



Pierre Duhem's virtue epistemology

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Received 5 April 2006; received in revised form 12 August 2006

Abstract

Duhem's concept of 'good sense' is central to his philosophy of science, given that it is what allows scientists to decide between competing theories. Scientists must use good sense and have intellectual and moral virtues in order to be neutral arbiters of scientific theories, especially when choosing between empirically adequate theories. I discuss the parallels in Duhem's views to those of virtue epistemologists, who understand justified belief as that arrived at by a cognitive agent with intellectual and moral virtues, showing how consideration of Duhem as a virtue epistemologist offers insights into his views, as well as providing possible answers to some puzzles about virtue epistemology. The extent to which Duhem holds that the intellectual and moral virtues of the scientist determine scientific knowledge has not been generally noticed.

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Keywords: Pierre Duhem; Good sense; Virtue epistemology; Underdetermination

1. Introduction

Duhem is famous for his argument that it is impossible to refute definitively any scientific theory, since theories 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 theory. Duhem thus raises a central issue in the philosophy of science: How are theories chosen when empirical evidence is underdetermined? However, Duhem thinks that we can justifiably adopt and refute scientific theories, given that we are not limited to a deductive method. We have an intuitive reasoning ability, which Duhem terms

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‘good sense’, that allows scientists, like judges in a legal setting, to be able to weigh evidence and to be fair and impartial (Duhem, 1954, p. 218).

It has not been generally noticed the extent to which Duhem’s ‘good sense’ is an ethical term and the extent to which Duhem thinks that the intellectual and moral virtues of the scientist determine scientific knowledge. He says that scientists have to be neutral arbiters of theories in order to produce knowledge, thus demanding mature judgment on the part of the scientists. While Duhem does not have an epistemological theory, he does have an account of how scientists should treat evidence and how they should decide between competing theories. Thus, Duhem has important things to say about epistemology. We can better understand Duhem if we look at his discussion of evidence and theory choice in the light of recent work on values in epistemology and we can better understand virtue epistemology if Duhem can be read as an historical example of a philosopher who adopted such a position.¹ Duhem’s philosophy of science can also help answer one of the major open questions in current epistemological research—how virtue epistemology could provide a more complete account of knowledge than reliabilism.

2. Virtue epistemology

Beginning in about 1980, several philosophers started to advance theories of knowledge described as ‘virtue epistemology’. ‘Just as virtue theories in ethics try to understand the normative properties of actions in terms of the normative properties of moral agents, virtue epistemology tries to understand the normative properties of beliefs in terms of the normative properties of cognitive agents’ (Greco, 2004). The key point about virtue theories is that there is a change in what is taken to be primary in analysis of ethical terms. Virtue theorists argue that moral or epistemic virtues are basic. Rather than define a virtuous person as one who conforms to principles of morality, the virtue theorist defines a right action as that which would be done by a virtuous person. Likewise in epistemology, the strong form of virtue epistemology would define justified true belief in terms of what an intellectually virtuous person would believe (Blackburn, 2001, p. 16). Like contemporary virtue epistemologists, Duhem also takes knowledge to be dependent on the virtues of the knower. Scientists must have intellectual and, indeed, moral virtues in order to reach scientific knowledge, especially when choosing between empirically adequate theories. I will discuss the parallels in Duhem’s views to those of Linda Zagzebski, who treats epistemic evaluation as a form of moral evaluation (Zagzebski, 1996, pp. 6, 256), as well as taking the aretaic approach common to all virtue epistemologies, that is, taking the primary object of evaluation to be persons.

In the strong form of Zagzebski’s virtue epistemology, justified belief and other epistemic terms are defined in terms of epistemic agents. A belief is justified because it is the sort of belief that an intellectually virtuous person would have: ‘A justified belief is what a person who is motivated by intellectual virtue, and who has the understanding of his cognitive

¹ For an up-to-date survey of virtue epistemology, see Greco (2004). In denying the existence of precursors to virtue epistemology, Zagzebski may well be correct when she says that ‘... no epistemological theory is based on a carefully developed virtue theory’ (Zagzebski, 1996, p. 15), but she also notes that ancient and medieval philosophers maintained a strong link between intellectual and moral virtues (ibid., pp. 198–99, 211). Indeed, I suspect that it is only in the late modern period, with the establishment of the fact/value distinction that we see the now commonplace disconnection of morality and knowledge. Duhem maintains the traditional connection.

situation a virtuous person would have, might believe in like circumstances' (ibid., p. 241). Zagzebski also allows for a weaker version of virtue epistemology in which the belief that an intellectually virtuous person might have acts only as a criterion for justified belief, not as part of the definition:

...in a weak (merely agent-focused) virtue theory, what these 'definitions' do is help us fix the properties of right and wrong to their proper objects, but they do not tell us what makes right right or wrong wrong. (Ibid., p. 232)

Zagzebski hopes that all epistemic evaluation can be understood as part of a theory of value that encompasses both ethical and epistemic evaluation:

My purpose in writing this book is to draw more attention to the side of epistemology that overlaps with ethics and, in particular, to show how one form of ethical theory—a pure virtue theory—can be developed in ways that are rich enough to permit the kinds of evaluations of epistemic states that are crucial to epistemology. (Ibid., p. 336)

In particular, she proposes to derive the definition of justified belief from a cluster of intellectual virtues in the same way that the rightness of an act can be defined in terms of moral virtue in ethical theory (ibid., p. 38). Zagzebski hopes that the conceptual richness of the language of intellectual virtues will provide a better vocabulary of normative and descriptive terms for epistemology, much as virtue ethics has been thought to provide a richer vocabulary for moral evaluation (ibid., pp. 17–18).

Despite his holism and his famous thesis that it is always possible to save a scientific theory from refutation by empirical evidence, Duhem thinks that scientists are able to weigh evidence and make decisions and that the decisions they make depend on the intellectual and moral virtues of the scientist as a cognitive agent. Over and over again, Duhem returns to the image of the scientist as impartial judge:

We are thus led to the conclusion so clearly expressed by Claude Bernard: The sound experimental criticism of a hypothesis is subordinated to certain moral conditions; in order to estimate correctly the agreement of a physical theory with the facts, it is not enough to be a good mathematician and skillful experimenter; one must also be an impartial and faithful judge. (Duhem, 1954, p. 218)

Here and elsewhere, Duhem is explicit in linking epistemic virtues to moral qualities:

In the realm of every science, but more particularly in the realm of history, the pursuit of the truth not only requires intellectual abilities, but also calls for moral qualities: rectitude, probity, detachment from all interest and all passions. (Duhem, 1991b, p. 43)

The epistemic virtues mentioned by Duhem fit very well with some of those discussed by Zagzebski, such as impartiality, intellectual sobriety (anti-enthusiasm) and intellectual courage (Zagzebski, 1996, p. 13; quoting Montmarquet, 1993, p. 23).² While neither Duhem nor Zagzebski seem to take their lists of epistemic virtues to be final, the virtues mentioned are remarkably similar. In Duhem's requirement of detachment we see a

² Zagzebski (1996), p. 114, gives a much longer list of intellectual virtues when contrasting them with skills.

version of the second virtue mentioned above. The first virtue mentioned by Zagzebski, impartiality, is clearly very important to Duhem, given that scientists must be fair and impartial judges.

The link between Zagzebski's virtue epistemology and Duhem's philosophy of science goes beyond a shared ethical vocabulary of epistemic norms, however. Zagzebski's interest in applying a virtue ethics to epistemology follows from her desire to eschew rules in developing a theory of epistemic choice:

A second and more compelling set of considerations favoring a virtue approach to ethics is that more and more philosophers are becoming convinced that morality is not strictly rule governed. The idea is that there can be no complete set of rules sufficient for giving a determinate answer to the question of what an agent should do in every situation of moral choice. (Zagzebski, 1996, p. 18)

Duhem finds exactly this situation in scientific examples of theory choice. When should a scientist give up on a theory and move on to consider rivals? Duhem introduces his central notion of 'good sense' precisely because he considers rules to be insufficient for such theory choice in experimental science:

If the mathematical mind owes to the rigor of its approach all the force of its deductions, the penetration of the intuitive mind belongs entirely to the spontaneous suppleness with which it moves. No unchangeable principle determines the path which its free endeavors will follow. At one moment we see it, with an audacious leap, clear the abyss which separates two propositions. (Duhem, 1991b, p. 83; also see p. 126)

Virtue theories of ethics are attractive not only because they help explicate the normative aspects of epistemology, they also permit the flexibility of non-rule governed explanations of epistemic choice.

3. Duhem's epistemology of scientific theory choice

In his excellent study of Duhem (Martin, 1991), R. N. D. Martin successfully connects Duhem's historical and philosophical work by explaining their cultural setting. The key to both Duhem's historical and philosophical works, according to Martin, is the influence of Pascal. In history of science, Duhem is famous for discovering medieval science, thereby advocating a still controversial thesis on the continuity of science. Martin shows that the existence of medieval science surprised Duhem, causing him to interrupt his research and seriously revise his views, a rupture visible in *Origins of statics* (Duhem 1991a). Therefore, although he was a devout Catholic, Duhem was not looking for medieval science as Catholic apologetics. Indeed, Martin shows that Duhem was involved in a late nineteenth-century revival of Pascal, rather than the simultaneous revival of neo-scholasticism, so there is not necessarily any connection between Duhem's philosophy and scholasticism. For our purposes here, Martin's analysis gives us reason to think that Duhem should be read as inventing a modern version of virtue-based epistemology, rather than merely continuing the scholastic tradition.

In philosophy of science, Duhem derives his central notion of 'good sense' from Pascal. To understand Duhem's epistemology, it is crucial that a distinction be maintained between his term 'good sense', which is a moral virtue, and 'common sense', which, according to Duhem, consists of universally held propositions. Common sense, which is

emphasized by Martin (1991, pp. 113–115), plays a role in mathematics, where axioms are viewed as founded on intuition or common sense. Even here, one must have good sense to know when deduction leads one astray, but Duhem says emphatically that it is in experimental science, where there are no assumed axioms, but rather only approximate truths founded on experimental results, that good sense is essential:

More complex yet is the choice of hypotheses upon which will rest the entire edifice of a doctrine pertaining to experimental science, of a theory of mechanics or physics. Here the matter which ought to furnish the principles is no longer common experience, spontaneously available to every man from the time he leaves infancy. It is scientific experiment [expérience] . . . the physicist, in order to choose his axioms, will need a faculty distinct from the mathematical mind [esprit géométrique]. He will have to appeal to the intuitive mind [esprit de finesse]. (Duhem, 1991b, pp. 81–82)

So-called self-evident propositions that come from common sense can also be highly misleading in science, according to Duhem. Indeed, Duhem points out that the Newtonian laws of motion are contrary to common sense and are, rather, the product of a hard won struggle with scientific concepts (Duhem, 1954, p. 263). The distinction between good sense and common sense is important for our purposes here because only good sense is an ethical category. Justification of scientific theories is supposed to be special because science is empirical; however, there is no direct way to justify theories.

First, we need a theory before we can gather data, in order to know what to take as the facts that are 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. Hypothesis formation requires creativity and decisions about what is relevant (Hempel, 1966, p. 11).³ Secondly, there will always be alternative hypotheses that can account for a given set of facts. Just as one can always find an infinite number of curves that go through a given finite set of data points, no matter how large the set becomes, it is always possible in principle to come up with alternative hypotheses that accounts for all known facts. In order to tell which theories are good, we must test the theory against the facts, but since theories are created in order to explain facts, it is easy to make up theories that get all the facts right. This is why Popper puts such an emphasis on prediction of new facts as the test for a theory. Furthermore, rather than confirm a theory, Popper says that we must try to falsify the theory, that is, make predictions with the theory and then check to see if the prediction is correct. We need to find areas where theories make different predictions in order to test competing theories, that is, we need to find what Bacon called a ‘crucial experiment’. Testing is very important to Popper’s account of science because it is all that guarantees the objectivity of science. We have already admitted that there is no method for the discovery of hypotheses—any hypothesis is acceptable as long as it is testable. Furthermore, there is no way to prove that a hypothesis is correct. Rather, one must use the hypothetical–deductive (H–D) method and try to prove that a hypothesis is wrong.

It will be felicitous to follow Hempel’s presentation of the H–D method, since one of the examples he uses is from Pascal’s scientific work, the experiment with a barometer at Puy-du-Dôme (Hempel 1966). Pascal argued that if atmospheric pressure is responsible

³ Taking this point a step further, Popper argues that there is no method of hypothesis formation at all—there is no logic of discovery. The objectivity of science comes only from the testing of hypotheses, according to Popper.

for holding the mercury in a barometer at thirty inches at sea level, the mercury should be lower than thirty inches on a mountain top. Thus, Pascal predicted a consequence of the atmospheric pressure hypothesis and devised a way to test his prediction. If the height of the mercury in the barometer is a result of nature's abhorrence of a vacuum, then the mercury should stay at the same level, independent of altitude. Pascal's brother showed that the height of the mercury column did change, so the vacuum hypothesis is false.⁴

The third problem with empirical testing is the 'Duhem–Quine' problem, or holism. In order to test our hypothesis, we devise an experiment that may falsify it. However, as Duhem pointed out, we never test hypotheses in isolation:

...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, 1954, p. 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 hypotheses, but rather we only know that we made a mistake somewhere in our system of beliefs. For example, we assumed that nature's abhorrence of a vacuum would not change with increasing altitude, but maybe it does. Perhaps Pascal's experiment provides evidence that it does! The simple H–D schema is misleading because it makes it appear that hypotheses can be definitively falsified. According to Duhem, it is always logically possible to maintain your original hypothesis by adjusting your other assumptions. Taking one of the auxiliary assumptions to be false allows one to maintain the truth of the hypothesis under test even when the evidence discovered is negative.

In cases such as Pascal's experiment, Hempel claims that we might be able to rule out changes in the vacuum hypothesis with rules of method: you cannot change your theories after the negative result of an experiment, since that would introduce *ad hoc* hypotheses, and *ad hoc* hypotheses are not allowed in science. Thus, Hempel tries to give more rules—more method—in order to show how scientists can be forced to give up their hypothesis. However, he acknowledges that there are limits to his rules of method, stating that: 'There is, in fact, no precise criterion for *ad hoc* hypotheses ...' (Hempel, 1966, p. 30).

Duhem does not think that it is always wise to maintain one's hypotheses in the light of negative evidence, but rather than focus on method, Duhem emphasizes the choice of the scientist as a judge of theory—as a moral agent. Scientists must decide where the problem lies, when a scientific experiment comes out negatively (Duhem, 1954, p. 216). Duhem says that we always have two choices when faced with negative evidence: timidity, holding on to our existing theories and changing auxiliary assumptions to accommodate the new facts, or boldness, replacing the old theory with a fundamentally different one that accounts for the new facts and the old ones too (*ibid.*, p. 217). Duhem says both choices are rational and that we need 'good sense' to make a judgment about which path to take,

⁴ Unlike Hempel, Conant expresses skepticism about the Pascal brothers' result, saying that the results are too accurate to be seen with such primitive equipment. Conant (1948), p. 8.

yet there is no formal method by which to make a decision.⁵ In Duhem's account of scientific theory choice, there is openness, since strict rules do not apply, but also objectivity. The source of this objectivity is the epistemic agent—the scientist who acts as an impartial judge and makes a final decision:

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. (Ibid., p. 218)

Holism threatens to make testing impossible, yet Duhem believes that scientific consensus will emerge. While the pure logic of the testing situation leaves theory choice open, good sense does not. Duhem claims that the history of science shows that while there is controversy in science, there is also closure of scientific debates.

4. Why prefer virtue epistemology to reliabilism?

One large unresolved issue for virtue epistemology is whether (and if so, why) we need virtue over and above reliability in order to have knowledge. In Zagzebski's theory, reliability is a necessary but not sufficient condition for knowledge. Reliabilists claim that methods that generally lead to truth are both necessary and sufficient conditions for knowledge. Of course, Duhem is an instrumentalist, claiming that a virtuous scientist's judgments lead generally to useful theories, not true ones. Duhem's instrumentalism may be seen as an advantage, given that proving a link between intellectual virtue and truth seems a very daunting task. Of course, proving a link between intellectual virtue and utility may be no easier, but clearly any argument for the first will be automatically an argument for the second.⁶ I suppose that many epistemologists will see Duhem's instrumentalism as too weak, but I will pass over this issue and develop a Duhemian argument that reliability alone is not a sufficient condition for knowledge.

According to Duhem, good sense is reliable, given his instrumentalist reading of reliability. Is good sense more than merely reliable? It is hard to see how it can be. It is suspicious that when Duhem criticizes common sense as insufficient for experimental science, he immediately claims that common sense is unreliable (specifically, misleading). Is there anything more to virtue than reliability? Zagzebski develops an argument that seems to lean on the idea of accidental reliability to make her case that reliabilism is too weak (Zagzebski, 1996, pp. 305ff., esp. p. 308) Zagzebski's main example of reliable unvirtuous belief formation is a cognitively lazy person who just follows authority. This argument is unconvincing, since the reliabilist could easily dismiss this example by arguing that following authority is not, in general, a reliable procedure. After all, the only reason that Zagzebski's example provides a critique is that she can point to philosophers' overwhelming disdain for arguments from authority. However, the fact that authority is not taken to

⁵ Popper's account of the H–D method seems to push scientists toward boldness, a point that Lakatos raised in critique of Popper. If you get negative evidence, Popper says that you should give up your hypothesis, but his methodology is unrealistically strict—scientists often work on theories that have negative evidence. As Lakatos said, when they are first produced, scientific theories 'are submerged in an ocean of anomalies (or if you wish, counterexamples)' (Lakatos, 1978, p. 48).

⁶ van Fraassen makes a similar argument against scientific realism; any argument for the truth of a theory will be an even stronger argument for the theory's empirical adequacy (van Fraassen, 1980).

be reliable, it could be said, is precisely why this is not a counterexample to reliabilism. If, on the other hand, Zagzebski simply postulates that in this particular case, the authority is reliable, then it seems that the counterexample is undercut—accepting evidence from an authority that is known to be reliable should be acceptable (after all, your evidence for the knowledge claim is then strong). I take it that the case Zagzebski has in mind is one where we know (or postulate) that the authority is reliable, but the agent does not, hence the accidental reliability of the agent's knowledge claim. Again, the reliabilist can say that in general it is not a reliable method to base one's evidence on an authority not known to be reliable, thus discounting the validity of this counterexample.

The situation here seems similar to a comparison of consequentialist and virtue (or other non-consequentialist) theories in ethics. Just as the reliabilist can argue that reliability is all that matters—it is the only justification we need to call something knowledge, so a consequentialist can argue that only the outcome of an action matters—outcomes are all that we need to look at to say that an action is ethical. In the ethical case, it is fairly easy to find examples where many people say that even a good outcome does not justify an action, such as the case of using one person as a means to get some social benefit (killing one person in the lifeboat so that others have a better chance of survival, for example). Thus, consequentialism seems to justify acts very different from those justified by virtue theories, but is this true in the epistemological case? It is possible that every reliably method of acquiring knowledge will also be intellectually virtuous, in which case we cannot say, *pace* Zagzebski, that something is missing from the reliabilist account of knowledge.

Perhaps it will be helpful to think about impartiality, one of the virtues mentioned by both Zagzebski and Duhem, and see how it might possibility give us more justification than mere reliability. Should biased reliable claims count as knowledge? As in the case of the argument of authority described above, whether biased claims are reliable depends on the source. If one is biased towards a theory that is true (or at least reliable), then surely your judgments will be reliable. So bias does not guarantee unreliability. Therefore, impartiality is not a necessary condition for reliability. Is it a necessary condition for knowledge in the way that reliability is? We still do not have a way to answer this question, but the fact that the source of knowledge is so important does suggest a way of approaching the issue that could lead to a more productive dialogue.

I suggest that the best way to approach the issue of whether virtue epistemology is any better than reliabilism is to focus on what assumptions are being made about the field of choices that present themselves, and here Duhem's discussion of theory choice in science is very helpful. Duhem's main reason for advocating good sense is the complexity of theory choice in experimental science (Duhem, 1991b, pp. 81–82; quoted above). Duhem's point goes further than merely claiming that theories are complex, however. The central point of Duhem's holism is that theory choice is underdetermined by empirical evidence. In many cases in science, competing theories approximately match all empirical evidence, so both are reliable. Reliability is an insufficient criterion, the virtue epistemologist can argue, because it cannot decide between rival theories in many cases. For example, star charts based on the Ptolemaic system as well as the Copernican can be used reliably for navigation. This is precisely the point of Duhem's critique of empirical testing. Theory choice involves more than just checking reliability, other kinds of factors (other virtues of the theories) need to be taken into account. Therefore, Duhem and the virtue epistemologist can argue that their theory is better than reliabilism. Reliability is an insufficient criterion for deciding between competing scientific theories because it can leave the choice before two

equally good theories unsettled. The scientist must choose, so other criteria must come into play.

There are at least two kinds of responses to this situation that could allow one to reject virtue epistemology. The first is simply to deny that there really is a problem of empirically equivalent theories. One could claim that it will always be possible to find some empirical difference between theories or that one can block the revisionary moves necessary to maintain a theory in the face of negative evidence, as I outlined above when discussing Hempel's treatment of *ad hoc* hypotheses. This first response denies that the Duhem–Quine problem is real, a response that may be favored by many reliabilists. A second kind of response is to accept the Duhem–Quine thesis while denying that there are any further virtues that allow us to decide between theories. Duhem himself sometimes seems close to this conventionalist alternative:

No doubt the physicist will choose between these logically equivalent theories, but the motives which will dictate his choice will be considerations of elegance, simplicity, and convenience, and grounds of suitability which are essentially subjective, contingent, and variable with time, with schools, and with persons; as serious as these motives may be in certain cases, they will never be of a nature that necessitates adhering to one of the two theories and rejecting the other, for only the discovery of a fact that would be represented by one of the theories, and not by the other, would result in a forced opinion. (Duhem, 1954, p. 288)

According to conventionalists, there is simply no cognitive way to decide between empirically equivalent theories. Despite the fact that Duhem is sometimes read as a conventionalist, I maintain my reading on the basis of quotes given earlier that show that a scientist with good sense will choose between competing theories, despite the fact that it is possible to continue to defend a theory with sufficient adjustments to auxiliary assumptions. Duhem seems confident that scientific controversies will always be settled eventually, because good sense will weight so heavily on one side that no one will be able to maintain the other. In the passage quoted here, Duhem maintains that the objectivity of the theory selection rests with the scientist as an epistemic agent, not with nature. Furthermore, such a choice by a scientist with good sense will result in genuine knowledge, according to Duhem.

I cannot pretend to have given a defense of virtue epistemology here, but I do hope to have shown how Duhem's view of the choice between competing scientific theories leading to knowledge is comprehensible and may lend some support to virtue epistemology. At the very least, we can understand Duhem's view that scientists with good sense can arrive at genuine scientific knowledge if we take him to be advocating a form of virtue epistemology—a view that knowledge depends on the intellectual and ethical virtues of the knower.

5. Values and bias

We have seen both a common ethical vocabulary and a rejection of the adequacy of rule governed epistemology in Duhem's philosophy of science and in Zagzebski's virtue epistemology. I have argued that Duhem's holism provides a basis for arguing that reliabilism is not sufficient to characterize knowledge and that the virtues of epistemic agents need to be taken into account in epistemology. I have also pointed out some ways that epistemologists could reject Duhem's virtue epistemology. I will raise here some further

questions about Duhem's philosophy of science and consider the extent to which these questions also apply to virtue epistemology.

In history of science, Duhem is famous for discovering that important developments in science occurred in the middle ages. When combined with his forthright Catholicism, he has been accused of being a neo-scholastic apologist, a charge from which, as I mentioned above, he has been successfully defended by Martin. Another kind of possible bias shows up in Duhem's series of lectures published as *German science*. The fact that the material in this book was written as propaganda during World War One could not be more evident. Duhem himself tells his audience at the Catholic Students Association of Bordeaux University that 'I come before you to take my humble part in the national defense' (Duhem, 1991b, p. 6). The war context is submerged in discussions of scientific styles, but brought back again at the end of each lecture, where Germans are criticized and shown to have a style of thinking that must be subordinated to the French style.

Duhem's presentations are well worth study, not only for the elaboration of good sense and the discussion of historiography found in them, but also because his nationalism is counterpoised so strongly with his demand for impartial judgment in science. Is Duhem fair? He does praise some German scientists who rise above national style, such as Helmholtz, Clausius and Gauss (ibid., pp. 68, 73), and he stresses the value of the deductive method that he thinks represents the German style of science, even if deduction is insufficient and must be subordinated to (French) good sense. But he is still advocating nationalism as well as disinterested impartiality, a point which needs to be considered further. Duhem's essays in *German science* tell us interesting things about what he means by impartiality. Clearly he does not see a problem with being both a partisan and a scientist. So there is nothing wrong, according to Duhem, with a scientist who is mandated to be fair and impartial judge having many strongly felt values. Values and impartiality are not inconsistent in Duhem's philosophy of science, indeed, as we saw above, values are required for objectivity to be possible, given that they are part of what makes up good sense. The same point holds for virtue epistemology.

When Duhem claims that scientific judgment should be impartial, it is not values that he is most concerned to avoid, but rather metaphysical commitments. In his essay 'The physics of a believer', Duhem makes this point quite emphatically:

In fact I have constantly aimed to prove that physics proceeds by an autonomous method absolutely independent of any metaphysical opinion; I have carefully analyzed this method in order to exhibit through this analysis the proper character and exact scope of the theories which summarize and classify its discoveries; I have thereby denied these theories the power to draw the plan of any metaphysical system, as I have denied metaphysical doctrines the right to testify for or against any physical theory. (Duhem, 1954, p. 274)

Duhem does not rule out advocacy, as long as it is clear what kind of truth claims one is committed to in each field of knowledge. He can be a devout Catholic and a French partisan, as well as an impartial scientist. Duhem requires a separation of fields of knowledge; his holism does not extend beyond science. The ethical and political values one holds cannot be connected directly to the scientific choice one is making. Loving your country will not necessarily interfere with a choice between, say, the Copernican and Ptolemaic systems, but perhaps national pride could interfere with scientific judgment when a rival theory is developed in a rival country.

Acknowledgements

I would like to thank Linda Zagzebski and Abrol Fairweather for introducing me to virtue epistemology and for helpful comments on an early version of this paper. Comments from an anonymous reviewer also helped improve this paper.

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