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French Conventionalism

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Abstract

The label French Conventionalism has generally been used to refer to Henri Poincaré and Pierre Duhem, who were seen as having the same view. Current scholarship presents a more complex picture of French philosophy of science in the early twentieth century. There are many conflicting interpretations of both Poincaré and Duhem, but at least we have learned that they do not have the same viewpoint. However, Duhem and Poincaré do share the idea that in some areas of science, we make a choice that is not empirically determinable. We can certainly say that there was an important set of issues being debated in French philosophy of science in the very early twentieth century and that these debates centered on the views of Poincaré and Duhem, no matter what label we use.

Introduction

French conventionalism is a term that has been used for a long time, generally to refer to Poincaré and Duhem, who were very widely cited in the philosophy of science. However, it was not a label used in France. Rather than conventionalism, the movement that was current in France at the time and to which Poincaré and Duhem were associated was called New Positivism, which was the preferred label given by the most extreme French conventionalist of the period, Édouard Le Roy (Le Roy 1901b, Brenner 2015, de Paz 2021). Neither Poincaré nor Duhem labeled their views as any sort of "ism," so the labels applied to them were always from others. Furthermore, the extent to which Duhem and Poincaré's views on science can be seen as the same is controversial. Interpreting Poincaré as using an underdetermination argument for his geometric conventionalism, Schlick seems to be the one who propagated the equation of Duhem and Poincaré that became ubiquitous among the Logical Empiricists and many who followed them (Stump 2023).

Schlick understood geometric conventionalism as a way to bolster his empiricism by rejecting Kant's a priori view of geometry (Shieh 2023: 258-9). Following Schlick, Carnap casually equates Duhem and Poincaré in a comment in *The Logical Syntax of Language*, showing how much the link between Duhem and Poincaré was taken for granted: "Thus the test applies, at bottom, not to a single hypothesis but to the whole system of physics as a system of hypotheses (Duhem, Poincaré)" (Carnap 1937 [1934]: 318). Popper adds to this equation by frequently citing the conventionalism of Poincaré and Duhem as a foil for a position that he opposed (Jarvie 1998: 2). It is quite telling that in at least one instance, Popper refers to the conventionalism of Poincaré and Duhem, but then only cites Duhem (Popper 1992 [1935]: 57). Popper does, of course, focus on testing so he is most concerned with Duhem's version of what has been called French conventionalism.

Contemporary scholarship no longer equates Duhem and Poincaré (Ivanova 2015) and some even express surprise that they could have ever been conflated:

> even by any stretch of the imagination, comparing Duhem and Poincaré seems rather far-fetched given their radical disagreement as far as the tenets on which the foundation of physical theory is based are concerned, that is to say the nature of the mathematical reasoning, the role of definitions, the existence of a continuity or not between the mathematical and physical methods, and the status of hypotheses in physics (Bonnet and de Calan 2009: 122).

Nevertheless, Duhem and Poincaré do share the idea that in some areas of science, we make a choice that is not empirically determinable. For Poincaré, a keystone of his philosophy is the idea that we make a conventional choice as to which geometry we use to describe space, however Poincaré's conventionalism is circumscribed. Only metric geometry and a few principles of physics are conventions. When Le Roy radicalized the viewpoint by saying that there is a lot of choice and freedom to choose conventions in science, Poincaré objects, arguing not only that conventions are quite limited, but that even those that remain are guided by experience.

Some argue that, at least in his mature writings, Duhem is not a conventionalist at all (Maiocchi 1990). However, Anastasios Brenner points out that Duhem uses the very word convention in early texts to express the idea that we chose definitions when we establish a science (Brenner 2022: 82). Principe (2017) also links the early views of Duhem to Poincaré, and Brenner points out that some of their contemporaries saw a link between their views as well (Brenner 2015: 20; 2021: 434). Duhem is most famous for rejecting the idea of crucial experiments in science, arguing that we must make a choice between accepting the negative results of an experiment and giving up our theory, or on the other hand, claiming that we can accommodate the results in existing theory (1991 [1906]: 188).

Perhaps the best way to distinguish Poincaré and Duhem on conventions is to point out that, for the most part, choice comes into play in science at very different stages in their respective views. For Poincaré, conventions are chosen at a quite early stage, before any application to physical theory. For Duhem, there is choice at the beginning, at least in his early writings, but the choice that he emphasizes and for which he is most famous comes in during and even after experiment, where scientists have to make a choice on how to interpret results. A vast literature strives to understand the views of each of these authors, with the limits of conventionalism making up a large part of the debates that have taken place. We can certainly say that there was an important set of issues being debated in France in the very early twentieth century under the heading New Positivism and that these debates centered on the views of Poincaré and Duhem (Brenner 2015: 29).

Historical Context

Thanks to historical work in the philosophy of science, even those who do not read French can now know a lot more about the context in which Duhem and Poincaré developed their views. Pioneers such as Gary Gutting (1998, 2001) and HOPOS stalwarts such as Anastasios Brenner (2003; 2014; 2021; 2022), Cristina Chimisso (2001, 2008; 2019), María de Paz (2021; 2023) and Warren Schmaus (1994, 2004, 2017, 2018, 2020, 2024) have made much progress in expanding the English language literature on the French tradition in the philosophy of science. The two luminaries Duhem and Poincaré were not the only French philosophers of science, even though the post-World War II English language literature in the philosophy of science could give the impression that they were. The central French philosopher of science in the early twentieth century was arguably Gaston Bachelard, although there are many others, such as Émile Meyerson, Leon Brunschvicg, Lucien Lévy-Bruhl, Abel Rey, André Lalande and Gaston Milhaud.

One could argue that French philosophy of science starts with Descartes, but for the figures that we are considering here, Auguste Comte is a more plausible beginning (Brenner

2021; Schmaus 2024). The debates in French philosophy of science at the turn of the twentieth century under consideration here can be seen as both a reaction against and a continuation of Comte's positivism. The group who founded the journal *Revue de Métaphysique et Morale*, for example, saw themselves as presenting a scientifically grounded alternative to positivism (and also an alternative to mysticism) (Soulié 2009: 11). It is important to note that almost all of Poincaré's philosophical articles were published in that journal. It is also important to note that philosophy had been revitalized in the Third Republic and that this emphasis on philosophy (as a replacement for religion) is an important element of the context of the period. Despite (or perhaps because of) its importance, women were excluded from philosophy given that the official school curriculum for girls did not include the study of philosophy (Bonnet 2022: 10-11). The title of Annabelle Bonnet's book—*The Beard does not make the Philosopher*—is a line attributed to Plutarch that has been picked up by French feminists. Given this current theme, it seems strikingly appropriate that Chimisso began her study of Bachelard with the philosopher's beard (Chimisso 2001: 11). Bachelard had a long beard and long unkempt hair, which made his image the archetype of a philosopher. The fact that girls could not study philosophy led to a ripple effect where women were not prepared for advanced study in philosophy and were therefore in effect excluded from academia with a few exceptions. In the history and philosophy of science, the most important exception is surely Hélène Metzger, who is well known for her histories of chemistry, but had a philosophy PhD and had very innovative things to say about historiography and the philosophy of history. She never got an academic position despite the high praise for her work. She was brought to the attention of an international audience by

Kuhn's mention of her work and finally has had a study devoted to it (Chimisso 2021; also see Bonnet 2022: 215 ff.).

The French tradition in philosophy of science is arguably unique in ways that made it a poor fit with Logical Empiricism. For example, French philosophy of science was profoundly historical from the beginning. They did not need Kuhn to alert them to the importance of history. Quite to the contrary, French philosophy of science strongly influenced Kuhn, who mentioned Koyré, Meyerson and Metzger as sources in the preface to *Structure of Scientific Revolutions* (Kuhn 2012 [1962]: xl).

It is interesting to note that Duhem and Poincaré were scientists, not academic philosophers, and that academic philosophers of science such as Bachelard and Brunschvicg were opposed to their conventionalism, and especially that of Le Roy, not surprisingly given that he was the most extreme (Chimisso 2001: 117-20). Even Le Roy had his degree in mathematics, not philosophy, though he was a protege of Henri Bergson, who was the dominant general philosopher in France in the early twentieth century. Conventionalism was thus the product of scientists reflecting on their profession and engaging in public debates of their time, both with philosophers and with the general public. Poincaré was a very well known figure in the press (Ginoux and Gerini 2012). The relation between science and philosophy, and between science and popular culture was at issue in debates over the use of conventions in science.

Poincaré

A central feature of Poincaré's view of science is that it makes essential use of conventions that are neither a priori nor empirical. Metric geometry cannot be determined a priori because there are consistent alternatives to Euclidean geometry. Poincaré argues that the metric geometry of space also cannot be determined empirically, a controversial claim that provoked disagreement from Russell (1898; 1905), Enriques (1914 [1906]) and many contemporary authors who write on the philosophy of space and time (DiSalle 2006; Earman *et al.* 1977; Earman 1989; Friedman 1983; Norton 1994; Sklar 1974 and 1986).[1] Adolf Grünbaum (1968) provides the classic modern defense of the conventionality of metric geometry, though his argument differs from Poincaré's. Given that Poincaré thinks he has shown that metric geometry cannot be determined either a priori or empirically, he claims that it must be a convention, that is, we make a choice of which geometry to use in physics.

It is important to note that Poincaré understood conventions as one of the types of hypotheses used in science. He saw the recognition of the role of hypotheses in science as an important alternative to both rationalism and empiricism. In *Science and Hypothesis* (1902; 2018), his aim is to show that both in mathematics and in the physical sciences, scientists rely on hypotheses that are neither necessary first principles, as the rationalists claim, nor learned from experience, as the empiricists claim. These hypotheses fall into distinct classes, with conventions being only one type of hypothesis used in science. Poincaré argues that, as conventions, geometric statements are neither true nor false, just as there is no real scale of temperature, rather just different systems that are conventionally adopted.

When he argues against any empirical determination of the metric geometry of space, Poincaré is often thought to be using something like the Duhem–Quine underdetermination

[1] The consensus view that conventionalism about the metric geometry of space is incompatible with our current theories of space has been challenged recently by Dürr and Read (2024).

thesis. However, this cannot be the correct interpretation of Poincaré's geometric conventionalism, because all empirical theories, and not just physical geometry, are underdetermined in the Duhemian sense. The major interpretive problem for those adhering to this epistemological interpretation of conventionalism is to explain why Poincaré holds that only metric geometry and a few principles of physics are conventional, not all of science (Stump 1989: 348; Friedman 1999: 73). As we see clearly in Poincaré's critique of Le Roy in *The Value of Science*, and even earlier in *Science and Hypothesis,* he firmly rejects the idea that there is a generalized conventionality of science (1905; 1902: 153; 2018: 100). Instead, I have argued, his thoroughgoing relational theory of space leads him to the view that the metric geometry of space cannot be determined empirically (Stump 1989).

Poincaré has often been taken to be presenting a hierarchy of the sciences in *Science and Hypothesis* and in later work, an interpretation that has recently been the subject of debate, with Dunlop (2016) rejecting the interpretation and Folina (2019) and I (Stump 2018) defending it.[2] While it is true that Poincaré does not use the term 'hierarchy' to describe his image of the relation of the sciences and mathematics, he does present the sciences in a specific order. I have argued that the only claim being made about the hierarchy is that each level of the sciences requires the previous one, a viewpoint that Poincaré endorses in the following remarks: "The purpose of mathematical theories is not to reveal the true nature of things. Such a claim would be unreasonable. Their only goal is to coordinate the physical laws that experiment reveals to us, but that we could not even state without the help of

[2] For an earlier interpretation of Poincaré's hierarchy and its relation to Comte, see Brenner (2003: 83).

mathematics" (Poincaré 2018: 143). In other words, we need mathematics in place before we can do any empirical science.

In *Science and Hypothesis*, Poincaré's presentation starts with arithmetic, where mathematical induction is essential, because only by using it can we make assertions about all numbers. Poincaré considers mathematical induction to be a genuine synthetic *a priori.* He next considers magnitude, which requires arithmetic, but goes further. Likewise, geometry extends our knowledge still further while requiring the theory of magnitude to make measurements, and arithmetic to combine numbers. Poincaré then considers classical mechanics, which again extends our knowledge while relying on the mathematics that came before it. Finally, he considers theories of physics, where we have genuine empirical results based on the mathematics, hypotheses and conventions that came before. The lower levels are necessary preconditions for higher levels, but they are not sufficient. It is very important to note that geometric conventions are not at the bottom of the hierarchy, rather, they come in the third step. This is consistent with the idea that there is something special about space, in Poincaré's view, that makes application of metric geometry conventional, rather than simply its place in the sequence of sciences.

Le Roy

A generation behind Duhem and Poincaré, Édouard Le Roy is most remembered for the critique Poincaré wrote of his views in articles in the *Revue de Métaphysique et de Morale* that were reprinted and expanded in *The Value of Science* (Poincaré 1905), although recently Le Roy has received a little more attention (Brenner 2003, 2015; de Paz 2021). Le Roy generalized and extended the role of conventions in science, thinking that he was following Poincaré. However, Poincaré disavowed Le Roy's view and argued for a more limited role of conventions in science. As de Paz points out, Poincaré was forced to clarify his own views in order to distinguish himself from Le Roy and was at pains not to be associated with the cultural movement of which Le Roy was a part (de Paz 2021: 447).

Le Roy obtained a PhD in mathematics, with Poincaré serving as the reader of his dissertation. He taught mathematics until 1914, when Henri Bergson designated Le Roy to replace him at the Collège de France. From 1921 to 1941 he held the chair of philosophy that had been Bergson's. Thus, he held a very prominent position in French philosophy. Le Roy argued in favor of Bergson's philosophy of freedom and extended it to the philosophy of religion, a move that Bergson praised. Although Le Roy was a devote Catholic, his books on religion were immediately put on the index. Le Roy was connected to the Catholic Modernist movement of the time, before it was shut down by the Pope in 1907 (de Paz 2021: 456).

Although Le Roy called his position New Positivism, Brenner points out that it is unclear whether he considers his view as a reform of Comte's positivism that aims to make it more consistent, or rather aims at throwing it out and replacing it with something completely new (Brenner 2021: 435). As far as science is concerned, Le Roy's central concern is to stop scientists and their philosophical allies from overreaching by trying to control all domains of human life (de Paz 2021: 451), that is, we might say that he was arguing against scientism. In particular, he wanted to support spirituality and to apply the idea of freedom of choice to science, which is where the idea of conventions came into play. It seemed to Poincaré that he was claiming that every aspect of science is conventional because to Le Roy science was nothing but a language and hence conventional, just as language is conventional (Poincaré 1905: 151; de Paz 2021: 453). Poincaré calls Le Roy's position, that we make up arbitrary categories that we impose on the world, nominalism (Poincaré 1902: 2; 2018: 2; 1905: 163; 1982 [1913]: 333), a view that Poincaré rejects and argues that science discovers real relations between things. Le Roy also argued that scientists create facts. Poincaré responded that while scientists create the language in which facts are expressed, the facts themselves are not created (Poincaré 1905: 162; 1982 [1913]: 332; cited in Brenner 2015: 23).

Duhem

Duhem is best known for his holism, where he argued that it is impossible to refute definitively any scientific theory, since theories and hypotheses must be tested in conjunction with auxiliary hypotheses concerning the experimental procedure. Therefore, a negative result only casts doubt on the whole, not on a specific hypothesis:

> . . . the physicist can never subject an isolated hypothesis to experimental test, but only a whole group of hypotheses; when the experiment is in disagreement with his predictions, what he learns is that at least one of the hypotheses constituting this group is unacceptable and ought to be modified; but the experiment does not designate which one should be changed (Duhem 1991 [1906]: 187).

Rather than derive a simple prediction from a single hypothesis, we always make multiple assumptions and draw on other theories involved in setting up the test. We do not directly falsify a hypothesis, but rather we only know that we made a mistake somewhere in our system of beliefs. It is worth noting that Duhem thinks that this applies especially to physics because when setting up an experiment, physicists must use parts of their own theory as auxiliary hypotheses and are thus at risk of arguing in a circle (Duhem 1991 [1906]: 183).

We need a theory before we can gather data, in order to know what to take as the facts relevant to a particular problem. Given that hypotheses and theories cannot be read directly from experimental facts, a strict form of inductivism is ruled out. Furthermore, there will always be alternative hypotheses that can account for a given set of facts. Since theories are created in order to explain facts, it is easy to make up theories that get all the facts right.[3] We need to find areas where theories make different predictions in order to test competing theories, what Bacon called a 'crucial experiment', which Duhem says is impossible. Holism threatens to make testing impossible, however, Duhem still believes that scientific consensus will emerge. While the pure logic of the testing situation leaves theory choice open, good sense does not.

> In any event this state of indecision does not last forever. The day arrives when good sense comes out so clearly in favor of one of the two sides that the other side gives up the struggle even though pure logic would not forbid its continuation (Duhem 1991 [1906]: 218).

Duhem claims that the history of science shows that while there is controversy in science, there is also closure of scientific debates. In Duhem's account of scientific theory choice, there is openness, since strict rules do not apply, but also objectivity. Most cases are settled empirically,

[3] Thus, Popper emphasizes prediction of new facts as the test for a theory and rejects the use of ad hoc additions (Popper 1992 [1935]: 20, 60, 131).

but the ultimate source of this objectivity is the epistemic agent—the scientist who acts as an impartial judge and makes a final decision (Stump 2007).

Conventions in General

Linguistic conventions are perhaps the broadest and purest form of conventions. Conventionalism has often been considered to be the view that logic, mathematics and some principles of science are true by definition. The basic idea is that there are conventions that implicitly define the terms used in a given area of science. Paul Horwich (1998) gives a concise overview of this understanding of conventionalism, the problems that it faces and potential solutions. Even though Duhem and Poincaré seem to start with the idea of linguistic conventions, each in their own way develops a viewpoint that is quite distinct and not based on linguistic conventions. Despite this, many have embedded discussion of their views in a broader notion of conventionalism and make that the focus, often making comparisons with other philosophers such as Wittgenstein. As I stressed, what is central for both Poincaré and Duhem is that we have to choose certain positions because we cannot, in their viewpoint, find an empirical answer as to which position is correct.

Poincaré uses a series of analogies to explain his conventionalist view of the geometry used in physics. He says that mathematics is the language of physics and that we can translate a physical theory that uses Euclidean geometry into one which uses non-Euclidean geometry in much the same way as we might translate a French text on physics into German (Poincaré 1900: 79; 1982 [1913]: 93, 338). Alternatively, he claims that in physics, Euclidean and non-Euclidean geometries are as interchangeable as Cartesian and Polar coordinates, or as interchangeable as metric and British units of measure, or as interchangeable as the Fahrenheit and Reaumur temperature scales (Poincaré 1886-1887: 90–91; 1899: 266 and 1982 [1913]: 82, 238, respectively). These passages unfortunately leave people thinking that Poincaré's conventionalism is based on linguistic changes, while in fact these are just analogies, not the argument that he uses for conventionalism. In order to understand Duhem and Poincaré it seems better to turn away from the general literature on conventions, which can be misleading.

Conclusion

Duhem and Poincaré both had a profound effect on the development of the philosophy of science. Often cited by the Logical Empiricists (Brenner 2022), their views have continuously been debated and discussed for the one hundred and twenty odd years since their original publications. Given their status as scientists who turned to philosophy, they have had a remarkable influence on the field and they transcend the national and linguistic boundaries that seem to have limited the international impact of other French philosophers of science.

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