

ARTHUR FINE

THE SCIENTIFIC IMAGE TWENTY YEARS LATER¹

What we represent to ourselves behind the appearances exists only in our understanding . . . [having] only the value of memoria technica or formula whose form, because it is arbitrary and irrelevant, varies . . . with the standpoint of our culture.²

I. INTRODUCTION

*The Scientific Image*³ arrived in 1980 like a breath of fresh air. Although in the introduction van Fraassen counts me among the realist foot soldiers, at just that time Micky Forbes and I were engaged in rethinking the whole realism/antirealism issue. The result was NOA. Van Fraassen's powerful and enlightening monograph encouraged us in that project. If Mickey and I are parents of NOA, then Bas is perhaps a godfather. Paul Teller too, since he was among the people then who helped us refine our ideas as they developed. So, today's symposium feels rather like a family reunion. Of course, notoriously, such family events can be quarrelsome. But, despite some criticism to come, I do not expect today's event to have that character.

Anyway, there is already plenty of criticism of constructive empiricism, much of it directed at certain features that are highlighted in *The Scientific Image*. I have in mind, in particular, two distinctions: one between what's observable and what's unobservable and the other between belief and a strong notion of acceptance-with-commitment. I confess to being among the critics, which is too bad. For criticism on these topics, I think, has deflected a lot of thinking away from what now seem to me to be the more central and challenging ideas of constructive empiricism. To try to bring that out, in my presentation today I would like to try locating constructive empiricism among its philosophical peers and in a way



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that shows much of the criticism – including mine – to be largely off the track.

Although constructive empiricism is certainly a kind of empiricism, what I want to argue today is that it is more enlightening to locate it as a kind of instrumentalism. Now, so far as I know, there are really only two philosophical programs that have been called instrumentalism. There is the program I learned about in graduate school. That's the instrumentalism that became a whipping boy for realism in the 1960s and which realists often hold up today as a degenerate example to frighten those who would question their doctrine.

II. FAUX INSTRUMENTALISM

Karl Popper began this unfortunate episode in his 1956 essay, "Three views concerning human knowledge", where Popper attacks a view he labels "instrumentalism", but never defines very clearly.⁴ There is a clearer statement of the view that Popper seems to have in mind in a 1928 manuscript of Frank Ramsey's. Ramsey does not use the term "instrumentalism" at all but describes instead a

radical philosophy of science ... on which science begins with observation and laws which assert observed uniformities; and these laws are then explained by theories which introduce undefined entities and relations. Some of the statements which a theory makes about these undefined entities are to be interpreted by means of a 'dictionary' in such a way that they can be proved true or false by observation. But other statements about undefined elements have no such interpretation, and are regarded as having no 'truth', except such as can be derived from the satisfactoriness of the theory of which they form a part.

Ramsey adds that these statements about undefined entities are

interesting as showing that a large body of sentences, which appear to express judgments and are manipulated according to the laws of formal logic may not express judgments at all.⁵

Ramsey's reference here to a "dictionary" almost certainly connects with his reading of Norman Campbell,⁶ and Ramsey himself also associates this view with that of Hertz. Moreover it was probably this "radical philosophy" of Ramsey's that influenced Wittgenstein in developing a similar view about the general propositions

of arithmetic, following Wittgenstein's return to Cambridge in 1929.⁷

On this conception, that I will call Ramsey's, instrumentalism is a doctrine about the language of science. According to it scientific theories or laws are defined by their inferential role in connecting statements about observables. Thinking of today's inferential semantics, this does not seem like such a outlandish conception. Still, Popper does not like it and that is because it does not conform to the moral tenets of his falsification-driven critical rationalism. According to Popper, we need to search for and test the most far flung empirical consequences of our laws or theories. If they fail such a severe test, we are morally bound to overthrow the theory and seek a new one. According to Ramsey's instrumentalism we also need to look for severe tests, since inferences that are supported or that fail in such tests literally constitute what our laws or theories amount to. But if a severe test fails we are not necessarily bound to give up the theory. Arguably, it is a matter of judgment as to what to do. Sometimes, for instance, we might simply adjust the boundaries of the theory to exclude the bad inference. For Popper, however, titrating the boundaries is wicked. It is an act directed against the very soul of science, behavior at odds with the Enlightenment promise of the progress of science and the hope that promise holds out for humankind. Well, probably Popper – and later critics like Israel Scheffler and Ernst Nagel – are a little over the top here.

Still, I think I see reflections of their distaste for Ramsey's instrumentalism in *The Scientific Image*. It is where van Fraassen emphasizes that although he does not believe in unobservables he regards statements about them as capable of having a truth value, where "true" is to be understood in its literal sense (whatever that is). So van Fraassen is making it as plain as could be that he dissociates his view from Ramsey's instrumental idea that theoretical sentences "which appear to express judgments and are manipulated according to the laws of formal logic [do] not express judgments at all." According to van Fraassen they do express judgments, they can be true, and we may accept them and even act on them; but nothing compels us to believe them. Indeed one of the functions played by the distinction between belief and acceptance in *The Scientific*

Image is to differentiate constructive empiricism from Ramsey style instrumentalism, a view that in 1980 was badly scarred.

III. REAL INSTRUMENTALISM

There is, however, another program called “instrumentalism”, indeed the original program; namely, the pragmatism of John Dewey. For instrumentalism is the brand of pragmatism associated with Dewey’s “Chicago School of Thought”. The very word “instrumentalism” is Dewey’s.⁸ Before Dewey came to refer to his ideas as pragmatism he coined “instrumentalism” (along with “experimentalism”) to describe his pragmatic treatment of “how thought functions in the experimental determination of future consequences”.⁹ It is not a doctrine about language or semantics and it is not something special to science. According to Dewey’s instrumentalism what we look for in all the various contexts of inquiry – whether around the house, in the study, or in the laboratory – is instrumental reliability; that is, we want our theories or concepts to be useful in all the practical and theoretical endeavors for which we try them out. This is what Dewey means to suggest when he writes,

[C]onceptions, theories and systems of thought . . . are tools. As in the case of all tools, their value resides not in themselves but in the capacity to work, as shown in the consequences of their use.¹⁰

William James’ well-known characterization of truth as the expedient in thinking yields an excellent expression of this instrumentalist idea. If we substitute “reliable” for “expedient” then James ask us to look for

the reliable in the way of our thinking Reliable in almost any fashion; and reliable in the long run and on the whole of course; for what meets reliably all the experience in sight will not necessarily meet all farther experiences equally satisfactory.¹¹

Note James’ empiricist-friendly reliance on experience. James, like Dewey after him, was interested in reliability with respect to negotiating our way about and manipulating the objects we find, reliability with regard to our success at communication, reliability as it helps us to understand and to explain what we find happening, and reliability in so far as it contributes to accurate predictions. I like to call

Dewey's pragmatic notion that of "general reliability". If a concept or theory is generally reliable, in this sense, not only can we trust it for empirical work, we can trust it for theoretical work as well. To be sure, like truth, it may be that no theory has such a high degree of trustworthiness. But, like truth, general reliability could still function as a regulative ideal.

My understanding of Dewey's instrumentalism, then, is that it represents an attitude toward inquiry in general, and not a specific epistemology or semantics for science, or for unobservables. The attitude is to treat the activity of inquiry, like other human endeavors, as having an end; namely, that in inquiry we strive for concepts and theories that are generally reliable – although often we make do with less. From this perspective Popper's challenge about why test our theories has an obvious answer. In testing we are looking to see whether the theories are in fact generally reliable. When our tests fail, we understand that the answer is "no". What we then choose to do depends on the circumstances. We can dismember and overthrow our theory, or we can fine tune it. Unlike Popper, Dewey does not have an *a priori* methodology into which all of science must fit. In fact, one of Dewey's most important thoughts is that we develop methodology as we go along. We learn in inquiry how better to pursue it.

Certainly instrumentalism treats theories as instruments or tools. As above they are tools to help us manipulate, communicate, understand, explain, predict – and to help us construct new theories or models. They are tools, that is, for all the practical and theoretical tasks that we may want to perform. It is no part of this kind of instrumentalism to hold that the only role for theories is to connect some phenomenal descriptions with others. Theories are not inference tickets (to use Gilbert Ryle's term). They are not tickets at all. Rather theories are the general purpose tools of inquiry. Moreover Dewey's instrumentalism is not eliminative. It is not committed to the dispensability of theories or of theoretical representations. To the contrary, according to instrumentalism it is only by means of theories and their representations that we manage to conduct inquiry and succeed to the extent that we do.

I hope this way of presenting Dewey's program, which is the original instrumentalism, makes my thesis plain. It is to suggest

that at heart constructive empiricism is a version of Dewey's instrumentalism. Or to put it differently, that the heart of constructive empiricism is pragmatism of Dewey's stripe. To make the connection explicit, when van Fraassen advises us to accept a theory as empirically adequate and also, pragmatically, to be committed to approaching the world through the eyes of the theory we should read that as advice to believe in what I have been calling the general reliability of the theory.

In *The Scientific Image* van Fraassen distinguishes his constructive empiricism from realism as follows. Realism, he says, aims for truth and when realists accept a theory they believe that it is true. Constructive empiricism aims for empirical adequacy and for them to accept a theory is to accept it as empirically adequate. Now, notoriously, pragmatists are supposed to have told an implausible story about truth, for they are usually read as simply identifying truth with general reliability. I am not scholar enough to judge the accuracy of that textual claim. I suspect that it arises, at least in part, from disbelief about the fundamental epistemological role pragmatism attributes to reliability, a role that many readers may be inclined to think should only be played by truth. For pragmatism holds that the function of epistemological norms is to guide us to reliable beliefs. For those brought up in a culture of realism, where epistemological norms are supposed to be guides to truth, this pragmatic twist may seem like an egregious error, an error that could only be made by someone who mistook general reliability for truth. In any case, I do not think that Dewey was very doctrinaire about identifying truth with general reliability. And we, certainly, do not need to make any such identification. If we don't do it, that is, if we distinguish truth from reliability, then the formula that van Fraassen uses to mark off realism from constructive empiricism marks the distinction of realism from instrumentalism in exactly the same way. Instrumentalists aim for reliability and in accepting a theory believe it to be reliable (not necessarily true).

As I have emphasized, believing a theory reliable amounts to trusting it in all our practical and intellectual endeavors. Thus when instrumentalists accept a theory as reliable they are already committed to understanding and dealing with the world from the perspective of that theory, whether or not it is true. In this way

instrumentalism gets for free what van Fraassen achieves by supplementing our acceptance of a theory as empirically adequate with the pragmatic recommendation that we also be committed to the theory in how we think about and approach the world. Looking at constructive empiricism from the point of view of pragmatism we can understand why van Fraassen employs his distinctive notion of acceptance-with-commitment for empirically adequate theories, for that is just general reliability. There is a nice irony here. Those who criticize van Fraassen's notion of acceptance-with-commitment generally argue that this strong notion is indistinguishable from truth.¹² On the understanding sketched here this amounts to arguing that pragmatic reliability is indistinguishable from truth. Thus van Fraassen's critics on this point seem to be defending what most regard as the pragmatists' notorious mistake!

IV. OBSERVABLES AND MODELS

What then of observables vs. unobservables? *The Scientific Image* makes much of this distinction, which I claim is of no special importance to pragmatism, and van Fraassen has been much criticized for it. He has been criticized by me and others for what we see as a circularity in the way he marks the distinction, and he has been criticized for making a modal notion, the "-able" in "observable", central to a program suspicious of modality. Finally, he has been criticized, if I may put it quaintly, for being unfair to unobservables. If my effort here in giving a pragmatic spin to constructive empiricism is on target, then I think that van Fraassen should simply shrug off the first two criticisms. He does not need any neat division between observables and unobservables, not even to support his empiricism. For if the name of the game of inquiry is reliability, then the only thing that counts is our experience (good and bad) in acting on our ideas and theories. Remember James' reference to "what meets reliably all [our] experience." So, it seems to me that a robust empiricism is already built into pragmatism.

Of course if van Fraassen goes along with my suggestion then he will have to modify his picture of how theories are applied. Recall that in the semantic view a theory is a family of models. His idea has been to separate off the empirical substructures of

the models, which is where the observables come in. Application of a theory then looks to models of the data isomorphic to these empirical substructures. But since I regard that idea as very wide of the mark, I think he will have retrench anyway. The problem with van Fraassen's picture is twofold. Firstly, there are probably no examples outside of textbooks or heavy-handed rational reconstructions where actual isomorphism obtains. As Duhem understood long ago, the match between theory and data is always approximate and always only from certain points of view.¹³ Secondly, the idea that the application of theories, even given a data model, is itself theory driven seems plainly wrong. In linguistic guise, this was the idea, I think, that Ramsey took from Campbell. The theory came with a dictionary that mapped the theoretical stuff to the observable stuff. In the language of models this is just the delineation of an empirical substructure. But theories do not come with dictionaries that define their empirical domains of application. For example in the *Definitions of the Principia*, Newton tells us that we can determine the application of "mass" (well, actually, "quantity of matter") by means of pendulum experiments, and that he has done so. But Newton then applies his mass formulas to the moon, and the planets. Whereas his (implicit) dictionary might well get us the masses of pendulum bobs, and the like, it won't get us the moon. No theory can lay out all of its possible applications and none does. Indeed the road from theory to applications generally involves a number of intermediate modeling stages. While guided by theory these are not derived from the theory nor generally theory driven. Almost always they involve creative inputs from outside the theory in question and often, in important respects, they actually conflict with the theory. Ian Hacking has stressed that experimentation has a life of its own that is quasi-independent of theory and Peter Galison stresses the same moral for instrumentation. Much recent work points in the same direction with respect to the construction and use of models.¹⁴ I conclude that isomorphism to empirical substructures does not even begin to capture the complexity of genuine theory application in science. Of course we should not fault *The Scientific Image* for oversimplifying the problem of theory application. Even today we are just beginning to get a handle on how such modeling works. I only suggest that there is no reason to cling to the idea of empirical substructures in

looking for a more adequate account. Does this mean giving up the semantic view of theories? Perhaps, or perhaps it means suitably modifying that view. In either case the move would improve our understanding of the relationship between theories and their applications and would do so without depending critically on the notion of an observable. What is really important to constructive empiricism would, I think, remain in place.

V. THE DOUBLE STANDARD

This leaves the unfairness objection. The story here is interesting, and worth telling in detail. A number of commentators have complained that the empiricist epistemology of *The Scientific Image* is biased. Among observables, constructive empiricism allows ordinary scientific practices to support belief, but among unobservables those same practices warrant only acceptance. Here is how one critic describes it.

Thus, this brand of empiricism can follow the usual lattice of inferences and reasons that issues in scientific beliefs until it reaches the border of the observable, at which point the shift is made from belief to acceptance. But the inferential network that winds back and forth across this border is in no way different from that on the observable side alone. Nor does constructive empiricism impute any difference to it.¹⁵

This objection can be dressed up to make the recommendations of constructive empiricism sound arbitrary and artificial, unfairly applying one set of standards to observables and another to unobservables. The objection, however, rests on a certain realist presupposition. It is that ordinary scientific practices, “the usual lattice of inferences and reasons,” are concerned from the outset with warranting true belief. As I noted above, however, for instrumentalism inquiry aims at reliability and epistemological norms are not intended as guides to true belief but rather as guides to reliable beliefs (van Fraassen’s acceptance-with-commitment). If we take this instrumentalist point of view then what the usual lattice of scientific inferences and reasons should guide us toward are reliable beliefs, regardless of whether we are concerned with observables or unobservables. There are not two epistemological standards, only one, and that is applied evenhandedly – with justice for all.

Moreover, if we adopt the perspective of instrumentalism, it turns out that the realist-based objection itself involves a bias. It is unfair to observables. For realism takes inquiry among observables to be directed at truth whereas (from our perspective) inquiry among unobservables, which follows the very same methods, is directed at reliability.

What is interesting about the dialogue is this. Arguably, among observables warrant for truth is co-extensive with warrant for reliability (remember my James, “Reliable in almost any fashion; and reliable in the long run and on the whole of course”). So, restricted to observables, realist, truth-based epistemological norms and instrumentalist, reliable-based norms issue in the same warrants. They differ, however, when it comes to unobservables. Here one goes for truth and belief in the truth, the other for reliability and belief in reliability. In fact each trajectory across the observable/unobservable boundary (to speak metaphorically) is self-consistent. But we can see why, from the perspective of each, the other may seem to be biased and to involve a double standard.

Here then is an epistemologically coherent defense against the unfairness objection. I don't know whether van Fraassen will be pleased to accept it. An alternative would be to lean heavily on a commitment to empiricist epistemology, which is a hodge podge of warrants for belief in truth here and for belief in something less there. Despite a few argumentative gestures, I think that van Fraassen understands that there is no argument for such an empiricism that does not beg the question, although, of course, one may simply adopt the doctrine as an article of faith. The pragmatist alternative sketched out above is simpler, more coherent and, to me at least, more compelling. Its cost is a shift across the board from truth to reliability. What we find in *The Scientific Image* is a half way house. The most distinctive ideas there are reliabilist, in the pragmatist sense. But truth does keep cropping up, sometimes even correspondence truth.¹⁶ So, what I'd like to offer van Fraassen is a full house, which I regard as a better hand to play. In playing it, I would emphasize again, van Fraassen need not compromise empiricism as an attitude about experience as the source of knowledge. It is only the peculiar working out of this doctrine by way of positing an

epistemologically significant distinction between observables and unobservables that needs to be let go.

It may seem that one item on the agenda of criticism of constructive empiricism comes back at us even in the instrumentalism I have been sketching. It is the modal objection; for instrumentalism is all about reliability, and that seems to involve an irreducibly modal notion. The thought is that to say something is observable is to say that it can be observed. To say something is reliable is to say that it can be relied on. From the point of view of modal involvement, these look pretty much the same. Although I know that the mantra of *The Scientific Image* is that modality is in the models, I actually have no idea how van Fraassen would handle either of these cases. My own instinct here is to treat the modality as future tensed and negative. So to say that some idea or hypothesis is reliable is to say that you will not come to grief (run into difficulties, encounter resistance, etc.) over it as you go about acting on it. I offer this as a suggestion, in case – like van Fraassen – you regard modal notions as in need of a non-modal base. Note, however, that even if this suggestion is a workable way of parsing “reliable”, it does not work for “observable” - - despite the superficial resemblance of the two. Observable marks a potentiality that need not be actualized, so that something may be observable although it will never be observed. Reliable is different. It does not have the character of positing an achievement (like an observation) waiting to happen. Rather it has a negative character, amounting just to “this will not fail you”. From a strict empiricist point of view *reliable* certainly looks more friendly than *observable*. If so, perhaps this is another reason to treat constructive empiricism as instrumentalism.

VI. GLOBAL APPROACHES

In reading constructive empiricism as Deweyian instrumentalism I have been trying to defend it against some of its critics and also to locate it, retrospectively, within the framework of twentieth century thought. But I have not been intending to endorse constructive empiricism. Let me put it this way. Much of the criticism of constructive empiricism has come from the realists and rationalists of our time. I am happy to join with van Fraassen in

fending off these philosophical neo-conservatives. But there are also some radical lines of criticism to which I am more sympathetic. I have in mind, especially, reservations about van Fraassen's program that spring from some constructivist and postmodern concerns. I have already indicated one area where I am in sympathy with those concerns; namely, over the way models enter into the application of theories. As I see it, if we ignore much of the hyperbole over constructivism and postmodernism generated by the science wars debates, the underlying issue there has to do with the extent to which one wants to look at science in the making and to understand it in more or less local terms, as opposed to treating finished science understood in the light of Kantian-like universals. Thus my problem with van Fraassen's approach to models is that he seem to be looking for one theory-driven pattern that fits all cases universally. My sense is that we have to attend to the variety of scientific cases and we have to be open to the possibility that there may be no one pattern for the relationships of theories to models and of models to data. To use Nancy Cartwright's language, in this respect the world may simply be dappled and untidy.

That may be true more generally and, indeed, whether you accept my instrumentalist rendition or not, I am skeptical about the global approach that constructive empiricism takes to science. That approach treats sciences as though it were a single enterprise for which there are universal goals (empirical adequacy; compare: truth, reliability), a universal understanding of what it means to accept a hypothesis (accept as empirically adequate; compare: as true, as reliable), a universal pattern for how theories are applied, and so on. I think all this is fiction. It does not seem to be about any science that I know and I do not believe any of it. I favor a more open attitude toward science, one not committed to reconfiguring scientific practice to suit the needs of pre-set philosophical agendas – the attitude I call NOA. One irony of van Fraassen's global approach is that it merges with more or less traditional metaphysical projects when it asks, as van Fraassen does, after the "content" of a theory or "how the world could possibly be the way this theory says it is".¹⁷ At this level of generality these questions invite us to construct an ontology for what the world is like ("must" be like) in order for our theories to be true (or empirically adequate, or reliable). While

van Fraassen certainly rejects such ontological projects, the global approach taken by constructive empiricism flirts with them. But when rejection is certain in advance, I would suggest that flirtation is not entirely wholesome. Even when he tries to set his approach apart from others, in the use of the term “constructive”, universalism again comes through strongly. He tells us that “constructive” is meant to indicate “that scientific activity is one of construction rather than discovery: construction of models that would be adequate to the phenomena”.¹⁸ Notice, firstly, that this is a nicely pragmatic notion, since construction is something we humans do. But notice too that the dictum here is perfectly general – in science there is only construction never discovery.

The Scientific Image approaches science from the top down. In this respect, as I have emphasized over the years, van Fraassen’s approach is just like that of the scientific realism he opposes. They both share the legacy of logical positivism, which is to set for philosophy an agenda of topics to be treated in a perfectly general way: theories, laws, explanation, probability, confirmation, and so on. Logical positivism, especially in the hands of Carnap, Reichenbach, and – yes – Popper made the philosophy of science an enterprise dedicated to exploring general answers to these general questions. Only Neurath, I believe, demurred and then earned himself a lot of bad will among his colleagues by referring to Popper’s approach (and implicitly to that of his friends within the Circle) as pseudo-rationalist. The pseudo-rationalist tradition of logical positivism, I am afraid, is the tradition still of *The Scientific Image*. The freshness and originality it displays on many issues makes constructive empiricism an important achievement of the late twentieth century. It is tied, however, to earlier programs in a way that may limit its promise for us now in the twenty-first.

VII. CONCLUDING THOUGHTS: REAL REALISM

Since this is a retrospective occasion, I would like to close with some thoughts about the role that *The Scientific Image* has played in the philosophical literature of our time and how we might move forward from there. Many have noted that in the twentieth century philosophy took two turns. One was a turn to epistemology and another a

turn to language. With its break from the language-based syntactical conception of scientific theories and its endorsement of the model-based semantic view, *The Scientific Image* dramatically took back one of those moves. Almost by way of compensation, however, it enhanced the other. In redefining realism as a doctrine about truth and belief in the truth, van Fraassen set up the debate over realism as a debate over the reach of evidence. Does the evidence support belief in the truth of our theories or does it only reach as far as belief in their empirical adequacy? Notice that this is a purely epistemological question and this is the question on which almost all the recent literature in the realism debate has centered. Still, it really is a set up. Like a skilled magician doing slight of hand, van Fraassen's focus on the epistemological question has distracted us from what realism actually involves. Any student in a freshman philosophy course knows that realism is a metaphysical doctrine. It asserts the existence of a real, external world. In *The Scientific Image* van Fraassen made that world disappear from the debate. To create that illusion and to hold us in its thrall for twenty years is really quite a trick. Once we have noticed the slight of hand, however, what options do we have? We certainly do not want to go back to speculative metaphysics – at least I don't want to. We could, however, go forward to ask about the metaphor of externality and the role of related notions like that of objectivity, independence and what is really "real". These topics have been the focus of some recent constructivist and feminist literature. So one positive effect of restoring the metaphysical side of realist doctrines would be to bring these literatures into mainstream philosophy of science. Of course, like a curator's assistant in Madame Taussaud's museum, I understand that there is no question of reviving realism, just of restoring it to a semblance of its original shape. For twenty years the one-dimensional realism of *The Scientific Image* has provided the occasion for good philosophical reflection. My hope is that restoring the original doctrine would enlarge that discussion and move it forward. Anyway, so restored, realism would certainly make a more interesting target for philosophical practice – and a bigger one.

NOTES

- ¹ Delivered at the Symposium “*The Scientific Image, Twenty Years After*” at the American Philosophical Association (Pacific Division), Albuquerque, April 2000. Thanks to Richard Otte for organizing the symposium and to Paul Teller and Bas van Fraassen for a wonderful session.
- ² Mach, p. 49.
- ³ van Fraassen, 1980.
- ⁴ See Popper (1953). This form of instrumentalism is commonly associated with Duhem, Mach and Poincaré. It is difficult, however, actually to find it in their writings; especially if we read these figures in the context of their own times and complex of ideas.
- ⁵ Rescher (ed.), pp. 33–34.
- ⁶ Campbell.
- ⁷ Marion discusses this connection between Wittgenstein and Ramsey.
- ⁸ Dewey (1916).
- ⁹ Dewey, 1943, p. 463.
- ¹⁰ Dewey (1920), pp. 144–145.
- ¹¹ James (1907), p. 106.
- ¹² See, for example, Blackburn, p. 223 and Horwich, 1991.
- ¹³ Teller expands on just these themes.
- ¹⁴ See the essays in Morgan and Morrison.
- ¹⁵ Of course, I am the critic: Fine, p. 169.
- ¹⁶ See van Fraassen, 1980, p. 90 and 97.
- ¹⁷ Van Fraassen, 1991, p. 4.
- ¹⁸ Van Fraassen, 1980, p. 5.

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Northwestern University
Evanston, IL, USA

and

University of Washington
Seattle, WA, USA

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