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Hacking, Popper, Theories and Fictionalism

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Abstract Fictionalism along with falsificationism may provide us with a realist picture of science that allow us to sidestep problems that arise due to faulty realist conceptions of the three core stances, which we see notably in Stathis Psillos' work. This examination advances current discussions of scientific realism because it re-casts a past debate in an entirely new light, giving new hope and life to a topic that has been thought thoroughly exhausted. The author supports the position that a scientific theory can be true and yet have nonexistent entities.

Keywords Scientific Realism, Falsification, Experimentation, Fictionalism

1. Introduction

This paper traces, independently and through another route, reasoning similar to that found in Roman Frigg's recent work "Fictionalism and Scientific Representation." Much of my view is a variation of Vaihinger's. But in addition, Frigg adds to this view the work of Cartwright, Maxwell, McCloskey, Sklar, and Godfrey-Smith. Importantly, this paper points out that "fiction" is not merely a *failure to refer*--it is *not necessarily the case*. This take is not entirely apparent in Vaihinger's Philosophy of 'As If'. In this respect, I am in agreement with the more contemporary view. Part of my novel take is that the possibility of a successful correspondence here dovetails with a Popperian view, among other things. In general, one garners an appreciation for the poignancy of fictionalism when approaching the topic of scientific realism. It is important to note that astute philosophers of science have ubiquitously recognized two noteworthy components commonly involved in debates about scientific realism: entities and theories.

Worrall and Devitt are the two big names I will credit with promoting the following distinction I plan to discuss, although I will focus on a short paper written by Ian Hacking in 1982 entitled "Experimentation and Scientific Realism" (which can also be found in his book *Representing and Intervening*). We will see that the semantic pillar of scientific realism as phrased notably by Psillos in 1999 must be radically changed or expunged from most contemporary accounts of scientific realism (SR), and it is a matter of simple economy to be rid of it. Psillos boldly stated that "if scientific theories are true, unobservable entities they posit do inhabit the world." [1]

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Taken alone as a proposition, this thesis makes a claim that is hard to validate in any satisfactory way. Theses such as these (there are three on most accounts) comprising SR's spinae erectus, if you will, require sensible formulation for a suitable conception.

Despite where the particular philosopher stands in relation to the ontic, semantic, and epistemic pillars of SR, the epistemic or ontological status of unobservable entities is a challenge realists must face. In order to fully explain skepticism about an external reality, we might be required to revisit old Humean or Cartesian concerns. Although these earlier philosophical concerns would not altogether be an unsuitable point of discussion, a full exegesis on the contemporary pertinence of these views would be beyond the scope of this short paper. What we need to bear in mind for the time being is that the semantic thesis on many accounts makes an epistemic claim. Hacking writes:

> I leave aside questions of methodology, history, taxonomy, and the purpose of experiment in natural science. I turn to the purely philosophical issue of scientific realism. Simply call it "realism" for short. There are two basic kinds: realism about entities and realism about theories. There is no agreement on the precise definition of either. Realism about theories says that we try to form true theories about the world, about the inner constitution of matter and about the outer reaches of space. This realism gets its bite from optimists: we think we can do well in this project and already have partial success. Realism about entities —and I include processes, states, waves, currents, interactions, fields, black holes, and the like among entities—asserts the existence of at least some of the entities that are stock in the trade of physics. [. . .] The two realisms may seem identical. If you believe a theory, do you not believe in the existence of the entities it speaks about? If you believe in some entities, must you not describe them in some theoretical way

that you accept? This seeming identity is illusory. [2]

2. Four Possible Views

What is it to say that a theory is true, although its theoretical terms may not refer to actual unobservable entities? Phillip Kitcher wrote: "No sensible realist should ever want to assert the idle parts of an individual practice, past or present, are justified by the success of the whole." [3] There have been various attempts to make this more precise from various angles, to be sure. How can a theory be true if it does not get all the details correct? Epistemology takes detailed and tricky turns in the hands of Edmund Gettier and Robert Nozick, as the history of philosophy has seen. How do we know which theories—and in particular—which *parts* of theories, accurately correspond to the world? Are we *approximately* right? Our minds turn perhaps to Richard Boyd's "background" theories, or secondarily to the concepts underlying inference to the best explanation.

A third possibility to entertain in the face of incessant uncertainty is recourse to a weaker truth predicate (maybe we know or we *don't* know). We can say along with Popper that a theory may have passed a crucial test. We can also say with the pragmatist that a theory can have more instrumental value than another. Without relying too heavily on instrumentalism or pragmatism, we might say my view is compatible with the D – N theory of explanation.

If we want to call a theory either true or false, and at the same time are quirky embodied creatures that are far from omniscient, what is our relation to theoretical entities and theories themselves? Differing positions in the philosophy of science lead us to consider four possible views:

Table 1

(1) A theory might be false and have nonexistent theoretical entites. (Hacking)	(2) A theory can be false and have nonexistent theoretical entities. (Laudan)
(3) A theory might be true and have existent theoretical entities. (Psillos)	(4) A Theory can be true and have nonexistent entities. (Worrall, Devitt)

3. What does Falsification Tell Us?

While looking at this, it is important to bear in mind Karl Popper's hypothetico-deductivism. Loosely: although theories may be either true or false, we will remain in the dark until we *prove* which ones are *false*. A consistent look at the table would suggest we could side with him here, and maintain that there are things called facts, and yet theorists may get things *wrong* (which might leave open the door to how conclusive falsification is, as well). This also resonates strongly with Aristotle's early writings on classical logic. Epistemic states with respect to entities that are constituents of that theory may change, and in some cases, it turns out the referent is not there. Falling back on instrumental and/or experimental success, or even the causal theory, or consiliences, there may be cases wherein "false theory" in these cases may be a misnomer, however. I call (2) the "preferred scenario". As Wilfrid Sellars put it: "To have good reason for holding a theory is ipso facto to have a good reason for holding the entities postulated to exist." [4]

Historically, though, it has been shown that to say that one of the theoretical terms standing for an unobservable did not refer may pan out may be true as well. If it is the case that Lavoisier did indeed hold the phlogiston theory along with the oxygen theory, as Kyle Stanford suggests, it may simply "agree" with the oxygen principle, which was responsible for "the phenomena of combustion and calcination." [5]

However, Hacking comments further. "Experimenters are often realists about the entities that they investigate, but they do not have to be so." [6] Isaac Newton's theory of gravity, also known as Newton's law of universal gravitation, was first formulated in his 1687 *Philosophiæ Naturalis Principia Mathematica*. Newton's law was later superseded by Albert Einstein's theory of general relativity (1915-16), but it still may be considered true in domain-specific applications. More to the point about entities, what Mendel had originally conceived as a gene has undergone a change since its inception. Putnam says: "Surely the gene in molecular biology is the gene (or rather, "factor") that Mendel intended to talk about!" [7] A principle of charity was used in transporting Mendel's gene from T1 to T2. Indeed, he was not able to isolate the particle. This was a case wherein a posited unobservable turned out to exist, although the term he used may not have referred perfectly to the entity he meant to describe. So at least in certain cases we see fictionalism is apt.

Although arguably Mendel's theory may have been, at base, obliquely successful in a referential sense, there have been historical instances of complete referential failure. There may be, within some part of the theoretical framework, a non-referring term. This does not mean that every proposition in a theory should be predicated with an F. Quine knew this could be the case with his web of beliefs, as did Duhem with his auxiliary assumptions. Boyd points out a similar phenomenon with his notion of background theories. Importantly, scientists can revise the background information. Theories come along with a number of possibly falsifiable propositions. Notoriously, Priestley held the phlogiston theory after Lavoisier's oxidation theory of combustion and respiration superseded it. He published a pamphlet in 1800 entitled the *Doctrine of Phlogiston Established*, which he later expanded in 1803. Priestley's discovery of a colorless gas that allowed a candle to burn and a mouse to breathe also addressed questions of why and how things burned and allowed rodents to live. As Stanford argued in the Lavoisier case, phlogiston was in Priestley's set of beliefs. In a correspondence sense, it may be accurate to call a theory true, although there may be an unobservable hypothetical "x" in the equation that does not, in actuality, have a referent. Chakravarty writes:

> This is precisely the sort of conclusion that dismays critics of the appeal to the causal theory of reference. It trivializes reference, they claim, to say that Priestly was talking about oxygen (assuming that his experiments involved inter alia the presence or absence of oxygen as opposed to phlogiston), but realism appears ridiculous if one says that assertions about phlogiston and oxygen are mere linguistic or notational variants of one another. [8]

The causal theory of reference is again, the idea, for example, that "blue" may be described by the thing or "stuff" that causes the visual blue sensation detected by our eyes. But I would think the above would be a problem with pragmatist views, although Chakravarty points to an underdeterministic issue as well. The causal theory used exclusively does have its downside. Descriptively it fails, if not in terms of truth and falsity. Fictionalism about entities is a viable solution, and this is obvious in the Mendelian gene scenario.

4. Fictionalism –The Possible Way Out

Despite cases of semantic slippage or what have you, a problem that resurfaces in the philosophy of science is that we have continual claims that we ought to treat hypothetical terms as *literally* referring. Hacking quips about theories that correspond: "There is an important experimental contrast between realism about entities and truth about theories. Suppose the latter view is the belief that science aims at true theories. Few experimenters will deny that. Only philosophers doubt it." [9] By the other token, they might not get the model right. Models and theories can change over time as new evidence is discovered and alterations are made. John Dalton's model of the atomic world, for example, is not the same as the model used by physicists today. Dalton proposed his model of an atom, often referred to as the "billiard ball" model, where he defined an atom to be a ball-like structure. [10] This model has since been updated to account for new discoveries such as the atomic nucleus and electrons.

Similarly, while we can use tools like the electron microscope to observe and study microbes, for example, we still have a limited understanding of these particles. The wave-particle duality of electrons, wherein they display properties of both waves and particles, is still a subject of study and debate in the field of quantum physics. In science, models are useful because they help us understand and make predictions about the world around us.

Fictionalism is, in short, the thesis that the theoretical unobservables are not necessarily real, although they are beneficial in some way. Arthur Fine, who promoted his own view in response to arguments in the realism/anti-realism debate, wrote:

> 'Fictionalism' generally refers to a pragmatic, antirealist position in the debate over scientific realism. The use of a theory or concept can be reliable without the theory being true and without the entities mentioned actually existing. When truth (or existence) is lacking we are dealing with a fiction. Thus fictionalism is a corollary of instrumentalism, the view that what matters about a theory is its reliability in practice, adding to it the claim that science often employs useful fictions. Perhaps the fullest expression of fictionalism occurs in Vaihinger's once popular philosophy of 'as if'. [11]

Our agnostic view sides with antirealism to the extent that hypothetical or theoretical entities do not "have to" be real. A realist can be agnostic about unobservables, like Mendel positing a "gene" without seeing it, or even the conception of Democritus' atom. As Popper pointed out, we might view a hypothesis as a guess. Even a mature theory may have parts that do and parts that do not refer. Richard Boyd's background theory thesis here rings true. Components of past theories may have had a degree of accuracy attached to them. These are components that may be passed forward, in the case of progressing theories. Psillos' notion of approximate truth is described in this way. Boyd and Psillos' versions might be indicated by instrumental or experimental success.

Both the pragmatists and Popper had noteworthy reasons prompting their respective systems. In our view, verisimilitude, truthlikeness, probable truth, and warranted assertibility are viable alternatives, and I remain pluralistic about mutual exclusivity with correspondent truth, although usually it is favored and simply must be if science is to remain science. Antagonism here is neither necessary nor descriptively beneficial. It may be wise to keep in mind they denote different things. Indeed, I may feel warranted in asserting something, and I might be justified, but I might be indifferent as to whether it is ultimately true or not. There is nothing forbidding me from saying "the straw looks bent" or "that seems to work".

Approximate truth is tied to the idea of epistemic optimism in the debate we cited. As time moves on, will we get closer to "the capital 'T'"? The above characterization which mentioned Boyd and Psillos is, in a way, highly antagonistic to Kuhnian accounts of the history of science. [12] Their descriptions highlighting approximation suggest not an incommensurability but a continuity. In astronomy, the heliocentric view was built upon previous observations. This historical example shows us that a new cosmology was not erected to explain the movement of celestial bodies out of the blue.

At the age of 27, Kepler became the assistant of the wealthy astronomer, Tycho Brahe, who asked him to define the orbit of Mars. Brahe had collected a lifetime of astronomical observations, which, upon his death, was bequeathed to Kepler. [13] Using these observations, Kepler found that the orbits of the planets followed three laws. The orbit of a planet is an ellipse; the second law states that a planet moves faster when it is closer to the Sun and slower when it is farther away. The third law states that the time it takes for a planet to complete one orbit around the Sun (its orbital period) is related to its distance from the Sun. [14]

Brahe's system, prior to that, retained parts of the Ptolemaic system. This is an excellent example of Boyd's view that knowledge is retained from previous theories.

There may be cases, and I think Hacking and Psillos agree, in which a theoretical entity may turn out not to exist, and a theory may be false. If the humors go, then the humoral theory of medicine goes along with them. This is the picture Larry Laudan had in mind with his 1981 list of "theories" . . . This is not an exhaustive picture of philosophical and scientific accounts. The unconventional focus on Hacking's discovery not only clarifies problems in the philosophy of science, but also says something overlooked about a potentially creative and organic processes of what it means to hypothesize. [15] This may have involved the concomitant process mentioned briefly in the writings of Popper, Peirce, and Hume. However, the recurrent problem of splicing entity and theory together (you can even find this in Worrall) has to do with semantics. Micheal Devitt was adamant on this point: realism is not concerned with semantical questions, confusion about unobservables can result. I admire his frankness when he asserts: "Most scientific statements about unobservables are (approximately) correspondence-true. [. . .] Why would people believe this?" [16] The fusing together is itself a problem.

5. More on Hacking's View

For clarification, it might be pertinent to review some of the views present in our table. Popper's falsificationist view says that one could take it that theories are what we should remain agnostic about, rather than entities. We must keep in mind our major concentration is on the entity/theory rift and possible combinations in connection with truth and factual reference. Psillos wrote:

> [T]he issue at stake is different. It is this: can we assert that electrons are real, i.e. that such entities exist as part and parcel of the furniture of the world, without also asserting that they have some of the properties attributed to them by our best scientific theories? I take it that the two assertions stand or fall together. [17]

But importantly we see that the relationship between theory and unobservable entities does not seem to always fit a positive pattern, and others have taken note. The claim above also mentions the negative instances, such as those illustrated by Laudan's list. If there are no epicycles, then so much worse for Ptolemaic astronomy.

However, it may be argued that these dismissals may be a tad rough and ready. Boyd and others pointed out that in practice this picture is a bit too simplistic. One cited case is the Michelson-Morley experiment, which was an attempt to detect the velocity of the earth with respect to the hypothetical luminiferous ether, a medium in space proposed to carry light waves. The experiment was first performed in Germany in 1880-81 by A.A. Michelson and later refined in 1887 with his colleague Edward W. Morley at what is now Case Western Reserve University in Cleveland, Ohio. [18] Although the luminiferous ether was dropped from classical physics, many of the theories and equations that were developed based on the assumption of its existence are still used today. Worrall's example cites Fresnel's equations, which describe the behavior of electromagnetic fields, [19] which were originally based on the assumption that electromagnetic waves were transmitted through an ether. These equations are still used today because they accurately describe the behavior of electromagnetic fields, even though the ether has been dropped from the theory. Maxwell's later theory was mathematically similar. Although there may be no ether something in the theory was retained. Hacking was a realist about entities and not theories. We have mentioned briefly views that have cited simply the irrationality of accepting an entity based upon theoretical validity. He draws attention the instrumental value of, perhaps, an imprecisely defined x, although with Laudan the actual theoretical component remains unimportant in contrast to the existence of a factual counterpart to x. Furthermore, theories are temporally constrained on his view, entities are not, and also for experimental reasons that one can use theoretical entities in subsequent experiments, including waves, laws, etcetera. He wrote: "[t]here is [. . .] no present set of theories that one has to believe in. If realism about theories is a doctrine that one has to believe in. If realism about theories is a doctrine about the aims of science, it is laden with certain kinds of values." [20]

6. Conclusions

I, too, disagree with the assessment that we have to believe in theories. This was illustrated by our table. My sprinkling of comments on Popper was meant, partially, to foreshadow fallibilism about theories. In loosely endorsing Popper's deductivism, we will not say that we are epistemically committed to a theory. A theory may be true or not. This is ontologically realistic if one endorses correspondent truth. At the same time, one can remain fictionalist about entities. It looks to be the case if we are to remain both honest and precise, that theories once endorsed as true may turn out to be false, and an entity once thought to exist, may not. Yet again, it is not logically impossible that we may have cause in the future to entertain "entities" such as an ether of some kind. Furthermore, it might be the case that falsified theories could be resurrected in some way. This paper in turn hopefully provided some housekeeping or clarification in terms of the debate. Kitcher, Devitt and others pointed out that even if we take a theory to be "approximately true" there is a necessary argument from the opposing camp requisite for the endorsement of the unobservable theoretical entities posited therein to be necessarily existent. Similarly, a move to splice "the unobservable x" as "the theory" is either an oversight or imprecise on earlier views. In the latter case we are dealing with truth, and in the other, what is real. Fictionalism provided a missing piece.

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