

Dewey and the Subject-Matter of Science

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1. Dewey and Reichenbach

In 1939 John Dewey was the first person to be the subject of a "Library of Living Philosophers" volume (Schilpp and Hahn, 1939). The result includes meetings between Dewey and critics representing a range of philosophical schools and styles. There is a sometimes prickly exchange between Dewey and Bertrand Russell, and another with Hans Reichenbach. Reichenbach is sometimes classified as a logical positivist. This understates the originality of his views, though he was certainly an ally of the logical positivist movement. Reichenbach developed his own scientifically engaged form of empiricism.¹ He was sympathetic to Dewey, and presents his essay in the "Library of Living Philosophers" volume as one offering criticisms from a viewpoint that featured much agreement. So this is a useful exchange for thinking about how Dewey relates to other currents in scientifically-oriented philosophy. In this paper I will start by looking at one of Reichenbach's criticisms, and Dewey's reply. I'll then use their exchange to

¹ For a summary, see Reichenbach (1951).

navigate a path through several parts of Dewey's later philosophy, drawing primarily on *Experience and Nature* (first edition 1925, revised edition 1929a) and *The Quest for Certainty* (1929b). The main topic of the paper is the content of scientific theories, but for Dewey this question connects to many others.

Reichenbach claims in his essay that Dewey held a "nonrealistic" view of science. Reichenbach gives a series of quotes from Peirce, James, Dewey, and Mach. He takes all of them to express versions of the idea that scientific language which apparently refers to unobservable entities really just describe patterns in observables. Here is what he says about Dewey: "John Dewey calls the scientific object an 'instrumentality of multiplied controls and uses of the real things of everyday experience'" (1939, p. 161, quoting *Quest for Certainty* p. 106). Reichenbach then says that the difference between pragmatism and positivism is that positivism treats the contents of the immediate world as "complex" and tries to reduce them further, to collections of sense data. Pragmatism rightly does not do this: "sense data are abstractions as much as are objects of physical science." (p. 162). Reichenbach credits Dewey with this insight.

Reichenbach then patiently criticizes all such "nonrealistic" views. His main argument is that the inferences in science about unobservable objects are of the same kind as inferences used in everyday life to get us to conclusions about ordinary things that are hidden or misleadingly presented. Dewey seems opposed to the idea that the picture we get from science can correct and replace the common-sense picture of the contents of the world. But within everyday life, we engage in these corrections all the time, especially when we deal with mirages, illusions, and dreams. We find ourselves relegating various entities to a category of the illusory or unreal. Reichenbach thinks that science often does the same thing. When the correction science makes of a common-sense view is small, there is usually no need to talk about it *as* a correction and substitution, though strictly speaking this is what it is. We find this situation in the case of the comparison between the scientific picture of a wooden oar and the common-sense picture. The common-sense view has it that the oar is completely solid. Science sees it as made of atoms. Reichenbach sees this as a very minor, but genuine, correction (p. 169). Other corrections are more substantial. Reichenbach urges that we see our eyes and other senses as like speedometers, which successfully register states of environmental variables provided that

conditions are appropriate. Visual illusions are cases where the speedometer is in inappropriate conditions or is not functioning properly.

Reichenbach was no doubt surprised when Dewey strenuously objected to his interpretation of him, and insisted that he did not have a "non-realistic interpretation of scientific concepts" (1939, p. 535). Dewey suspected that the source of the misinterpretation was his (Dewey's) "identification of the scientific object with relations" (p. 535). He conjectures that Reichenbach must be one of the many philosophers who think that "relations have not the empirical reality possessed by things and qualities." Why should *that* be diagnostic here, and give rise to the appearance of disagreement on what looks like a quite different topic?

2. Relations and qualities

Dewey claimed that there had been a persistent downgrading of the reality of relations in much of the Western philosophical tradition. This he saw as a long-standing mistake. The claim that relations have often (rightly or wrongly) been accorded a second-class status seems generally fair. Two useful landmarks here are Aristotle and Locke. Aristotle saw the world as made up of substances and their properties (universals). A property inheres (in each case) in just a single substance; properties are all "monadic" rather than "polyadic." We can talk about situations in which things stand in a certain relation, but these cases must be analyzed in terms of how monadic properties inhere in substances.² Moving to the early modern period, in Locke we find a starker claim: relations have "no other reality, but what they have in the Minds of Men."³ It has been common to see our talk of relations as not mapping directly to relational elements in the world itself, but as having a more indirect application to a world in which real properties are always

² For relevant discussions of Aristotle's *Categories* and other works see Studtmann (2007), Cohen (2008), and Brower (2009). Brower discusses medieval responses to Aristotle's view. As he describes it, medieval philosophers were slowly forced by the Christian doctrine of the Trinity towards a more realist view of relational properties (God is the father, and that is a relational property), but they only moved away from Aristotle's framework of solely monadic properties with much reluctance.

³ Locke's *Essay* (1690/1975, II, xxx, 4): All relations have "no other reality, but what they have in the Minds of Men." They are nothing "but my way of considering, or comparing two Things together, and so also an Idea of my own making" (III, x, 33). Leibniz, who disagreed with Locke on many issues, had a similar view on this one.

monadic. Our talk about intrinsic properties can represent intrinsic properties that things themselves have, but our talk of relations is not given this straightforward analysis.

Dewey opposed such views, and thought that their untenability had been made evident by the practice of modern science. Scientific theories provide our best examples of factual knowledge about the world, and science has learned that relations are what can most fruitfully be studied by organized inquiry (1929a, Chapter 4). Science is concerned with patterns, correlations, and functional dependencies; it is concerned with what happens *here* when you prod things over *there*. Science has realized the importance and reality of relations in its practice, but philosophy is taking longer to catch up with the idea.

These points can be put in a still broader context. For Dewey, there are several things that the mainstream philosophical tradition has inherited from the ancient Greeks.⁴ One is a view of knowledge as contemplation of being.⁵ A couple of different aspects to this idea can be distinguished: the "being" that is contemplated is a matter of the forms or internal natures of things, and "contemplation" contrasts with intervention and transformation. A second and distinct inheritance is the idea that questions about knowledge have a special bearing on questions about what the universe contains; the objects that we *know* about are those that are "ultimately real" (1929a, p. 19).

With the rise of modern science, contemplation was replaced by experimentation and intervention, and relations acquired a centrality to scientific knowledge. Once relations replace intrinsic properties as the subject-matter of science, there is the possibility of asserting a metaphysical view that directly inverts the one that came down from the Greeks. A person might say: science has taught us that relations are what is real, and intrinsic properties are mere constructs or illusions. One form of the "structuralist" tradition in philosophy of science says things like this. I will look at that option below. But this is not Dewey's approach, and that is because of the second inherited error that he wants to correct, the idea that only things that we interact with cognitively or

⁴ Dewey freely used "the Greeks" as a category in his philosophical histories, sometimes paying little attention to the differences between different Greeks – for example, between Plato and Aristotle. When describing Dewey's analysis here I will sometimes use the same blanket category.

⁵ See Dewey (1929a), p. 332; (1929b), pp. 14-15.

epistemically can be real. Dewey thought that insufficient philosophical attention had been paid to the non-epistemic or "non-cognitive" side of our experience. What are presented as general theories of our interaction with the world are usually theories of our *cognitive* interaction with the world, theories of what and how we can know. These theories, in turn, are often used to make arguments about what the world contains. But those arguments are compromised because they are views based on only one part of our traffic with the world, the cognitive part. Philosophers suppose that if something is not the object of *knowledge* then it cannot figure in our experience *at all*.

Dewey argues, in contrast, that much of our experience of the world is not a matter of knowing about it, representing it, investigating it. There is also a great mass of non-cognitive interaction with things: eating them, bumping into them, handling them and habitually using them. Dewey sometimes describes this by saying that things can be *had* as well as *known* (1929a, p. 21). The term "having" is often awkward and I am not sure how generally Dewey means to apply it – which interactions count as "havings" – but many of the ordinary perceptual encounters that go on constantly in our lives are in this category. Inquiry and knowledge comprise one facet of experience, which arises in particular circumstances. Cognitive engagement with the world arises when we encounter an obstruction or threat to our more habitual and unreflective activities. The cognitive side of life is embedded in a richer matrix of non-cognitive engagement with the world. So if a person is going to make arguments about what the world contains based on premises about our interactions with it, based on premises concerning the nature of our experience, they should not restrict "experience" to its cognitive side.

For Dewey, in the non-cognitive side of experience we encounter *qualities*. Qualities are contrasted with relations.⁶ It is not clear how exactly Dewey intends to divide things up here. In current philosophy, a category that contrasts in a relevant way with relations is that of an *intrinsic property*. Roughly speaking, an intrinsic property of an object is one whose instantiation by that object does not logically depend on the existence and arrangement of any other objects. An *extrinsic* property is one that is not intrinsic. (See Langton and Lewis 1998 and Weatherson 2008 for more careful formulations along the same lines.) Dewey's notion of a quality may be a somewhat a

⁶ See Dewey (1929a), pp. 110, 263, 421.

different category than this modern idea of an intrinsic property.⁷ Qualities are also described in terms of their "immediacy." In some places what "immediacy" seems to refer to is a kind of particularity or unrepeatability, which suggests the modern notion of a property-*instance* (or "trope"), as opposed to a universal.⁸ "Immediacy" also sometimes looks more like a feature of our interaction with things, as opposed to a feature of the properties themselves, and Dewey also says that strictly speaking, qualities exist in interactions between organisms and things external to them (1929a, p. 259). In that case no qualities of objects would count as intrinsic in the contemporary sense. So it is an oversimplification to map Dewey's notion of a "quality" directly onto the modern idea of an intrinsic property, but Dewey does treat qualities as things which contrast with relations in how they attach to particular things, and also in their role within our lives. Most importantly: "Genuine science is impossible as long as the object esteemed for its own intrinsic qualities is taken as the object of knowledge." (1929a, p. 130; see also p. 263)

This gives us Dewey's reorganization of the picture that came down to us from the Greeks. For Dewey, relations are known and qualities are "had." Neither is primary in a metaphysical sense, more real or more furniture-like. Neither is to be "explained away" in some manner that is not applicable to the other. They have different and complementary roles in our lives. The error of downgrading relations is rectified without making the error of installing relations in the position of metaphysical primacy once occupied by qualities.

With Dewey's picture laid out, a comparison can be made with another modern view which asserts that relations are the objects of knowledge. In philosophy of science this view is now often known as "structural realism." It has links to an older "structuralist" tradition, going back through Russell and Poincaré, and also to some Kantian views.⁹

⁷ In a 1936 paper Dewey distinguishes between qualities and "attributes," noting that many unfortunately take these to be equivalent. A quality is something "existential," a real trait of some object, and not merely a specification to which an object *may* conform – an attribute (1936, p. 97). As far as I can tell, this complication does not affect the issues discussed in this paper, as here we are always dealing with real traits of objects.

⁸ See Dewey (1929a), pp. 85, 142, and for "tropes" see Armstrong (1989).

⁹ See Ladyman (2009) for a survey, and Langton (1998) for the connection to Kant.

Structural realism was introduced in its contemporary form by John Worrall (1989) in response to epistemological arguments against scientific realism. The "pessimistic meta-induction" holds that because the entities posited by most past scientific theories are now thought not to exist, the same fate is likely to befall the entities posited in our current theories (Laudan 1981). Worrall argued that the history of science is less unfriendly to realism if we focus just on the "structural" claims that past theories have made. When theories are replaced, commitments made by the old theory about structural features of the world are often retained even though the entities posited by the old theory are abandoned. These "structural" features are networks of relations.

Some structural realists infer from these arguments that we can have confidence that our current scientific theories capture some structural features of the world with some degree of accuracy, but we should not hope for scientific knowledge of the nature of the entities that stand in these networks of relations. Ladyman calls this "epistemic" structural realism. It is also possible to claim, more strongly, that what we have learned from these facts about the development of science is that the world *consists* in pure structure; reality contains a network of relations with no individuals in the familiar sense standing in those relations. This is what Ladyman calls "ontic" structural realism.

Dewey, as we saw, holds that scientific theories describe relations. But Dewey differs from structural realism in both its epistemic and ontic forms. The contrast with the ontic version is sharpest. From Dewey's point of view, the ontic version is an example of a view holding that if the cognitive side of our lives (exemplified by science) has no concern with some putative kind of entity, that is reason to think it does not exist at all. Dewey rejects this. The cognitive side of our lives is concerned with relations, and science is the most refined expression of that side of human life, but there is also the non-cognitive side.

In recent discussions of ontic structural realism, some have argued that the view is incoherent; it makes no sense to say that the world could be constituted solely by a network of relations (see eg., Psillos 2001). For a relation to be present, some particular entities related must also be present. Relations cannot be self-sufficient. Dewey asserted a version of this argument in 1925.¹⁰ For Dewey, the incoherent version of structuralism

¹⁰ "[A]ll structure is structure *of* something (1929a, p. 72; see also 1929 p. 193).

comes about by combining the insight that scientific theories are concerned to represent relations with the mistaken tendency to think that a scientific inventory of the world is *the* inventory of the world.

The "epistemic" version of structural realism does not make an inference to any claim about the world's consisting entirely of relations. Epistemic structural realism is only a view about what we can know. This is closer to Dewey's view, but there are still some differences. Epistemic structural realism is usually a fallback from a simpler version of scientific realism, motivated by anxieties about our access to things other than relations. For Dewey, the fact that we do not know about the qualitative does not reflect the existence of some barrier or shortcoming, but instead is a functional matter.

Things in their immediacy are unknown and unknowable, not because they are remote or behind some impenetrable veil of sensation of ideas, but because knowledge has no concern with them. For knowledge is a memorandum of conditions of their appearance, concerned, that is, with sequences, coexistences, relations. (1929a, p. 86).¹¹

There is nothing about the qualitative that makes it inaccessible. Rather, these aspects of the world have a different role in our lives from what we investigate and know.

This brings us to a possible problem with Dewey's view, however. Dewey says that the qualitative is not remote, because we have dealings with these features of the world, though they are not cognitive dealings. But these direct and non-cognitive interactions would only seem to connect us with the qualitative features of what are sometimes called "middle-sized" objects (which Dewey calls objects of "primary experience"), rather than the intrinsic qualities of aspects of the world that are extremely small, or otherwise removed from ordinary experience. What sort of relation do we then have with the intrinsic qualities of unobservable things? We can't know about them, because they are qualitative rather than relational. And we can't apparently "have" them, because they are too far from ordinary experience. This makes it seem that there is one kind of natural feature that we really are cut off from. Dewey is opposed to philosophical views that assert gulfs and failures of contact, but it is hard to see how he avoids one here.

¹¹ Should it be "sensation *or* ideas"?

This problem connects back to the issues that concerned Reichenbach in his 1939 essay on Dewey. Here (with Reichenbach's ellipses removed) is the best of the quotes that Reichenbach uses to allege a "nonrealist" character to Dewey's thought:

Put positively, the physical object, as scientifically defined, is not a duplicated real object, but is a statement, as numerically definite as is possible, of the relations between sets of changes the qualitative object sustains with changes in other things – ideally of all things with which interaction might under any circumstances take place. (Dewey 1929b, p. 105, quoted in Reichenbach 1939, p. 164).¹²

Reichenbach interprets this as claiming that what appears to be talk about hidden objects in physical science is really no more than talk about relations between observable things. Reichenbach has a point here; it is not enough to say that science is concerned with "relations" unless you say what sort of relations they are and what they are relating. The issue that Reichenbach wants to focus on in his discussion is whether apparent descriptions of unobservables in science are really just shorthand descriptions of patterns in the behavior of observable things. Once we look specifically at this question, it does sometimes appear that Dewey's view collapses to a more familiar empiricism, in which the role of scientific theories is to describe only relations between things we can observe. In his reply to Reichenbach, Dewey is determined to avoid such a view. When a scientific theory posits a "swarm of atoms" in explaining a physical structure of the kind we would ordinarily call a table, Dewey does *not* want to deny that this invisible swarm really exists. He only wants to deny that it constitutes a "ghostly kind of table" (1939, p. 537). I am not sure if this reply to Reichenbach squares with everything Dewey says in *The Quest for Certainty*, but let's take him at his word: physics does try to describe swarms of invisible objects (atoms, and also "electrons, deuterons, etc.": p. 537). A swarm of this kind is a collection of things with qualities – things with intrinsic properties, at least. But then we face the problem raised above: what sort of contact can humans have with the intrinsic properties of objects that are far removed from ordinary experience? We don't seem to be able to know them *or* to "have" them.

¹² See also Dewey (1929a), p. 148 for a similar passage.

3. Knowing and having

At the end of the previous section I began to turn from interpretation to criticism, and I will continue in that vein by looking more closely at the idea that scientific theories are concerned with relations. I will look at both Dewey's view and those of his structuralist relatives. I will give an argument against one kind of structuralism. The argument also has some bearing on Dewey's position, though difficulties of interpretation make its impact less clear. After that I will look again at our non-cognitive interactions with the world.

Dewey and the structuralists hold that that science describes relations. They appear to be right that relations are central to much of what modern science describes. But is science *solely* concerned with relations? If so, what is ruled out? In particular, is there a philosophical problem with the idea that science can reasonably attempt to describe the intrinsic properties of things?

Consider a table. What does science have to say about it? We can look for descriptions of how the table might interact with other things, but we can also look at its internal make up. The table, we find, is made of wood. Wood is largely made up of cellulose and a chemical called *lignin*. Cellulose, in turn, is made entirely of carbon, oxygen, and hydrogen (as is lignin). A carbon atom is made up of protons, neutrons, and electrons. Those are all facts about the intrinsic make-up of wood.

There is certainly a role for structures and relations in this description of wood. Cellulose, for example, is not just an undifferentiated mix of carbon, oxygen, and hydrogen, but a combination of those elements in a certain arrangement. The arrangement is all that distinguishes cellulose from easily-digested *starch* – their ingredients are the same. So when one looks inside cellulose, one finds a structure – a set of relations between parts. But when we do this we also gain knowledge of an intrinsic nature – knowledge of the intrinsic nature of cellulose.

Philosophers writing about knowledge frequently make use of a contrast between intrinsic properties on one side and extrinsic or relational properties on the other.¹³ Knowing one of these is seen as a different matter from knowing the other. There is indeed a contrast of this kind between intrinsic and extrinsic properties *at* a given level in nature, but when we think *across* levels things are different. Then the extrinsic properties of entities at level n may be part of the intrinsic nature of entities at level $n+1$. When we learn about relations between carbon and oxygen within cellulose – for example, how they bond – we are learning something about cellulose's intrinsic nature. Looking across levels in a part-whole hierarchy, the relationship between intrinsic structure and external relations is "correlative" rather than being simply contrastive. When a whole has physical parts, the whole's intrinsic properties are due in part to the extrinsic or relational properties of those parts. They are also due in part to the intrinsic natures of the parts themselves, and the intrinsic properties of those parts can be handled the same way – as consequences of the inner natures and external relations of their own smaller parts.

Why might a picture like this be resisted? I will look at a couple of possibilities.

First, a person might say that the cellulose example is entirely compatible with the idea that science is exclusively concerned with relations. If someone discovers that wood contains cellulose, they are asserting a relation between those things – between wood and cellulose. Part-whole relations are, after all, relations. So where is the problem?

If someone says this, though, their view is entirely consistent with the idea that science describes the intrinsic natures of things. If "science is concerned with relations" in only *this* sense, then none of the distinctive theses of structural realism, or Dewey's view, are supported. All that is being said is that it is possible to express the content of scientific knowledge in a relation-asserting form. It then becomes unclear what the contrasts could be between this view and others. What is being ruled out? Even the idea that genuine knowledge is contemplation of essences would be compatible with this picture; we contemplate the relations between things and their essences.

Here is a second way of resisting the view sketched above. I said that wood contains cellulose which contains carbon which contains protons.... But where will this

¹³ From here I will contrast the intrinsic with the extrinsic, not with the relational. This is because of cases in which a property is both intrinsic and, in some sense, relational. Weatherston (2008) uses the example of *having longer legs than arms*.

bottom out? When we get to the fundamental constituents of reality, which have no parts, how can we hope to describe *their* intrinsic nature? (Perhaps there is no such fundamental level, but I will assume it for the purposes of discussion.) When we get to the fundamental level, all a theory can do is describe relations between entities at that level. Perhaps our theories can get no grip on the intrinsic natures of things at the fundamental level, and this undermines the claims we made about the higher levels.¹⁴

To this I would reply: even if we don't know *everything* about the intrinsic nature of cellulose (because its ultimate constituents remain intrinsically mysterious), we have still learned *something* about the intrinsic properties of cellulose when we learn that it contains three elements – carbon, oxygen, and hydrogen – arranged in a particular way. We have some knowledge of the intrinsic in this case, even if not total knowledge.

A third possible objection challenges the claim that it really is an intrinsic property of cellulose that it contains carbon. What this would mean is that a sample of cellulose would contain carbon no matter what the rest of the universe was like. Even if our table was the only thing in the universe, it would contain carbon. But physics may well tell against this picture. Perhaps if the rest of the universe was sufficiently different, it would not be possible for protons and electrons to exist at all. If *being a carbon atom* requires containing six protons, and protons do not exist in a one-table universe, then it is not an intrinsic property of the table that it contains carbon. Perhaps the state of the whole universe, or some large part of it, at time t is implicated in this table's containing carbon at time t .

In reply, perhaps it is true that the state of some large part of the universe is involved in the table containing carbon at time t . This is an issue within physics itself. Perhaps physics will determine that containing carbon is not intrinsic, and will posit new intrinsic properties of objects like tables. Perhaps physics will instead become holistic in a way that implies that no proper parts of the universe have any intrinsic properties at all. Physics might come out that way and it might not. This conclusion could not be reached on the basis of general philosophical arguments about what can be known and how science works.

¹⁴ Lewis (2009) argues that ignorance of the intrinsic properties of fundamental entities undermines knowledge of the intrinsic properties of higher-level entities (such as samples of carbon) using a Ramsey-sentence interpretation of physical theories.

In this section so far I have sketched a view of how science is sometimes able to describe the intrinsic nature of things, and resisted structuralist arguments that it can not do this. I have not tried to grapple with the special problems that arise in fundamental physics. My aim has been to show that in a large range of non-fundamental scientific work, the intrinsic is a straightforward target for scientific investigation, and the traditional contrast between knowledge of the intrinsic and extrinsic can easily be mis-applied. How much trouble do these points cause for Dewey? As emphasized earlier, I am not sure how to interpret some parts of his treatment of the differing roles of relations and qualities. But Dewey was clearly attracted to a transformation of the Aristotelian view in which relations are downgraded and the intrinsic natures of things are the proper objects of inquiry. Dewey wanted us to "surrender the traditional notion that knowledge is possession of the inner nature of things" (1929b, p. 105). Any view holding that science describes relations *rather than* the intrinsic, and understands as "science" fields other than fundamental physics, has to confront the arguments given above. Whenever entities contain structured arrangements of parts (as molecules, organisms, and many other things do), there is no opposition between describing networks of relations and describing intrinsic natures.

Dewey's view has some other distinctive features. As noted earlier, sometimes when Dewey talks about qualities he emphasizes a kind of particularity or unrepeatability. Then there is a different reason why science might be unconcerned with qualities: they are unrepeatable, and science searches for generality. But if so, showing that science is not concerned with qualities would not be enough to show that science was only concerned with relations. There would also be the question of the repeatable intrinsic features of things. Maybe science is concerned with relations *and* with the repeatable intrinsic features of things, such as *containing carbon*.

So far in this section I have looked at our cognitive engagement with relations and intrinsic properties. I have argued that science is not solely concerned with relations, in the sense in which relations are contrasted with intrinsic features. I now look at the flip-side of this issue. Dewey thinks that relations are known while qualities are "had" – encountered in a non-epistemic way. I am not entirely sure whether he means to deny that relations can also be "had." That seems to be the flavor of the view in *Experience and*

Nature: qualities are had but not known, relations are known but not had. But (unless I've missed it) I don't think the idea that relations are not had was asserted explicitly. Still, let's look at the version of Dewey's view that does assert such an inversion: the Greeks said that qualities are known and relations barely exist; the modern discovery is that only relations are known and qualities have their home in the non-cognitive side of our experience. We looked at whether the intrinsic can be known. Can relations have the non-cognitive role in experience that qualities have?

It is hard to assess this because these non-cognitive encounters were not described in a very concise way. But clearly Dewey means to include our ordinary unreflective perceptual and active encounters with such features as colors, shapes, and solidity. And then I would argue that whatever a non-cognitive encounter with a quality might be, the same sort of thing can exist in the case of relations. However we characterize our "immediate" practical encounters with colors and shapes, we have the same sort of encounters with arrangements and layouts – with the fact that this thing is next to this one, and this one is blocked by that. Our non-cognitive interactions with things in the world are not just encounters with the qualitative features of objects, but also with the relations between them. In particular, we encounter things in their spatial and temporal arrangement. These relations between things are just as important to habitual behaviors, practical manipulation, and "enjoyments" as intrinsic qualities are, and are just as "immediately" experienced.

4. Conclusion

I have criticized some parts of Dewey's view of science in this paper, but this is also a collection of topics where I think Dewey shows much insight. Dewey is right that the development of science forces a break from the metaphysical downgrading of relations seen in much mainstream philosophy. Dewey is right that our cognitive or epistemic engagement with the world is embedded in a matrix of other kinds of engagement, and this fact is neglected in many philosophical treatments of experience. But, I have argued, the re-drawing of the scene Dewey attempts is too stark. Too much of the shape of traditional philosophical views has been retained, resulting in an ungainly separation of roles.

In his treatment of science, Dewey is determined to avoid a view in which the scientific picture of the world and the picture found in "direct" experience are *rivals* of each other (1929b, p. 109). The separation of roles Dewey tries for (with science handling relations, and ordinary experience the home of qualities) can indeed achieve this dissolving of rivalry: "The relations a thing sustains are hardly a competitor to the thing itself" (1929b, p. 105). This maneuver works when the "things" exhibiting qualities and relations are things directly encountered in experience. Then scientific change, the replacement of one theory by another, would involve the discovery that we were wrong about some of these relations, or the discovery of further relations that had not been previously appreciated. The qualities experienced would remain the same, and there could be no rivalry between the scientific description and ordinary experience; all the rivalry is between one scientific theory and another. But matters are different if science is partly about hidden and hypothesized entities far from ordinary experience – swarms of atoms, and so on – and is concerned with the intrinsic natures of those things as well as their relations. Then science gives us an alternative inventory of the things making up the world. Looking at this alternative inventory, we can ask whether it is a more detailed account of the same things we can recognize in ordinary experience, or an account that shows something factually wrong with the picture we get in ordinary experience. This possibility is explored by Reichenbach in his essay on Dewey. For Reichenbach, the relation between a scientific and common-sense picture of some part of the world may well feature conflict, rivalry, and replacement. It depends on what particular sciences say. Rivalry might arise, and it might not. That is something to assess on a case-by-case basis. Here I side with Reichenbach. Dewey's account of science, for all its insights, comes too close to issuing a guarantee that rivalries of the kind that Reichenbach discusses are impossible – impossible, again, because the "relations a thing sustains are hardly a competitor to the thing itself." Dewey vigorously criticized other philosophies for trying to give guarantees of things that cannot be guaranteed. I think he ends up doing something like that here, and he also does so, I have argued, by drawing too much on the same metaphysical inheritance that he dissected and described so well. So on both of these points, my criticism of Dewey is a Deweyan one.

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