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The rationale behind Pierre Duhem's natural classification

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ABSTRACT

The central concern of this paper is the interpretation of Duhem's attitude towards physical theory. Based on his view that the classification of experimental laws yielded by theory progressively approaches a natural classification—a classification reflecting that of underlying realities—Duhem has been construed as a realist of sorts in recent literature. Here I argue that his positive attitude towards the theoretic classification of laws had rather to do with the pragmatic rationality of the physicist. Duhem's idea of natural classification was an intuitive idea in the mind of the physicist that had to be affirmed in order to justify the physicist's pursuit of theory.

1. Introduction

Traditional accounts have pictured Pierre Duhem as a paradigm instrumentalist: they take it that he maintained that successful theories of physics do not tell us how nature operates, but are just convenient tools that 'save the phenomena' and represent and classify empirical laws. Recently though, there has been a spate of work centered around his idea of natural classification, maintaining that Duhem was a realist of sorts—maybe a no-miracles type[1] realist, or a plausibility realist.

Here I argue that none of these accounts are satisfactory. I contend that Duhem had a positive attitude to physical theory—especially to what he calls 'logically unified' theory—which arguably may be seen as a realist attitude. But as the traditional accounts go, he was by no means a scientific realist in the usual sense: he did not think physical theories made—or approached or approximated—true claims about underlying reality. Duhem was not a no-miracles type realist or a plausibility realist. I shall argue that the passages that are claimed in recent work to support these different realist readings of Duhem do nothing of the sort. Contrary to the underlying supposition of these new interpretations, Duhem does not ground his pro-attitude to logically unified theory in the past predictive success of the theory. Rather, he thought the physicist 'feels' or 'surmises' that theory affords a classification of experimental laws that progressively reflects a metaphysically true classification of things. Beyond this, Duhem is concerned not directly with the truth, in some sense or another, of the claims of successful theories in physics but instead with the pragmatic rationality of the physicist. By affirming that the classification of laws afforded by theory approaches a "natural" classification, 1) The physicist who bets on the side of predictive success avoids folly and exposure to ridicule in doing so; and 2) The physicist who pursues logically unified theories rationally justifies the pursuit by identifying a meaning or purpose to the pursuit. But again, contrary to the traditional instrumentalist accounts I think this does warrant a realist reading of his attitude to theory. But importantly as above, the rationale behind sustaining this 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.* Karen Darling's (2003) motivational realist reading of Duhem comes closest to

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[1] What is claimed is not that he was a scientific realist, but rather that he was a no-miracles type structural realist, like Worrall (1989): a no-miracles type argument for structural realism goes that it would be a miracle if our theories don't get the structures of reality (approximately) right. Here I don't get into arguments about the object of Duhem's apparently realist attitude—whether it was structure or something else. It is clear that that object was classification of laws and I leave it at that. Here I'm interested in his rationale behind the realist attitude.

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what I take to be the right interpretation of him among existing views, but I propose here that Hasok Chang's (2009) ideas on the intelligibility of activities and pragmatic rationality fit Duhem even better.

2. Natural classification—background and overview

A physical theory for Duhem represents, organizes and classifies experimental laws. Duhem discusses the case of "light vibration" for instance: he says it is given a direction, an intensity, and is geometrically represented by a line with a periodically varying length, and the components of light vibration will "will serve in writing some equations with partial derivatives and some boundary conditions, condensing and classifying with admirable order and brevity all the laws of the propagation of light, its partial or total reflection, its refraction, and its diffraction." (Duhem, 1906/1954, p.129) Duhem held that a theory should also be logically unified in that it should not employ multiple, incompatible ways of classifying laws.

Duhem rejects the view that theories go beyond this and explain phenomena in terms of underlying causes, for such explanation, for him, is the business of metaphysics. Physics for him is only concerned with studying phenomena, finding experimental laws, and organizing and classifying these laws. According to Duhem, it is beyond the means of physics to study the causes underlying the phenomena: the experimental method of physics does not have the resources to provide any positive metaphysical knowledge.

Further, Duhem argues that given the vast number of metaphysical disagreements and irreconcilable metaphysical positions (regarding the nature of matter, of light, of magnetism etc.) throughout the history of physics, the physicist should not get involved with such concerns. Physics, according to Duhem, must be entirely separate from metaphysics in its interests and concerns. He cites the perennial rampant disagreements between different metaphysical schools and argues that pursuing explanations would make physics subordinate to metaphysics; whereas physics, according to him should be an autonomous pursuit. Hence for him, metaphysical explanations have no place in physics.

For Duhem, physical theories provide an "economy of thought" and serve to store an otherwise intractable number of experimental laws—laws of the kind we discover and record in experiment and careful observation—in "condensed representations" (Duhem, 1906/1954, p.23). But "it matters little" for him whether the operations performed to combine various hypotheses together "do or do not correspond to real or conceivable physical transformations". (Duhem, 1906/1954, p.20) All that matters is that theories must be consistent with the laws they represent.

Three quotes from Duhem are illuminating when looked at together. First, in light of the above claims about theory being disconnected from metaphysical reality, Duhem allows a very limited criterion for calling a theory *true*:

D1: "Agreement with experiment is the sole criterion of truth for a physical theory." (Duhem, 1906/1954, p.21)

As above, in addition to effective representation, what is most important about theories for Duhem is that they *classify* experimental laws. Duhem says about theory,

> Thus alongside the laws which govern the spectrum formed by a prism it arranges the laws governing the colors of the rainbow; but the laws according to which the colors of Newton's rings are ordered go elsewhere to join the laws of fringes discovered by Young and Fresnel; still in another category, the elegant coloration analyzed by Grimaldi is considered related to the diffraction spectra produced by Fraunhofer. The laws of all these phenomena, whose striking colors lead to their confusion in the eyes of the simple observer are, thanks to the efforts of the theorist, classified and ordered. (Duhem, 1906/1954, p.24)

So Duhem means 'classification' quite literally: what he has in mind is just grouping and ordering. Is this classification in any way indicative of any features of a metaphysical reality? Not in any straightforward sense, for Duhem. Duhem says, "… physical theories are only a means of classifying and bringing together the approximate laws to which experiments are subject; theories, therefore, cannot modify the nature of these experimental laws and cannot confer absolute truth on them." (Duhem, 1906/1954, p.171) This line is again echoed in his *Essays*… (1996). He says, "Laws of physics retain exactly the same sense when a theory connects them as when they are dispersed and isolated." (Duhem, 1996, p.36) Theorizing—i.e. representing and classifying laws economically—has no effect on the character or content of physical science: "It remains physics; it does not become metaphysics." (Duhem, 1996, p.36) He adds,

D2: "A classification, in fact, is not a judgement. It can be convenient or inconvenient, good or bad; it cannot be true or false." (Duhem, 1996, p.37)

Despite D2, Duhem greatly valued the classifying power of theory. Not only did he think this classification was 1) "beautiful" (Duhem, 1906/1954, p.24), but also that 2) the elegance and efficacy of the classification persuade us to believe that it tends to reflect a *natural, underlying classification or order*; to believe that the relations among phenomena established by theory "truly correspond to relations among things" (Duhem, 1906/1954, p.28). A natural classification for Duhem is a limiting case of regular theoretic classification: a natural classification is a perfect, ideal classification of all experimental laws, and it is *natural* because it would perfectly mirror ontological relations between the realities behind the phenomena.

So in what seems like a stark contrast to D2, in the following remark on physical theory—and several such remarks throughout *Aim and Structure of Physical Theory* (A&S)—that is especially telling of his anti-instrumentalist dispositions, Duhem says,

D3: "…we feel that the groupings established by our theory correspond to real affinities among the things themselves." (Duhem, 1906/1954, p.26)

(This affinities-speak has motivated a structural realist reading of Duhem, which I will not discuss here. I'm only interested here in the rationale behind this "feeling".)

Importantly, Duhem says that the physicist cannot account for this conviction through the "method at his disposal", which is "limited to the data of observation". "It therefore cannot prove that the order established among experimental laws reflects an order transcending experience…" (Duhem, 1906/1954, p.27) But he continues, "…while the physicist is powerless to justify this conviction, he is nonetheless powerless to rid his reason of it…. He cannot compel himself to believe that a system capable of ordering so simply and so easily a vast number of laws, so disparate at the first encounter, should be a purely artificial system." (Duhem, 1906/1954, p.27)

Duhem expresses this idea of the physicist's intuition about theory progressively reflecting a natural classification—an ontological order—in several parts of A&S. Consider for instance,

> … [The physicist] will note that physical theory in its successive advances tends to arrange experimental laws in an order more and more analogous to the transcendent order according to which realities are classified, that as a result physical theory advances gradually toward its limiting form, namely, that of a *natural classification*… (Duhem, 1906/1954, p.297)