905/1907, pp. 112–128)). Later authors often failed to pick up on the nuances of those discussions, and simply substituted one term for another when discussing the philosophy of French conventionalism. (This was particularly so where the Polish philosophical tradition was concerned.)

1.5 The Power of Authority

The last of the aforementioned circumstances responsible for hampering the reception of Duhem's works and helping to empower the phantom has to do with the impact of the received tradition of interpretation, and the power of authority figures therein.⁹ While traditions of research are of value (and may be essential) to any kind of academic research, they often serve to facilitate the replication of previously established views and evaluations, regardless of their probity. This may happen in various ways, but one of the most important is the induction of young people (students) into the circles of professional researchers. As part of this process of "academic socialization", they are likely to adopt many of the standardly held views of the professional community in question—if only because rejecting them will often entail one's exclusion from the latter. So it should come as no surprise that in many cases a student will *know*—having no reason to doubt what they have been taught in this regard—that Duhem's philosophy of science is a classic instance of instrumentalism. For an observer of this process, it is equally clear that when such a student takes over the professional position of their teachers, they are destined to pass on similar views to the next generation.

Popper may be considered a good example in this context, as he has undoubtedly played a significant role in creating and perpetuating the image of Duhem as a paradigmatic instrumentalist (along with a misguided view of French conventionalism in general). Ever since his early works, he had been engaged in criticizing conventionalist claims, treating them as a rival to his own account of science, but his essay *Three Views Concerning Human Knowledge* (1956/1963) is of particular importance in relation to our present concerns.

Let us recall that the eponymous three views are essentialism (a form of naïve realism), instrumentalism, and a "third view" amounting to a form of convergent realism (roughly speaking, the view that scientific theories are engaged in a process of approximating to the truth, with the theories that supersede others being closer to the latter than their predecessors). Popper discusses and rejects the first two, invoking in the process Duhem as a representative of those who "conclude that these [scientific] theories (which clearly do not describe our ordinary world of common experience) describe nothing at all. Thus they are mere instruments" (1956/1963, p. 104). He notes that Duhem rejected essentialism (on the grounds that he dismissed the explanatory potential of science¹⁰), and on this basis classifies him as an instrumentalist, not for a moment considering the possibility that Duhem, like Popper himself, might also have subscribed to a form of the "third view"—i.e. a non-naïve version of scientific realism. In other words, Popper proposes a framework for discussing rival accounts of science, but locates Duhem's position within this as the opposite of any form of scientific realism, be it naïve or not.

The impact of Popper as a figure of authority in 20th -century philosophy of science is, of course, undeniable. His works, including *Conjectures and Refutations*, saw multiple reprints in numerous languages. Moreover, throughout a significant period he was involved

⁹ It is worth mentioning that—rather ironically—Duhem's works in the history and methodology of science themselves constitute a multifaceted embodiment of the importance of tradition for the pursuit of scientific investigations of any kind.

¹⁰ Yet he fails to see that what Duhem was actually rejecting was only the capacity of science to provide ultimate or metaphysically significant explanations (cf. the preceding paragraph of this paper); this, as we see it, constitutes one of the main sources of Popper's misrepresentation of Duhem's views.

in the aforementioned process of “academic socialisation” in his role as a teacher. Thus, not surprisingly, a number of his students embraced, and perpetuated, his account of Duhem’s philosophy. Agassi, for instance, who studied, completed a doctorate, and worked under Popper, while reviewing the English edition of *La théorie physique. Son objet—sa structure*, described Duhem as “one of the most distinguished instrumentalist philosophers of all time” (1957, p. 241), contrasting his (supposed) views with the Popperian version of realism. Interestingly, Agassi *did* observe that some of Duhem’s remarks suggest that he “would agree [...] that we approach the truth by a series of approximations” (ibid., p. 247, emphasis omitted). However, adopting and arguing within the framework established by Popper, he seems to have been convinced that Duhem allowed for only two views of science: naïve realism (essentialism in Popper’s sense) and instrumentalism—which, of course, leaves no room for the possibility of his having subscribed to some non-naïve version of realism. Feyerabend—another significant author, and one who came into Popper’s orbit at some point—also accepted Popper’s account of Duhem as an instrumentalist, together with his alleged refutation of Duhem’s position (Feyerabend 1981, pp. 184–185).¹¹ Meanwhile, Giedymin, who attended Popper’s seminars and was a significant commentator on French conventionalism, while highly critical of Popper’s treatment of Duhem, did not reject his overall account of Duhem’s philosophy as a form instrumentalism (Giedymin 1976/1982).

We could continue at much greater length, and our list would by no means be limited to authors directly influenced by Popper during his years at the London School of Economics.¹² Furthermore, the phantom’s presence is not confined to scattered remarks in esoteric academic papers, as it also inhabits various encyclopaedias and dictionaries. For example, the most recognized Polish encyclopaedia of philosophy of science, in its entry on scientific realism and antirealism, lists Duhem as a classic proponent of (“comprehensive empiricistic”) instrumentalism, contrasting this with Popper as a representative of “comprehensive hypotheticist realism” (Zamiara 1987). In a similar entry in the *Routledge Encyclopedia of Philosophy*, Duhem is counted amongst the antirealists (Fine 1998). Considering how many influential authors and sources take it for granted that Duhem’s philosophy represents a form of antirealism, the persistence and vitality of the phantom is hardly a surprise.

2 Duhem’s Realism

As we have already stated, our aim is to show that contrary to a relatively widespread view, Duhem’s account of science was in fact that of a sophisticated, historically informed

¹¹ The rather casual comments on Duhem’s position in this text are complemented by a footnote encouraging us to acquaint ourselves with the criticism of this position presented in Popper (1956/1963). It thus seems that Feyerabend took Popper’s account of Duhem at face value, even after having become highly critical of Popper and his philosophy.

¹² Here we might also add Watkins (e.g., 1984, pp. 136–143) and Worrall (1982, p. 203). A listing of other influential authors would have to include van Fraassen (e.g., “Pierre Duhem, himself a paradigm anti-realist [...]”; 1980, p. 86), Hacking (e.g., “Duhem was an outstanding anti-realist [...]”; 1983, p. 115), Cartwright (e.g., 1983, esp. pp. 87–99), and Niiniluoto (1999; esp. pp. 109–146). One (from a certain point of view) exotic example of an influential authority figure concerns the “centrally planned” philosophy of the Eastern Block, with Lenin as its ultimate philosophical figurehead. Due to the socio-political circumstances, the latter’s brief remarks on Duhem as one of the “particularly confused and inconsistent” (Lenin 1909/1962, p. 52) idealists (cf. ibid. Ch. V), functioned as the only (supposedly) legitimate interpretation of Duhem’s position for the duration of the period of orthodox marxist (or Stalinist) rule.

scientific realist. One of the difficulties any such attempt is bound to face concerns the fact that while the roots of the contemporary scientific realism debate extend back over several centuries, neither Duhem, nor any of his contemporaries, saw themselves as championing any of the opposing sides in the debate as we have come to understand it today. Rather than reflecting merely the trivial fact that the very term “scientific realism” did not emerge before the second half of the 20th century, this is because Duhem and his contemporaries, in formulating their accounts of science, had rather different aims from contemporary authors: ones related to philosophical discussions ongoing at the time, as well as contemporaneously unfolding developments in science itself. This is why, while wishing to focus primarily on those of Duhem’s claims directly related to his take on the epistemic status of scientific knowledge, we nevertheless judge it essential to interpret these in the wider context of his opinions about science and scientific cognition as such.¹³ The latter include his views on nature, reality, and the concepts of *truth* and *explanation*. However, before we proceed to sketch the mosaic of Duhem’s philosophy of science, we think it important, as a way to avoid any terminological misunderstandings, to outline our own understanding of the contemporary scientific realism debate itself.

2.1 Scientific Realism and Antirealism About Science

As one of the central controversies of 20th -century philosophy of science, the scientific realism debate has witnessed the emergence of many divergent stances on its key issues. This abundance notwithstanding, it seems that one can make a relatively straightforward general distinction between two camps: realism and antirealism. The main argument of this article concerns the idea that Duhem can be placed unequivocally among the representatives of the first of these. Therefore, we think that for our purposes it will suffice to state the points made below.

(1) Scientific realism, and antirealism about science, constitute opposing positions concerning the epistemic status of scientific theories—i.e. the epistemic relation between scientific theories and a mind-independent reality.¹⁴ The polarizing question is whether our best scientific theories, or at least some of their parts (*viz.* various forms of “selective realism”), may be interpreted as furnishing true or approximately true descriptions of both *the observable and the unobservable* parts of the mind-independent world.

(2) Any position that gives a positive (even if qualified) answer to this question will amount to a form of scientific realism, while those that give a negative one represent a form of antirealism about science. The main claim of scientific realism—a common denominator of most, if not all, of its forms—is that science is capable of providing us with true or approximately true descriptions of the mind-independent world, or at least some of its parts and/or aspects, and that scientific claims and theories (or certain of their parts) can be

¹³ Given our claims, a proper understanding of Duhem’s philosophical project would obviously itself require a reconstruction of its broader historical context. This, however, would exceed the limits of this paper. Maiocchi (1990) provides a concise discussion of some of the elements of this historical context. More elaborate discussion of this topic can be found in Maiocchi (1985).

¹⁴ Admittedly, some authors have been convinced that one could state the realist position without invoking the theory–reality relation. Hacking (1983), for example, is convinced that he has achieved this through his entity realism. We shall take the liberty of ignoring such positions in our outline of realism–antirealism controversy, as we consider them untenable and, more importantly, irrelevant to the question of the proper interpretation of Duhem’s philosophy of science.

assessed as true (or approximately true) or false. Antirealism, on the other hand, denies science such epistemic possibilities.

(3) The answer one gives to this epistemological question may bear on the answer one gives to questions about the purpose of science. Thus, the realist will probably be more willing to acknowledge that the aim of the latter is to expand our knowledge about the world, while the antirealist, since she doubts the achievability of this, will be more motivated to emphasize its instrumental value. However, while there seems to be no necessary connection between the two questions, the conventional understanding tends to point in the direction of treating instrumentalism as a form antirealism about science (i.e. as a position which both denies the cognitive potential of science and emphasizes its instrumental value); therefore, we shall be using the terms “antirealism” and “instrumentalism” interchangeably here.

While such a brief characterization can hardly do justice to the plethora of versions of the realist and antirealist positions, it is sufficient for our aims. Additionally, let us point out that it leaves little room for the possibility of some sort of middle-ground or third way between the two general stances, as any position recommending that realists commit themselves to just some parts or aspects of scientific claims about the unobservable (such as epistemic structural realism, or semi-realism) will also count here as a form of scientific realism. While the idea that such positions could be construed as forms of realism proper was somewhat less obvious when they were first beginning to emerge,¹⁵ it now seems that most contemporary proponents of scientific realism only argue for one or other of its “selective” versions. On our reading, an approach that could be understood as carving out a third way would have to be one that in some way avoided taking sides—such as Fine’s Natural Ontological Attitude (NOA), for example.

2.2 Nature as Seen from the Perspective of Duhem’s Philosophy of Science

While commenting on Duhem’s conception of natural classification, several authors have touched indirectly on the question of his conception of Nature. Still, discussions concerning his attitude to the question of scientific realism typically lack any clear recognition of his broader views concerning the actual object of scientific research—i.e. the physical world. These are, to a large extent, expressions of his fundamental metaphysical and epistemological intuitions, and thus of his fundamental beliefs concerning the relation between humans (scientists) and the world. Rooted in Duhem’s studies of the history of science, they provide a metatheoretical framework for his more specific claims about the nature of scientific inquiry. We believe that keeping these views in mind while reading Duhem’s claims concerning the limits of scientific cognition and the epistemic status of physical theories can help one to avoid many misguided conjectures and interpretations. Therefore, we wish to draw the reader’s attention to two elements of Duhem’s views on Nature that seem of particular significance in the context of our analysis.

(1) The first is his belief in the mind-independent character of the physical world. Duhem was a strong critic of the modern ideal of science, and so his role in deconstructing our conviction that science is capable of fully reflecting the true order of Nature is often emphasized. Read today, many of his claims may be seen as precursors to subsequent constructiv-

¹⁵ For example, Hacking’s entity realism was viewed by certain authors as marking such a “third way” once (cf., e.g., Reiner & Pierson (1995)), while it seems that most commentators today would not hesitate to classify it as a form of scientific realism.

ist accounts of science. Such interpretations are not necessarily ill-conceived, as Duhem did argue against the idea that the human mind passively reflects the order of Nature, holding instead that the scientific image of the world is constructed through collective efforts on the part of the scientific community. It is, however, at the same time evident that the author of *La théorie physique...* was less of a sceptic than we have come to depict him as being. He had no doubts as to the mind-independent character of the physical world, and while he would have eagerly concurred that the scientific image is “negotiated” (as some modern constructivists like to put it), he remained convinced—and argued—that Nature is the ultimate arbiter of our theoretical constructs.

(2) The second is Duhem’s belief in the great complexity of Nature. In particular, this metaphysical intuition underlies his recurring criticism of the belief that by building mechanical models one will be able to correctly represent the subtle order of the latter. The same intuition lies behind a number of his general claims about scientific theories and scientific representations of the world. (We shall return to this point later on). Finally, it also plays a crucial role in his argumentation against “scientific metaphysics”—19th-century atomism, for example—and, consequently, in his postulating of the separation of physics from metaphysics.¹⁶ While by no means an absolute opponent of metaphysics as such, he rejected the idea that metaphysicians are capable of actually delivering an ultimate and universal description of the fundamental features of the world. He believed that any metaphysical proposition would sooner or later prove to be an inadequate and simplistic account of reality. The apodictic tone of traditional metaphysics was unacceptable to him, and it was precisely his conviction about the great complexity of Nature that prevented him from treating metaphysical explanations seriously.

2.3 Explanation and Truth

Two elements of Duhem’s philosophy of science came to be treated as key indicators of his antirealist orientation: his rejection of the idea of theories as explanations of phenomena, and his insistence on treating physical laws as neither true nor false. The reader will doubtless recall that we have already touched on the problem of how Duhem’s references to the explanatory role of scientific theories should be construed in the first part of this article. As we pointed out, to “explain”, for him, meant to provide an ultimate or metaphysical explanation. Therefore, what he was rejecting was the belief that science is capable of providing us with ultimate explanations of the phenomena in question: i.e. of providing us with literally true descriptions of the unobservable processes standing behind them. At the same time, the schemes for scientific reasoning he outlined on several occasions in his role as a methodologist bear a strong resemblance to more contemporary models of explanation: more specifically, they have much in common with the Deductive-Nomological (DN) model of Hempel and Oppenheim (1948).

The basic idea behind the latter is that to “explain” is to demonstrate that “the sentence describing the phenomenon to be explained” (the *explanandum*) can be logically derived from “the class of those sentences which are adduced to account for the phenomenon” (the *explanans*)—provided, that is, that several conditions are met, including the requirement of there being only true sentences and at least one general law in the *explanans* (ibid., pp. 136–

¹⁶ A very straightforward expression of Duhem’s views on the respective domains of physics and metaphysics and their relation to one another can be found in Duhem (1893/1996).

8). Now take, as an example, the description of the process of constructing a physical theory presented by Duhem (1906, 1914/1954, pp. 19–21). The subsequent operations Duhem describes in this passage (right after his claim that “A physical theory is not an explanation”!) may be seen as steps in the construction of an *explanans* for the experimental law (i.e. experimentally disclosed regularity) described in the *explanandum*. Those steps require us, amongst other things, to specify the hypotheses of a theory (propositions which “connect the different sorts of magnitudes”), establish the boundary conditions, and, finally, to show that the experimental law which the theory is supposed to account for can be logically derived from those hypotheses. Duhem would not have espoused the DN model, of course, as he could not possibly have consented to the idea that the truth condition for the sentences of the *explanans* can be met—rather, if anything, he would have argued that they are simply “accepted”. But this is beside the point. The lesson to be drawn from this comparison is that those who claim to find evidence for Duhem’s antirealism in his rejection of the explanatory capacities of the sciences are failing to acknowledge that (1) Duhem was using the term “explanation” in a very narrow sense, quite different from its contemporary usages, and (2) what he judged appropriate as schemes for scientific reasoning bear many similarities to what we have since come to associate with processes of scientific explanation.¹⁷

The problem of how to construe Duhem’s remarks on the question of the truth-value of physical laws in relation to the contemporary debate over scientific realism is similarly complicated by misunderstandings pertaining to his usage of the term “truth”. At first glance, the claim that physical laws are neither true nor false may seem like a straightforward rejection of anything resembling scientific realism, in that scientific realism generally asserts not only that those laws can be treated as either true or false, but also that our best physical laws are indeed true, or at least approximately so. However, Duhem’s employment of the classical concept of truth was stringent, to say the least. One can say that his stance concerning the truth-criteria of scientific claims was “uncompromising”: *conformity* of a law or a theory with reality means *full* conformity. His account leaves no room for ascribing a positive truth-value to statements that are “merely” approximate representations of some actual state of affairs. (At the same time, it would most probably be hard to find a contemporary scientific realist willing to seriously argue that physical laws are literally true). Consider the following example offered by Duhem (1894/1996): a botanist is searching for a rare species of tree, and asks two inhabitants of the countryside that he encounters for information. The first tells him that “There is one of those trees in this wood here”, while the second instructs him thus: “Take the third path that you come to. Follow it for one hundred paces. You will be at the very foot of the tree you are seeking”. The botanist follows these directions and finds the right tree, but to get to it, he has to take five more paces. Duhem concludes: “Of the two pieces of information that he [the botanist] received, the first was true and the second was false. Even so, which, of the two country people has more right to his gratitude?” (ibid., p. 110). Duhem used this example to convince us of the value of statements that serve to approximate to something while nevertheless being false.¹⁸ What is, however, also quite

¹⁷ More detailed analysis of Duhem’s usage of the term “explanation” and the controversies it has engendered can be found in Needham (1998, 2011).

¹⁸ This should not, however, be construed as an argument for a pragmatist approach to science. Duhem (1913/1987) distanced himself clearly from the pragmatist approach, arguing that there is more to a physical theory than just practical value. He summed up his position in these terms: “Differing from the various Pragmatist schools with regard to the value of physical theory, we do not under any circumstances count ourselves among their disciples” (ibid., p. 113).

clear from this example is his rigorous stance with regard to the concept of “truth”: for him, the statement made by the second resident of the countryside is not “approximately true”, but rather just plainly false. In the considerations that precede this example, he compares the laws of physics to the principles of common sense. One of the things distinguishing the former from the latter, he writes, is their precision: “It is the care in minute exactness and precise analysis that distinguishes physical science from common sense” (ibid., p. 109). However, that same precision makes physical laws “provisional and approximate”, and so false. Convinced of the great complexity of Nature he was sceptical about the possibility of ever formulating a law that could come to serve as an exact representation of this complexity. This is why he summarizes his deliberations by means of the following quote from Pascal: “Justice and truth are two points so fine that our instruments are too blunt to touch them exactly. If they do make contact, they blunt the point and press all round the false rather than the true” (quoted in ibid., p. 109).

2.4 Scientific Theories as Attempts at Describing Reality: Duhem’s Version of Convergent Realism

Duhem, then, was no naïve realist: he strongly rejected the view that our best scientific theories constitute literally true representations of the real world and that science could provide us with ultimate explanations of the phenomena it investigates. This rejection of naïve realism did not, however, lead him to embrace either instrumentalism or some other form of antirealism about science. Like some commentators before us (e.g. Lugg 1990), we see the key to understanding Duhem’s view of the epistemic potential of science in his conception of natural classification.¹⁹ In *La théorie physique...*, Duhem introduces the term “natural classification” after invoking Mach’s view of scientific theories as economical descriptions of experimental laws, which he deems insufficient as it ignores one of the crucial aims of scientific theories, which is to classify these. Classification, Duhem writes, imparts hierarchy and order to such economical descriptions. Still, he does appear to be thinking along similar lines to Mach when he points out that “[t]hese classifications make knowledge convenient” (Duhem 1906, 1914/1954, p. 24). At this point, however, he adds another dimension to the issue by considering the possibility that these classifications are natural ones. A theory will constitute a natural classification if its abstract terms, and the relations between these, reflect the real order of things. Given his views on the complexity of Nature and the limits of scientific cognition (discussed above), it should be quite evident that he would have rejected the possibility of formulating a theory that could reasonably be held to be an instance of such natural classification—on the grounds that Nature is too complex, and our tools too crude, to capture the truth about it. However, at the same time, he is far from considering physical theories to be purely artificial systems with no relation to the reality hidden behind the phenomena. While maintaining that a “physical theory never gives us the explanation of experimental laws; it never reveals realities hiding under the sensible appearances” (ibid., p. 26), he also suggests that

the more complete it becomes, the more we apprehend that the logical order in which theory orders experimental laws is the reflection of the ontological order, the more

¹⁹ It seems that all those willing to recognize the presence of certain realist motifs, at least, in Duhem’s philosophy of science, have sought to relate these to the concept of natural classification, while the majority of commentators, in viewing him as advocating antirealism, have practically ignored this notion altogether.

we suspect that the relations it establishes among the data of observation correspond to real relations among things, and the more we feel that theory tends to be a natural classification (ibid., pp. 26–27).

While the initial source for this conviction may be a feeling, of which “[t]he physicist cannot take account” even though they cannot simply dismiss it, Duhem finds the rationale for this same conviction in the “clairvoyant” properties of our best physical theories:

The highest test [...] of our holding a classification as a natural one is to ask it to indicate in advance things which the future alone will reveal. And when the experiment is made and confirms the predictions obtained from our theory, we feel strengthened in our conviction that the relations established by our reason among abstract notions truly correspond to relations among things (ibid., p. 28).

What needs emphasizing here, in the first instance, is that Duhem is seeking to justify his belief about well-developed physical theories’ approximating to instances of natural classification by formulating an argument very similar to that which, decades later, came to be called the “no-miracle argument” for convergent scientific realism. Like several of those later convergent realists, he is at the same time dismissive of the view that our best theories can be treated as literally true descriptions of the reality hidden behind phenomena, holding instead that they are both approximations (to the truth) and—given the progress of science—in the process of becoming ever more accurate. This steady progress towards natural classification is often not recognized by “the superficial observer”, who fails to acknowledge that theories are usually formed of two distinctive parts—an explanatory one that supposedly explains the nature of phenomena, and a representational one that functions to classify experimental laws, and that is solely responsible for predictive success (cf. ibid., p. 32). Drawing attention to the explanatory part, the superficial observer sees the history of science as a search for explanations that are proposed only to be sooner or later dismissed. But underneath these appearances, “by virtue of continuous tradition, each theory passes on to the one that follows it a share of the natural classification it was able to construct” (ibid., pp. 32–33). Summarizing his example of attempts to arrive at a theory of light refraction, Duhem likens the evolution of scientific theories—the successive failures of attempts at explanation paralleled by progress in theories’ predictive powers—to a mounting tide:

Whoever casts a brief glance at the waves striking a beach does not see the tide mount; he sees a wave rise, run, uncurl itself, and cover a narrow strip of sand, then withdraw by leaving dry the terrain which it had seemed to conquer; a new wave follows, sometimes going a little farther than the preceding one, but also sometimes not even reaching the sea shell made wet by the former wave. But under this superficial to-and-fro motion, another movement is produced, deeper, slower, imperceptible to the casual observer; it is a progressive movement continuing steadily in the same direction and by virtue of it the sea constantly rises. The going and coming of the waves is the faithful image of those attempts at explanation which arise only to be crumbled, which advance only to retreat; underneath there continues the slow and constant progress [of natural classification²⁰] whose flow steadily conquers new lands, and guarantees to physical doctrines the continuity of tradition (ibid., pp. 38–39).

²⁰ Curiously, Wiener’s translation is missing the phrase “de la classification naturelle”, which is present in both the first and the second editions of *La théorie physique...*, where we read: “Le va-et-vient des lames est l’image fidèle de ces tentatives d’explication qui ne s’élèvent que pour s’écrouler, qui ne s’avancent que pour

The history of science demonstrates, of course, that theories tend to be provisional not just in their explanatory aspect; physical laws, as described in their representational parts, are also subject to modification in order to account for new experimental data. This is one of the reasons why we can be never certain that our best theories constitute natural classifications. However, for Duhem, these will be adjustments in an endless process of progressing towards capturing reality:

The mathematical symbol forged by theory applies to reality as armor to the body of a knight clad in iron: the more complicated the armor, the more supple will the rigid metal seem to be; the multiplication of the pieces that are overlaid like shells assures more perfect contact between the steel and the limbs it protects; but no matter how numerous the fragments composing it, the armor will never be exactly wedded to the human body being modeled (*ibid.*, p. 175).²¹

As we have pointed out, the context in which Duhem was articulating his views concerning relations between physical theories and reality was very different from that of more contemporary debates over scientific realism. This means that any attempt to label his position a version of scientific realism of one kind or another is bound to raise questions. Nevertheless, the similarities between his argument for treating physical theories as approximating to natural classifications and those of later convergent realists for treating them as approximating to truth are evident enough to support the claim that Duhem was developing his own version of convergent realism decades before authors like Putnam and Boyd made the position popular. This claim gains even more support when considered in the context of other elements of Duhem's views on science and scientific cognition as discussed in the preceding paragraphs. Still, several authors have sought to undermine it, arguing that Duhem was either inconsistent in his views or neither a realist nor an antirealist in that he just pursued his own path, where this eludes such classifications. We shall therefore briefly discuss some verdicts of this kind, setting out our reasons for rejecting them.

2.5 Between Realism and Antirealism?

Duhem's remarks on the approximation of theories to natural classifications, in the sense of their coming ever closer to reflecting the "real relations among the invisible realities" (1906, 1914/1954, p. 28), may seem to leave little room for doubt as to whether he really believed this to be the case. Some commentators, however, while acknowledging his realist tendencies, have argued that his intuitions in this direction, together with his awareness of the problems affecting the realist account of science, led him to struggle for some sort of third way between realism and antirealism. McMullin (1990, p. 421), for instance, while commenting on the interpretation of Duhem's philosophy presented in Lugg (1990), insists that Duhem was "quite consciously trying to thread a middle way between two positions he regarded as extremes"—the positions of scientific realism and antirealism about science.

reculer; au dessous, se poursuit le progrès lent et constant de la classification naturelle dont le flux conquiert sans cesse de nouveaux territoires, et qui assure aux doctrines physiques la continuité d'une tradition" (compare both Duhem 1906 (p. 58) and Duhem 1914 (p. 32) with Duhem 1954 (p. 39).

²¹ It is worth noting that Popper, for whom, as we already mentioned, Duhem was an arch-instrumentalist, in his (2002) made use of a strikingly similar metaphor as regards the progress of scientific theories towards the truth: "Theories are nets cast to catch what we call 'the world': to rationalize, to explain, and to master it. We endeavour to make the mesh ever finer and finer" (pp. 37–38).

This middle way is supposed to have led him to espouse views similar to Fine's NOA. The main argument here revolves around the specific phrasing of some of Duhem's comments on theories as approximating to natural classifications: when suggesting that subsequent physical theories come closer to reflecting the ontological order of the world, he admits that one cannot prove this by scientific means alone, and that a scientist can only "suspect" or "feel" it.

Darling (2003) treads a similar course, opting for a *credo quia absurdum* kind of interpretation of Duhem's position. Stressing the wording of Duhem's realist claims ("feeling", "act of faith", etc.), she argues in favour of interpreting his position as a form of "motivational realism". This term was coined by Fine (1986) to describe the position of Einstein, who compared his own conviction about the intelligibility of nature to a religious feeling, and suggested that this sort of feeling is what motivates scientists by imparting meaning to their work. Einstein's "feeling", however, was not accompanied by any specific claims concerning the nature of epistemic relations between scientific theories and reality. Hence, Fine (1986, p. 111) characterizes motivational realism as "not a doctrine but a way of being, the incorporation of a realist imago and its expression in the activities of one's daily, scientific life". Darling finds this characterization appropriate for Duhem, who supposedly rejected realism on a rational level but endorsed it on an emotional one. She summarizes her position on this in the following terms:

The analysis demonstrates a sort of antirealism, but the intuitions urge us to believe (like the realist) that physical theory is approaching a logically unified and natural classification. In other words, critical reflection compels antirealist claims and an instinctive feeling compels realist ones. Because the latter are based on an innate feeling, I argue, Duhem would not endorse them as if they were on par with scientifically or logically confirmed hypotheses. For this reason, and because he grants his realist attitude a motivational role, I recommend motivational realism as the proper interpretation—the natural classification, if you will—of Duhem's philosophy (Darling 2003, p. 1135).

This, however, would suggest a rather extraordinary exercise in self-deception on the part of Duhem himself. One can easily imagine an honest "motivational realist" who, perhaps in Einstein's vein, believed in the epistemic potential of the natural sciences but did not at the same time indulge in any elaborate considerations as to the possible grounds for entertaining such a belief. However, it is harder to see how someone could be honest about their realist attitude if they were convinced that antirealism is the logical answer. Moreover, while Darling (like McMullin) is obviously right about Duhem's having been aware that his realistic intuitions could not be ultimately justified, this is hardly surprising given what scientific realism itself is—namely, a *philosophical* position.²² And this position (or belief, if one prefers) was neither left without any sort of justification, nor unaccompanied by systematic considerations about the nature of reality and scientific cognition—as, indeed, we have tried to show.²³

²² In addition, it is hard to know how to understand Darling's point that Duhem would not have endorsed realist claims as if they were on a par with scientifically confirmed hypotheses, given that he rejected the idea that the latter could be conclusively justified or that logic alone could compel us to accept them.

²³ According to Darling's summary of Fine's characterization of motivation realism, it is a position defined by three characteristic features: (1) that of being a realist attitude, (2) that of motivating and imparting mean-

On the other hand, could Duhem's realism have been something more than merely a "motivational" attitude, and yet still different from what we ourselves have been suggesting? Bhakthavatsalam (2015, p. 17) has argued that while being "epistemically much stronger than a motivational realist position", Duhem's stance should not be interpreted as driven by epistemological considerations similar to those advanced by later self-declared realists (especially those endorsing the no-miracle argument). This is because

[...] the rationale behind sustaining this [Duhem's] realist attitude was not that historical evidence compels us to hold it, as the no-miracles camps claim, but rather was a pragmatist one: it rationalized, on pragmatic grounds, the physicist's activity of pursuing theory (p. 11).

Bhakthavatsalam argues that ascribing some version of a no-miracle argument for scientific realism to Duhem is misguided for two reasons. Firstly, she points out that Duhem does not explicitly present his reasoning in a manner typical of the later no-miracle realists—i.e. he does not present it as a case of inference to the best explanation (IBE):

[In Duhem's argument, t]here's certainly no 'I', nor is there an 'E'. Duhem is not saying that we infer TNC [the thesis of natural classification]: TNC is an intuition, a feeling, not the result of an *inference* [...] (ibid., p. 13).

Secondly, and for Bhakthavatsalam more importantly, what distinguishes Duhem from later no-miracle realists is that rather than being interested in explaining the success of science, he was looking for a rationale for the pre-rational intuition that seems to be telling us that physical theories are embedded in a process of approximating ever more closely to natural classification. To prove her point, Bhakthavatsalam encourages us to focus attention on the line of reasoning presented in *La théorie physique...*, noting that Duhem introduces the thesis of natural classification as an intuition or feeling on the part of the physicist who is first confronted with the very structure of a physical theory—and thus also its elegance and efficacy—and only afterwards tries to ground this intuition in predictive success. The conclusion she draws from the form of Duhem's exposition is that "[...] the success of a novel prediction is not the basis for the TNC intuition, it only reinforces/vindicates it with 'particular clarity'" (Bhakthavatsalam 2015, p. 14).

How, then, is one to make sense of Duhem's construal of the idea of theories' coming ever closer to natural classification, if not as an endorsement of the position we have come to call "scientific realism"? The correct answer, according to Bhakthavatsalam, is that it served him as an "ontological principle" in the sense of Chang (2009): i.e. a principle we are led to embrace just to make our activities intelligible. Duhem, on Bhakthavatsalam's reading, subscribes to the thesis of natural classification as a principle that imparts meaning to his activity of physical theorizing.

Now, we are happy to grant—and have already hinted to this effect—that attaching labels to Duhem's philosophy that are really more at home in contemporary discussions is potentially problematic. Even so, the fact that Duhem's approach to justifying the claim—or "intuition", if one insists on this term—that physical theories are in the process of approximating to natural classifications (and so are closing in on being true representations of the

ing to scientific activity, and (3) that of not espousing a global doctrine or specific set of beliefs about reality (Darling 2003, p. 1134). In a nutshell, our main argument here is that where Duhem is concerned, this third condition is manifestly not fulfilled.

ontological order of things) differs from how later convergent realists have typically set out their argument does not make it a substantially different sort of argument. It is clear—and Bhakthavatsalam acknowledges this—that for Duhem, the predictive success of a theory provides a *justification* for believing that it is approximating to a natural classification. The order of Duhem’s exposition, however, is irrelevant here, and does not tell us much about his actual line of reasoning, since—as was already pointed out by Aristotle—the order of investigation need not be the same as that of presentation. What matters is that even if Duhem’s actual line of reasoning does turn out to be similar to Bhakthavatsalam’s reconstruction, it is hard to see why having realist intuitions prior to having arrived at a justification for embracing them should necessarily have any bearing on the character of one’s position. It rather seems to us that, as Worrall (1989, p. 100) once remarked, scientific realism is a view about science that most of us adopt unreflectively, and the question of scientific realism is a question about reasons for maintaining (or rejecting) this view. It would be a safe bet that many a self-declared scientific realist has started out entertaining realistic intuitions, and only afterwards (for whatever reason) sought justification for them. (Would Bhakthavatsalam argue that Putnam or Boyd were not no-miracle realists if she found them to have had realist intuitions prior to formulating their versions of the no-miracle argument?) To be sure, Bhakthavatsalam’s reconstruction might be considered somewhat plausible if Duhem had ventured explicit remarks concerning the nature of his stance, or the way in which he came to espouse it. However, if one opts to rely exclusively on the evidence of his own written words, and does not claim to have some special insight into what was actually happening in his mind when he was writing them, there is simply too much guesswork involved in the pursuit of accounts such as those just discussed. To be clear, we are not denying that Duhem’s realist attitude had a motivational or a pragmatic rationale—it certainly had. We just do not see the evidence, or reason, for claiming that it was only of this kind.

Nevertheless, we would regard talk about “Duhem’s third way” as not necessarily ill-conceived, and accept that McMullin was on the right track with his suggestion that Duhem was trying to forge a third way between the two extremes of scientific realism and instrumentalism. What he is mistaken about, in our view, is what, exactly, one of these extremes was. He describes scientific realism as “the view that the explanatory success of a scientific theory gives one valid (even though rarely conclusive) reason to believe in the existence of the underlying entities postulated by the theory” (McMullin 1990, p. 421). Such an understanding of that position (especially with its “rarely conclusive” part) does come relatively close to the contemporary understanding of what scientific realism (roughly) claims, but not to the “extreme” position Duhem himself was seeking to avoid, this being naïve realism (or, in the trichotomy of Popper (1956/1963), essentialism). Such realism, as we have already indicated, involves a belief to the effect that science is capable of providing us with ultimate explanations of how things really are. Too historically aware to simply grant science such capabilities, yet too much of a “believer” to accept a purely instrumental account of science, Duhem did not seek refuge in the agnosticism of NOA, but in a more sophisticated version of realism instead—one whose salient aspects we have tried to capture here.

3 Conclusion

As a final remark, let us point out that while we have touched on what we think are the most important elements of Duhem's philosophy of science that support taking him to be a sophisticated scientific realist, the mosaic is by no means complete. A closer look at certain aspects of that same body of thought passed over here (due to lack of space) could, we believe, make it easier for readers who remain less than wholly convinced to embrace our thesis. These would include, for example, his conception of the evolution of physical theories, along with his conviction that continuity of scientific knowledge is compatible with the emergence and acceptance of genuinely novel ideas. Let us just recall that for Duhem, genuine "theoretical revolutions" do not exist: even the most novel theories are, so to speak, "retouchings" of the knowledge accumulated by previous generations of scientists (albeit that at the same time this is not merely a process of "simple accumulation"). Another element of his philosophy that harmonizes with his realist orientation is his awareness of the subtle internal workings of scientific communities and research traditions, and his related accounts of the processes of knowledge production and empirical regulation of physical theories (where the latter is, for him, by no means a simple matter). Of course, none of these or other similar elements in his philosophy of science can count as decisive in themselves when it comes to debating its realist or instrumentalist orientation. For example, rejecting the idea of the discontinuity of scientific knowledge fits well with realism, but need not entail it. Still, should someone remain unpersuaded by our arguments and insist that all our evidence has been merely circumstantial, we would wish to indicate that there are still more such elements, and that these only become compatible with one another when one accepts the assumption that he was indeed a realist about the philosophy of physics.

By referring to certain aspects and motifs of Duhem's philosophy of science, we have tried to show that what is often taken to be this body of ideas is in fact a mere phantom: i.e. something that has little or nothing to do with his actual stance. Now, when over a hundred years have passed since his death, we would argue that the time has surely come to yield to the evidence of his own works and let the phantom be supplanted by the real thing.

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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