

“LET THE OCCULT QUALITY GO”: INTERPRETING BERKELEY’S METAPHYSICS OF SCIENCE¹

TOM STONEHAM, ANGELO CEI

University of York

ABSTRACT

Berkeley’s philosophy of science is normally interpreted as some form of anti-realism, usually instrumentalism or constructive empiricism. In this paper we identify a different strand in his thought about the metaphysics of science, a strand which can be interpreted as a form of structural realism. We begin by picking out this strand in Berkeley’s thought and then look in some detail at different forms of structural realism. While the parallels are striking, the motivations are very different indeed: Berkeley was motivated by an a priori philosophical metaphysical method whereas contemporary structural realists are motivated by a naturalistic method in metaphysics. The consequence is that Berkeley’s position is the more amenable to commonsense.

Key words: Berkeley; idealism; immaterialism; philosophy of science; structural realism; ontology.

“So fixed, so immutable are the Laws by which the unseen Author of nature actuates the [seen] universe.” DHP2 210

1. Introduction

At *De Motu* section 4, Berkeley wrote “Melius itaque foret, si, missa qualitate occulta”, which Luce translated as “And so men would do better to let the occult quality go.” The verb Luce translates as ‘go’ is ‘missio’, which makes clear that, despite Berkeley’s animadversions against metaphors in philosophy in section 3, the expression is metaphorical.²

¹ Those who know the two authors will quickly determine the responsibility for different parts of the paper. An earlier version was read at a workshop on Early Modern Philosophy and the Sciences at Leiden in October 2008, where Lex Newman and Eric Schliesser gave especially useful comments.

² Desmond Clarke (2008) translates it as ‘dismiss’, which has a greater connotation of action. ‘Let go’ has the implication that the occult qualities would naturally drift off into the unintelligible void were it not for the determination of some to hang on to them.

The metaphor has had a recent revival in philosophy of science in the title of James Ladyman and Don Ross's 2007 book *Every Thing Must Go*. That book defends a metaphysics of science called 'Ontic Structural Realism' (OSR), a view which has only been explicitly formulated in the late 20th century.³ An ontic structural realist believes that structure is what there is, that every thing else, in particular the things and their intrinsic qualities, do not exist and must thus be let go from our metaphysics. This is an interesting position which manages to combine the anti-realist's doubts about the plethora of obscure unobservable entities which science – especially physics – liberally postulates, with the realist thought that these sciences are so successful they must be on to something.

This combination of ontological caution and insistence on realism has a familiar Berkeleyian ring to it: the OSRist denies the existence of theoretical entities but claims we did not need them to be a realist anyway, while the Berkeleyian denies the existence of matter while claiming we did not need it to be a commonsense realist after all.⁴ In this paper we take this loose analogy a bit further by comparing OSR with Berkeley's metaphysics of science. Traditionally, Berkeley is read as some kind of instrumentalist or constructive empiricist about scientific theory, but if OSR is correct in its claims to realism without 'occult' entities, it may be better to see Berkeley as holding a form of that view.

It would of course be anachronistic to call Berkeley a Structural Realist, and given that anachronism, nothing in the texts is going to be decisive. Instead we want to argue that there are several texts where Berkeley evinces a more realist stance towards science than the instrumentalist interpretation would predict. These could be explained away, but it seems that OSR gives us an alternative charitable interpretation of Berkeley's thinking about science which reconciles the rejection of occult qualities with a generally realist attitude towards scientific laws and discoveries. Using contemporary categories to interpret historical philosophers is inevitably an inexact science which is best thought of as a matter of plotting the philosopher's remarks onto the contemporary conceptual map and looking for clusters. Our thesis is that, while there is undeniably a cluster in the region of instrumentalism, there is also a previously unnoticed cluster in the region of Ontic Structural Realism. At the end we reflect briefly on the extent to which OSR is Berkeleyian in spirit as well as letter.

2. Berkeley Exegesis

Our main source is going to be the 1721 tract *De Motu*, but first we want to discuss a feature of the *Principles* which is not discussed even in such careful exchanges as that between Garber (1982) and Wilson (1985) on whether Berkeley accepted corpusculari-

³ First given that name in Ladyman 1998; an ancestry can be traced to Cassirer 1936.

⁴ It may seem odd to some that we regard Berkeley as a realist, but that is how he thought of himself. His main point was that materialism arises when we mistakenly assume that the reality of ordinary objects like tables and trees requires them to be mind-independent. See Stoneham 2009 for these distinctions.

anism. This is the *narrative structure* of the discussion of laws and explanation. It is immediately striking that it is in these discussions that Berkeley makes one of his rare uses of numbered paragraphs in referring the reader back to earlier discussions, and by using these links we can see how he intended the argument to develop through the book.

The important passages are §§30–1, 58–9, 60–5, 101–7. In §30 Berkeley first introduces the “Laws of Nature” and here he is clearly thinking of general rules of thumb or heuristics which relate everyday experiences, such as “That food nourishes, sleep refreshes, and fire warms us” (PHK31). These heuristics have clear practical benefits and are easily discoverable by anyone who experiences both sign and thing signified (and who is prepared to perform a little inductive reasoning). His fourth example, “that to sow in the seed-time is the way to reap in the harvest” (PHK31) takes a little more sustained observation, but is only likely to be missed by those who have no knowledge of farming. So at this point, Laws of Nature have little to do with science and much more to do with folk wisdom.

While these laws are used often in the following discussions, they do not become objects of investigation again until §58 when he considers the objection that immaterialism is “inconsistent with several sound truths in philosophy and mathematics”, for example that the earth moves about the sun. His response has two parts. The first is to reduce the claim that the earth moves to the claim that were we “placed” in a suitable position, we would perceive the earth to move just like the other planets. The second is to note that this conclusion is “by the established rules of Nature, which we have no reason to mistrust, ... reasonably collected from the phenomena”.

This response marks a crucial change in his conception of the laws of nature. No longer are they merely heuristics linking everyday experiences. It is now seen to be acceptable to infer from those rules to an *inaccessible* possible experience, that is an experience which there is no way for the people using those rules ever to undergo themselves. The astronomers can tell us where we would have to be placed to see the earth moving, but neither they nor anyone else can tell us how to get there. The inaccessibility here is practical: the experience which the laws predict is one “pursuant to a great train of actions” (PHK59) and that train may be too long for the predictor ever to gain the experience. In effect, Berkeley is saying that there is some train of actions which will ultimately lead to space travel! But the important point is that he has allowed laws to predict perceptual experiences outside the normal range of human life.

§§60–6 are Berkeley’s response to the objection that microscopes and other instruments reveal an internal structure in plants and animals, which structure allows us to explain their behaviour along mechanical lines. The inescapable analogy of a watch comes up and the objection shows it can be transferred to artefacts: why does the watchmaker need to make all those intricate parts if God moves the hands directly? It is the first part of the response, in particular §62, which advances our understanding of the laws of nature and also contains a cross-reference to §31 and is referred back to at §105.

Berkeley's response to the objection from microscopes is well-known. It is that these inner mechanisms are "necessary to the producing of things in a constant, regular way, according to the Laws of Nature" (PHK62). But the laws he refers to here cannot be the everyday heuristics of §31, because these new laws are "learned by the observation and study of nature", presumably often using instruments and experiments. It becomes clear a few sentences later that Berkeley has in mind the "standing mechanical Laws of Nature." Presumably these are the laws of motion and impact which work as well for macroscopic as microscopic objects, for the objects of ordinary perception and for the discoverable inner structures of those objects. And because they have this generality, applying equally to all objects of perception whether those perceptions are aided by instruments or not, explanations which consist of subsuming the phenomena under those laws are better than explanations which use less general laws and thus discover less uniformity in the natural world:

explaining the various phenomena: which explication consists only in shewing the conformity any particular phenomenon hath to the general Laws of Nature, or, which is the same thing, in discovering the uniformity there is in the production of natural effects; as will be evident to whoever shall attend to the several instances, wherein philosophers pretend to account for appearances. (PHK62)

Berkeley is able to incorporate mechanical explanations in this way because of a subtle development of his conception of laws. At first he considered only laws relating ordinary experiences. Then he extended them to allow *prediction* of practically inaccessible experiences. Now he is allowing them to *explain* phenomena in terms of *relatively* inaccessible experiences, that is experiences which are usually only available to the natural philosopher in his laboratory. But it is crucial that the explanations are still framed in terms of actual and possible experiences. There is still at this stage no consideration of laws which explain in terms of things of which we are "under an invincible blindness" (PHK101), namely the "insensible particles" (PHK102) of the corpuscularian philosophy.

Between sections 66 and 100, Berkeley discusses at length the postulation of insensible things, be they immaterial spirits such as God, or matter itself. This provides a natural context for considering those who postulate unobservable natures of things, essences, which explain their phenomenal properties. And at first this move looks like a very natural extension of what Berkeley had said about inner structures at §62, for those structures are often unobserved, but their "presence" allows us to explain a wider range of phenomena by the simple and general mechanical laws. So it would seem that the postulation of a further layer of – necessarily hidden – structure merely extends this mechanical explanation even further (e.g. Garber 1982).

Many of Berkeley's criticisms of this proposal are based on independently established principles, such as that only minds have causal powers, but one is of particular rel-

evance to our present concerns. At §103 he takes a specific example, namely the "great mechanical principle now in vogue", attraction. He accepts that it is entirely legitimate to collect a variety of phenomena in which there is "mutual drawing of bodies" and say in each case attraction is at work. However, this is just a label for the common feature of the phenomena:

I do not perceive that any thing is signified besides the effect itself; for as to the manner of the action whereby it is produced, or the cause which produces it, these are not so much as aimed at. (PHK103)

Yet this labelling does serve a purpose, since some of the phenomena are very familiar but others are less so, hence explaining the tides as the attraction of the oceans to the moon helps bring it into the same category as more familiar phenomena such as falling stones. By subsuming several phenomena under a general rule we can explain them:

That bodies should tend towards the centre of the earth, is not thought strange, because it is what we perceive every moment of our lives. But that they should have a like gravitation towards the centre of the moon, may seem odd and unaccountable to most men, because it is discerned only in the tides. (PHK104)

The natural philosopher, then, is not someone who has esoteric knowledge of the hidden inner mechanisms which drive the observable behaviour of things, but someone with "a greater largeness of comprehension" (PHK105) who can see that apparently diverse phenomena can all be brought under a single description, so that "the particular effects [are] explained, that is, reduced to general rules", which rules are based upon the uniformity of observable things rather than hidden real essences. Rules so based can "extend our prospect" in the manner indicated in §59, that is by allowing us to predict inaccessible experiences.

Problems arise, however, if we do take ourselves to have discovered a hidden principle underlying the behaviour of bodies, for then we are likely to think it universal and thus overgeneralize, overlooking cases where there is no "mutual drawing of bodies", such as "the perpendicular growth of plants, and the elasticity of the air" (PHK106).

The error here is quite subtle. We are, it seems, quite reasonable in expecting that the mechanistic inner structures we find in plants and animals and exploit in artefacts will be entirely general. But we are unreasonable in expecting the mechanistic principle of attraction to so generalize. For that would be to treat attraction not as a label for an observed phenomenon but as an occult quality, a hidden mechanism. Since, by definition, occult qualities are merely *postulated* on the basis of the phenomena and *not observed* to go with those phenomena, we have no basis for an inductive inference. So the only law we could discover would not extend beyond actual observation of the phenomena which are meant to be explained by attraction. However, in the case of

microscopic knowledge, the mechanisms are not postulated but experienced. So a law which is grounded in experience may allow us to make “very probable conjectures” (PHK105) beyond the bounds of actual experience to possible and perhaps inaccessible experiences, but a law which is based on a postulated, occult quality cannot be projected in that manner because, without an observed correlation, the production of the phenomena depends upon the “will of the governing spirit” (PHK106) on a case by case basis. Effectively, someone who postulates a hidden essence is postulating a law according to which God is voluntarily constraining His will. Now, while it is reasonable to think that God does constrain His will to laws and that these laws are discoverable, it is only reasonable to think He does so in order to allow us to project discovered correlations in experience.

This conclusion appears to be where Berkeley starts in *De Motu*, which begins with a succinct and forceful summary of his position:

By reason, however, we infer that there is some cause or principle of these phenomena, and that is popularly called gravity. But since the cause of the fall of heavy bodies is unseen and unknown, gravity in that usage cannot properly be styled a sensible quality. It is, therefore, an occult quality. But what an occult quality is, or how any quality can act or do anything, we can scarcely conceive--indeed we cannot conceive. And so men would do better to let the occult quality go, and attend only to the sensible effects. (DM4)

What is itself occult explains nothing. (DM6)

However, he quickly realizes that a slightly more nuanced view is necessary, because there is a great deal of good science which is framed in terms which seem to name the very occult qualities he is rejecting:

Force, gravity, attraction, and terms of this sort are useful for reasonings and reckonings about motion and bodies in motion, but not for understanding the simple nature of motion itself or for indicating so many distinct qualities. As for attraction, it was certainly introduced by Newton, not as a true, physical quality, but only as a mathematical hypothesis. Indeed Leibniz when distinguishing elementary effort or solicitation from impetus, admits that those entities are not really found in nature, but have to be formed by abstraction. (DM17)

Now it is interesting that in admitting that good, useful science may need to make use of terms for occult qualities, Berkeley seems to have overcome his earlier worry about overgeneralization. Gravity and attraction are now connected with force, which does seem plausibly to be universal to all explanations of motion. It seems that he does now allow that the mechanical principles of gravity and attraction and impetus can be used to formulate laws which, though not based upon observed correlations, do extend be-

yond our experience, just so long as we still do not think that the truth of those laws is derived from their telling us about the essential natures of things. So there is a sound basis for discovering projectible laws other than enumerative induction, though he tells us nothing here about what this may be.

Though we may not have observed attraction (as opposed to its alleged effects), with the consequence that laws of attraction are not discovered by inductive generalization on experienced correlations, we may have reason to believe that the phenomena are universal and thus that God is operating according to a rule here. But we must not think that the way he operates according to this rule it to create insensible particles with insensible qualities which are such that, were we, *per impossibile*, to sense them, we could base the law on an inductive generalization.

He gives a rather effective example of a rule which is general but which we are not inclined to think is ultimately grounded in correlations between unobservable and observable qualities, in this case forces:

A similar account must be given of the composition and resolution of any direct forces into any oblique ones by means of the diagonal and sides of the parallelogram. They serve the purpose of mechanical science and reckoning; but to be of service to reckoning and mathematical demonstrations is one thing, to set forth the nature of things is another. (DM18)

We may well find it useful to resolve each force into two orthogonal ones, but it would be absurd to think that every force actually consisted of two unobservable forces which combined to create the observed effects of a single force, not least because of the infinite regress. So we can see that the objection in the *Principles* to laws based on alleged essences remains, but he is more open to there being projectible, highly general laws which are not based on induction. God not only constrains His will to make inductive generalizations work, but also further constrains His will to make the more abstracted sciences work.

Now we face a question about the status of these "useful" laws framed in terms of occult qualities. It would seem that, since the qualities do not exist, the laws cannot be true. But that sits at odds with other things Berkeley wants to say about them, particularly in *De Motu* sections 35 to 41, where he talks of:

...the mistake of rejecting the mathematical principles of physics... (DM35)

...in mechanical philosophy those are to be called principles, in which the whole discipline is grounded and contained, those primary laws of motions which have been proved by experiments, elaborated by reason and rendered universal. (DM36)

...once the laws of nature have been found out... (DM37)

Mechanical principles and universal laws of motions or of nature, happy discoveries of the last century... (DM41)

The clear direction of these remarks, which are not untypical, is that laws of nature are objects of knowledge. While Berkeley wants to emphasize that they are not “in the truth of things” (DM39), his point here is the old one that the occult qualities do not exist, not that the laws framed in those terms are not true propositions. Berkeley is making this point in his summary of the discussion:

From the foregoing it is clear that the following rules will be of great service in determining the true nature of motion: (1) to distinguish mathematical hypotheses from the natures of things; ... If we do so, all the famous theorems of the mechanical philosophy by which the secrets of nature are unlocked, and by which the system of the world is reduced to human calculation, will remain untouched; ... (DM66)

So long as we distinguish between the “true natures of things” and the truths which unlock the secrets of nature, we can leave the mechanical philosophy “untouched”.

There is a further discussion of force in *Alciphron* VII. Here Berkeley’s primary objective is to defend the possibility of rational assent to the Christian Mysteries against the charge that they are unintelligible because we have no ideas of, e.g. grace or a future state. The main element of his response is an analogy with force:

Excluding body, time, space, motion, and all its *sensible* [italics ours] measures and effects – we shall find it as difficult to form an idea of force as of grace ... (A VII, 6)

And yet ... there are very evident propositions or theorems relating to force, which contain useful truths: for instance, that a body with conjunct forces describes the diagonal of a parallelogram ... Ought we not therefore, by a parity of reason, to conclude there may be divers true and useful propositions concerning [grace] as well as [force]? (A VII, 7)

Of course, the analogy is only successful if we accept, as *Alciphron* does, that there are knowable truths about forces. And grounding the analogy is a theory of understanding, namely that having one’s thought and conduct influenced by a proposition constitutes sufficient understanding to make discourse significant and assent possible (A VII, 8), and assent is necessary for knowledge (A VII, 11). Furthermore, given that there are no abstract ideas, in non-observational knowledge:

the mind makes her progress ... by an apposite choice and skilful management of signs (A VII, 11)

[which] signs may imply or suggest the relations of things; which relations, habitudes or proportions, as they cannot be by us understood but by the help of signs, so being thereby expressed and confuted, they direct and enable us to act with regard to things. (A VII, 14 — 1752 edition only)

So truth and knowledge, in science and religion, depend upon the relations between signs – and between signs and actions – rather than a cognitive relation to what is (apparently) signified. Again we find the mixture of an instrumentalist concern with utility and an assertion of the possibility of cognitive success.

However, there is a problem, for a theist at least, with taking the analogy too far. While Alciphron is a realist about forces as intrinsic qualities, Berkeley has earlier told us they are occult qualities which we must let go. Yet Berkeley is unlikely to want to take the same line with the key terms of religious discourse: grace is no occult quality! The difference is that religious discourse concerns the actions of a divine mind and minds, being active, are things of which we cannot have ideas (A VII, 5). Scientific discourse, in contrast, concerns the physical world, which is something we can perceive (and, according to Berkeley, does not consist of matter). Unperceivable mental qualities are inevitable whereas unperceivable physical qualities are occult.

Though it is heavily laced with other considerations, we can find much the same view even in the *Siris*:

From the outward form of gross masses which occupy the vulgar, a curious inquirer proceeds to examine the inward structure and minute parts, and, from observing the motions in nature, to discover the laws of those motions. By the way, he frames his hypothesis and suits his language to this natural philosophy. And these fit the occasion and answer the end of a maker of experiments or mechanic, who means only to apply the powers of nature, and reduce the phenomena to rules. But if, proceeding still in his analysis and inquiry, he ascends from the sensible into the intellectual world, and beholds things in a new light and a new order, he will then change his system, and perceive that what he took for substances and causes are but fleeting shadows; that the mind contains all, and acts all, and is to all created beings the source of unity and identity, harmony and order, existence and stability. (295)

Note how the mechanical philosopher is said to reduce the phenomena to rules, and when he ascends to the intellectual world he rejects not the rules themselves but the non-mental substances and causes which he took to be the grounding or basis, or as we might say, the truth-makers, for those rules. The proper understanding of the nature of things does not undermine the mechanical philosophy but merely shows its limited scope: it correctly tells us of the patterns to be discovered in “gross masses”, but fails to tell us anything about why those patterns hold.

3. Where the Philosophy of Science is now

20th century metaphysics of science begins at an epistemological point which was familiar to Berkeley, namely the distinction between humanly observable and non-observable items in the world. Observation, and its ability to give us certain knowledge, is for the purposes of this debate, taken as unproblematic. The non-observable items (if there are any) make their way in to human cognition through the construction of theories. When we look at science we are indeed amazed by the impressive inventory of empirically tested data, the range of phenomena stabilized through the overlapping of varieties of experimental techniques and the painstaking modelling and theorizing.⁵ While it is a philosophical option to dispute the steady growth of empirical knowledge that is associated with the development of modern scientific disciplines, few of the positions in the modern debate do so and nor did Berkeley. On the contrary, Berkeley regularly emphasized the practical benefits of scientific knowledge. But practical benefits are measured in terms of the prediction of observations, so admitting them leaves open many questions about the non-observable theoretical items and the theories which apparently bring them into the range of human cognition. Such questions might be:

- (1) Does a proton or a quark, which can only be detected through its effects,⁶ exist?
- (2) Are genes and DNA sequences, which require highly sophisticated apparatuses in order to be detected, really out there?
- (3) Does the Schrödinger wave function describe a real feature of the world?
- (4) Can predictively successful theories be taken faithfully to represent even when they make claims beyond the scope of empirical confirmation?

A tendency to give affirmative answers to these questions is generally taken to be a mark of realism about science. On the basis of what we have seen about Berkeley's views above, we can already see some complexity here, for it seems that he would answer "No, Yes (think of microscopes), No, (qualified)-Yes".

Berkeley is not alone in this complexity of response, for realism comes in different brands. A first tentative partition of realist theories might go like this. On one hand there are the ones that commit to the approximate truth of predictively successful theories in their entirety and the reality of the entities and the laws they postulate. On the other hand, there are the ones that manifest scepticism about the truth of laws and successful theoretical frameworks while willingly accepting the existence of some non-observable entities or processes – so long as they can be subjected to various forms of

⁵ A rather more negative spin is put on this observation at DM16 and DM19.

⁶ "We must, however, admit that no force is immediately felt by itself, nor known or measured otherwise than by its effect; ..." (DM10)

experimental manipulations. Theories and laws play a substantially instrumental role allowing us to work out models and strategies to drive the interaction. On both hands the success of science is a clue to its latching onto something real but in the second case this does not depend upon sharp theoretical descriptions, rather it is associated with success in producing phenomena through causal manipulation. In the first case, in contrast, the philosophical position is called into play in order to explain what might appear mysterious or miraculous in scientific performances: their success. The truth of theories and laws, and the existence of the entities the theories introduce are seen as the explanation, the best explanation, of such success. When the debate is described like this, we see that logic dictates there is a third hand, a variety of realism according to which scientific theories are taken to be approximately true representations of reality, but the theoretical entities are suspect. This is the region of logical space inhabited by the Structural Realist.

Structural Realism was first explicitly identified as a position by John Worrall in a famous 1989 paper called 'Structural Realism: The best of both worlds?'. His thinking begins with a familiar concern that there is in fact a problem with thinking that the growth of empirical data from observation and experiment leads to progress in scientific theorizing, where progress is thought to mean greater approximation to the truth. The problem is that theories are constructed to account for one set of data and then discarded and replaced with new incompatible theories in the face of new data. This can strike the outside observer as "ruins piled upon ruins", to quote Poincaré's evocative phrase, leading to serious doubt that science is making progress.

Worrall's strategy was to concede that the advocate of a similar argument might have a point as far as the entities of certain past successful theories are concerned, but to try to block the pessimistic inference. Taking examples from Laudan (1981), Worrall makes the point that a theory which is radically wrong about the metaphysical nature of a phenomenon might still get something right. One example is Fresnel's "stationary luminiferous aether" theory of light. Here is what Worrall says about it:

[...] Fresnel completely misidentified the *nature* of light, but nevertheless it is no miracle that his theory enjoyed the *empirical predictive success* that it did; it is no miracle because Fresnel's theory, as science later saw it, attributed to light the right *structure*. (Worrall 1989, 117, second italics ours)

Fresnel's theory of the nature of light lacked empirical confirmation – we never managed to detect the aether! – but it was fairly successful in its predictions. If we are inclined to explain such successes not by luck but by scientists getting *something* right, then we should look to the structural features of his theory. These structural features can be understood to represent the relational properties of light, and since the structural features can be found in successor theories, in particular the electro-magnetic theory of light, we can see that Fresnel's theory was not completely discarded. To push

Poincaré's metaphor to its limit, Worrall is claiming that the electromagnetic theory was not built on the ruins of the aether theory, but upon the pillars and beams of that theory.

Worrall's conclusion was that since scientific progress occurs in the structural features of theories, not their claims about the natures of things, science can only give us knowledge of *structure*:

On the structural realist view what Newton really discovered are the relationships between phenomena expressed in the mathematical equations of his theory. (1989, 122)

This view came to be called 'Epistemic Structural Realism' (ESR) when other varieties were proposed. The echo of Berkeley's claim that Newton's talk of attraction was a "mathematical hypothesis" should be clear. However, ESR is implicitly committed to these theoretical entities in fact having a true nature, even though it is beyond our ken. In Berkeley's metaphysical framework, where the only causation in the physical world is Divine (with the possible exception of human actions),⁷ that commitment is equivalent to the redundant postulation of matter as an instrument by which God causes our experiences.

There is another brand of Structural Realism, Ontic Structural Realism, which explicitly drops this commitment.⁸ One of the main proponents of this view, James Ladyman, presents the difference between ESR and OSR as follows:

Worrall's position in his 1989 paper is not explicitly an epistemic one, [...] If the continuity in scientific change is of "form or structure", then perhaps we should abandon commitment to even the putative reference of theories to objects and properties, and account for the success of science in other terms. Others who have contributed to structural realism have more explicitly signalled a significant departure from *traditional realist metaphysics*. [...]

A crude statement of ESR is the claim that all we know is the structure of the relations between things and not the things themselves, and a corresponding crude statement of OSR is the claim that there are no 'things' and that structure is all there is. (Ladyman 2007)

Such a view is and should be extremely puzzling. Since the structures in theories are being taken to represent faithfully the relational features of the world, surely there can-

⁷ See Stoneham 2010 for a discussion of this point.

⁸ Intermediate between the two is Chomsky's (2009) position, which we might call 'Methodological Structuralism'. Chomsky's view is that when we come up with some equations which work but we find the question of why they work mysterious, as Newton did with gravity, which should ignore the 'Why?' question and get on with what works, for the sense of mystery is nearly always caused by a misunderstanding of the physical/material.

not be relations without relata. Does it really makes sense to say not only that the only bits of our theories which we have reason to believe are true are the structural features but also that the remainder, the claims about what entities there are and what their intrinsic properties are, cannot be true because there is nothing to make them true?

Well, this does seem very close to the position we attributed to Berkeley, namely that the mechanical theories are objects of discovery and knowledge, and thus presumably true, just so long as we do not take them to be explaining the phenomena in terms of hidden natures or essences of things which cause and explain their "discernible qualities" (PHK102). Indeed, while ESR is concerned with the extent to which, and the reasons why, we can take successful theories to be *approximately true* along the lines of a historically informed fallibilist attitude, OSR is motivated by the ontological problems raised by viewing those theories as true representations of the world *simpliciter*. And it seems that Berkeley too is motivated by such ontological concerns throughout his consideration of scientific knowledge.

We should, however, exercise some caution here. Firstly, there are many different varieties of OSR and most of those have motivations which are alien to Berkeley. For example, much of what proponents of OSR try to argue is that the theoretical entities of physics are not really entities at all, at least to the extent that they are either not individuals or they have no intrinsic natures over and above what is fixed by their relational properties (see next section for a detailed explication of this). This sort of debate would be ridiculed by Berkeley since he has prior and more general metaphysical reasons for doubting these unobservable entities. But that difference obscures a much deeper similarity: both Berkeley and OSR reject the thought that scientific explanations can only be understood to work in virtue of hidden intrinsic natures of things. Scientific theories work because they get the structure right and that is enough – to think that the structure only explains *in virtue of* something non-structural is, according to both, just plain bad metaphysics. The version of OSR which is most radical on this point – and also the one most strikingly similar to Berkeley's views – has understandably been described as 'Eliminativist'.

Berkeley's rejection of forces and other 'occult' qualities is driven by general metaphysical concerns which are taken to be prior to science and his primary concern is to show that this rejection is consistent with accepting the almost undeniable truth of Newtonian mechanics. In contrast, contemporary defences of OSR are largely motivated by the internal features of Quantum Mechanics and a certain naturalism about metaphysics, expressed by Fine as:

the potential in science itself for addressing *virtually all the sorts* of interpretative questions and issues that philosophy traditionally pursues. (Fine 1989, italics ours)

In other words, for contemporary proponents of OSR, when we correctly interpret physics it has the potential to refute certain metaphysical theses (for an account of Berkeley as the first person to identify and respond to this naturalism in metaphysics, see Schliesser 2005). This contrasts with the traditional philosophical account of metaphysics as first philosophy, thereby placing a constraint upon interpretations of physics. To quote Ladyman again:

Ontic structural realists argue that what we have learned from contemporary physics is that the nature of space, time and matter are not compatible with standard metaphysical views about the ontological relationship between *individuals, intrinsic properties and relations*. On the broadest construal OSR is any form of structural realism based on an ontological or metaphysical thesis that inflates the ontological priority of structure and relations. The attempt to make this precise splinters OSR into different forms [...]. (Ladyman 2007, 15, italics ours)

This extreme difference in philosophical method might make the comparison of Berkeley's view of science with OSR appear simply ridiculous. However, we think that the similarities run deeper than the differences. In particular, by looking in some detail at the argument for OSR from Quantum Statistics, we see that the basic thought is very Berkeleian in character, namely that a straightforwardly realistic interpretation of the physics as describing the behaviour of unobservable entities is not merely redundant and unmotivated (as the instrumentalist might say) but leads to incoherence. Which is pretty much exactly Berkeley's opinion of the unobservable material objects postulated by the scientists of his day.

5. Quantum 'mass culture': when particles lost their individuality

Metaphysicians have always taken particular interest in the concepts of individuality and distinguishability. A common theme has been that what constitutes the individuality of an item and what allows us to distinguish it from other individuals of the same kind are not necessarily the same feature; for example, we may only be able to distinguish twins by their location at a time, but that is a contingent feature and it might easily have been the other, distinct but not distinguishable, twin who was here now. Classical statistical mechanics has this idea sitting at its core. Consider the following arrangement of two particles, labelled 1 and 2, in two boxes, representing states the particles can be in:

1, 2	
	1, 2
1	2
2	1

This diagram appears to show all and only the in principle possible combinations. In classical statistics, the third and fourth arrangements are considered distinct states and given the same the same statistical weight; namely particle 1 in state *a* and particle 2 in state *b* is a *different* total state from particle 1 in state *b* and particle 2 in state *a* (French 1998, 94–5).

This is not true of the quantum case, where the statistics have to be in agreement with the spectroscopic evidence that forces upon us a completely different account of the possible states. There are two options. Bose-Einstein statistics treats cases in the third and fourth arrangement as one case and associate with it a probability double the other two states.

Going back to our boxes we can illustrate the possibilities on Bose-Einstein statistics as follows:

1, 2	
	1, 2
1 (2)	2 (1)

Pairs of particles for which these are the possible combinations of states are called ‘Bosons.’ Fermi-Dirac statistics, in contrast, rules out all the other possible combinations of states except the third in the above diagram, namely:

1 (2)	2 (1)
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Such particles are called ‘Fermions.’ We can skip the (very important) details about the technical differences between the statistics of Bosons and Fermions, for what is relevant to our discussion is that Quantum Statistics of both types seems to treat the names 1 and 2 as idle labels not picking out distinct individuals. It is as if any names we introduced for one of a pair of twins could always be applied to the other *salva veritate*. This result is due to a permutation symmetry principle known as the Indistinguishability Postulate:

If a particle permutation *P* is applied to any state function for an assembly of particles, then there is no way of distinguishing the resulting permuted state function from the original unpermuted one by means of any observation at any time.

(The state function of quantum mechanics determines the probability of measurement results. Hence what the Indistinguishability Postulate expresses is that a particle permutation does not lead to any difference in the probabilities for measurement outcomes.) (French 2006)

Now, *prima facie*, this situation seems to yield the conclusion that quantum particles are not individual entities. Permuting indistinguishable particles, it has been noted since the earliest interpretations of quantum concepts, is a fruitless business since permuted states do not count as new states. This suggests that the theory does not entail

that the particles own any identity over and above the conditions (states) in which they are distinguished. So – assuming that QM is not incomplete – the quantum particles are in some sense not individuals.

However, more careful analysis has been prompted by observing that this conclusion depends on what we take the above postulate to mean (French 1998, 95-96). In particular we have two possible interpretations:⁹

- Either:** the postulate is telling us which operators express observable states of the system and is saying in particular that an operator that permutes particles in two states is not expressing a genuine physical operation; i.e. the operator tells us nothing about the physical properties of the particles under investigation.
- Or:** the postulate is telling us which states are physically accessible or realisable and in particular is ruling out the non-symmetric ones. In other words, it is not denying that there are possible states of the system in which the permutation of the particles would count as physically distinct. It is saying that such states do not ever realise or, if you like, that the system cannot access them.

The conclusion for the non-individuality follows from the ‘Either’ interpretation only. The ‘Or’/inaccessibility interpretation is compatible with a metaphysical package in which particles are individuals, it is just that they are not distinguishable in any accessible states of the system. Now, if the underlying motivation behind OSR is that quantum particles are not individuals, and a non-structuralist account would have to say they were, then OSR must formulate objections to the inaccessibility interpretation. Whether or not this is a genuine case of the physics underdetermining the metaphysics, in which case the defence of OSR would have to rest on metaphysical principles, it seems quite clear that Berkeley would prefer the first option on metaphysical grounds. If there are grounds for preferring the first option which are compatible with the naturalistic approach to metaphysics endorsed by OSRists, then that presents no problem for Berkeley, who already arrived at the same conclusion by his own route. Thus, despite their methodological differences, Berkeley and the proponent of the argument from quantum statistics should see themselves as allies.

6. Commonsense

We want to end with a few reflections on the differences between Berkeley’s position and contemporary OSR.

⁹ The results that lead to the dilemma are unrelated to the development of Structuralism as a realist position and are not achieved by French alone; they reflect a lasting tradition of interpretative analysis of Quantum Physics; see for instance Huggett 1995 and 1997; French and Redhead 1989; Redhead and Teller 1991 and 1992; and van Fraassen 1984 and 1985. For an alternative analysis run from a naturalistic perspective see Saunders 2003.

Contemporary proponents of OSR usually want to extend their structuralism beyond the merely theoretical to the observed and observable entities as well. They want to claim that perception of medium-sized dry goods also only reveals structure, and that there are no entities at all which have intrinsic natures. There are two main motivations for this:

1) Naturalism about metaphysics.¹⁰ If physics, properly understood, rejects individual entities with intrinsic natures, then a naturalistic metaphysics will have grounds to reject all such entities.

2) Doubts about the coherence of the concept of identity. The concerns arising from quantum statistics can be seen as not only putting pressure on the claim that bosons and fermions exist, but also on the thought that anything, at least anything in a universe where quantum mechanics is true, conforms to the conditions required for being an individual object.

Of course, Berkeley rejects the naturalism of 1). His metaphysical concern with the occult qualities would lead him to dismiss the debate in terms of the individuality of unobservables as misleading metaphysics whether or not it is prompted by the details of physics. Nonetheless as we have seen the argument from the Indistinguishability Postulate would be something that serves his cause as much if not better than it serves the purpose of the OSRist, for it shows that physics might underdetermine metaphysics on quite basic matters in a way incompatible with strict naturalism.

Berkeley would have a rather more subtle response to 2), holding that the individuality of particular ideas is a rather different matter to the individuality of persistent public objects such as trees, let alone bosons (see Stoneham 2002, chapter 8). But a more fundamental concern would be his thought that it is unintelligible to extend OSR to the perceptible, observable world for the simple reason that our perceptual experience presents that world in terms of sensible qualities which are intrinsic. When someone sees that a coffee cup is green, they see it as having a quality, greenness, which is not exhausted by the relational features of the cup which might be represented in the structure of their 'theory' of it. To extend OSR to perceptible objects is to deny that those objects have the properties they seem to us to have. In other words, to extend OSR to the realm of the perceptible, one has to assume that our perceptual experiences misrepresent the world, and thus, *a fortiori*, that they are representational states. But Berkeley would deny that because for him seeing the greenness of the cup is not representing it at all (Stoneham 2006) and thus cannot be misrepresenting it. Rather, seeing the greenness is having that very property instance directly present to your mind. It seems, then, that extending OSR to perceptible things requires us to accept "those principles ... that lead us to think all the visible beauty of the creation a false imaginary glare" (DHP2 211). Thus Berkeley is no structuralist about the perceptible world.

¹⁰ We have been using 'naturalism' throughout to describe a methodology for metaphysics, a usage established in Papineau 1993. Physicalism is a doctrine that most, but not only, naturalists hold.

The resulting position has a certain attractiveness. It leaves in place the ordinary, everyday, perceptible world, replete with objects and their intrinsic (but not unobservable) natures, it allows us to understand science as revealing deeper truths not available in ordinary experience, but does not require us to accept mysterious, occult entities, hidden natures behind the diaphanous veil of the experienced world. The structuralist Berkeley agrees with the instrumentalist Berkeley that observable entities exist and unobservable ones do not, but disagrees on the status of scientific laws. For the instrumentalist, these are just calculating tools allowing us to predict experiences, for the structuralist, they also reveal the real structure of the world. This is admittedly a subtle difference, but an important one which allows us to regard the scientists as engaged in a process of discovering objective truths.

REFERENCES

- Berkeley, G. 1710. *Principles of Human Knowledge*. In Jessop & Luce 1948-51, referred to as PHK.
- Berkeley, G. 1713. *Three Dialogues Between Hylas and Philonous*. In Jessop & Luce 1948-51, referred to as DHP.
- Berkeley, G. 1721. *De Motu*, trans. A.A. Luce. In Jessop & Luce 1948-51, referred to as DM.
- Berkeley, G. 1732. *Alciphron or the Minute Philosopher*. In Jessop & Luce 1948-51, referred to as A.
- Berkeley, G. 1744. *Siris*. In Jessop & Luce 1948-51.
- Cassirer, E. 1936 [1956]. *Determinism and Indeterminism in Modern Physics*. New Haven: Yale University Press.
- Chomsky, N. 2009. The Mysteries of Nature: How Deeply Hidden? *Journal of Philosophy* 106: 167-200.
- Clarke, D. ed. 2008. *Berkeley: Philosophical Writings*. Cambridge: Cambridge University Press.
- Esfeld, M. 2004. Quantum entanglement and a metaphysics of relations. *Studies in History and Philosophy of Modern Physics* 35: 601-17.
- Esfeld, M. and V. Lam, forthcoming. Moderate structural realism about space-time. To appear in *Synthese*.
- Fine, A., 1989. Interpreting Science. In *PSA 1988: proceedings of the 1988 biennial meeting of the Philosophy of Science Association. Volume 2*, ed. A. Fine and J. Leplin. East Lansing, Michigan.
- Foster, J. and H. Robinson eds. 1985. *Essays on Berkeley*, Oxford: Oxford University Press.
- French, S. 1989. Identity and Individuality in Classical and Quantum Physics. *Australasian Journal of Philosophy* 67: 432-446.
1998. On the Withering Away of Physical Objects. In *Interpreting Bodies: Classical and Quantum Objects in Modern Physics*, ed. E. Castellani, 93-113. Princeton: Princeton University Press.
- French, S. 2006. Identity and Individuality in Quantum Theory. *Stanford Encyclopedia of Philosophy*, <http://www.seop.leeds.ac.uk/entries/qt-idind/>
- Garber, D. 1982. Locke, Berkeley and Corpuscular Scepticism. In *Berkeley: Critical and Interpretive Essays*, ed. C. Turbayne, 174-96. Minneapolis: University of Minneapolis Press.
- Huggett, N. 1995. What are Quanta, and Why Does it Matter? *PSA 1994: proceedings of the 1994 biennial meeting of the Philosophy of Science Association. Volume 2*, 69-76 East Lansing: Michigan.
- Huggett, N. 1997. Identity, Quantum Mechanics and Common Sense. *The Monist* 80: 118-30.
- Jessop, T. and A. Luce eds. 1948-51. *The Works of George Berkeley*. London: Thomas Nelson.
- Ladyman, J. 1998. What is structural realism? *Studies in History and Philosophy of Science* 29: 409-24.
- Ladyman, J. 2007. Structural Realism. *Stanford Encyclopaedia of Philosophy*, <http://www.seop.leeds.ac.uk/entries/structural-realism/>

- Laudan 1981. A confutation of convergent realism. *Philosophy of Science* 48: 19–49.
- Papineau, D. 1993. *Philosophical Naturalism*. Oxford: Blackwell.
- Redhead, M. and P. Teller, 1991. Particles, Particle Labels, and Quanta: the Toll of Unacknowledged Metaphysics. *Foundations of Physics* 21: 43–62.
- Redhead, M. and P. Teller, 1992. Particle Labels and the Theory of Indistinguishable Particles in Quantum Mechanics. *British Journal for the Philosophy of Science* 43: 201–18.
- Saunders, S. 2003. Physics and Leibniz's Principles. In *Symmetries in Physics: Philosophical Reflections*, ed. K. Brading and E. Castellani, 289–310. Cambridge: Cambridge University Press.
- Schliesser, E. 2005. On the Origin of Modern Naturalism: The Significance of Berkeley's Response to a Newtonian Indispensibility Argument. *Philosophica* 76: 45–66.
- Stoneham, T. 2002. *Berkeley's World*. Oxford: Oxford University Press.
- Stoneham, T. 2006. Berkeley's "esse is percipi" and Collier's "simple" argument. *History of Philosophy Quarterly* 23: 211–24.
- Stoneham, T. 2009. Berkeley: Arguments for Idealism. In *Routledge Companion to Metaphysics*, ed. Le Poidevin, Simons, McGonigal and Cameron, 119–30. Routledge.
- Stoneham, T. 2010. Berkeley on Action. In *Blackwell Companion to the Philosophy of Action*, ed. T. O'Connor and C. Sandis. Oxford: Blackwell.
- Turbayne, C. ed. 1982. *Berkeley: Critical and Interpretive Essays*. Minneapolis: University of Minneapolis Press.
- van Fraassen, B. 1984. The Problem of Indistinguishable Particles. In *Science and Reality: Recent Work in the Philosophy of Science: Essays in Honor of Erman McMullin*, ed. J. T. Cushing, C. F. Delaney, and G. M. Gutting, 153–72. Notre Dame: University Notre Dame Press.
- van Fraassen, B. 1985. Statistical Behaviour of Indistinguishable Particles: Problems of Interpretation. In *Recent Developments in Quantum Logic*, ed. P. Mittelstaedt and E. W. Stachow, 161–87. Mannheim.
- Wilson, M. 1985. Berkeley and the Essences of the Corpuscularians. In *Essays on Berkeley*, ed. J. Foster and H. Robinson, 131–48. Oxford: Oxford University Press.
- Worrall, J. 1989. Structural Realism: The best of both worlds? *Dialectica* 43: 99–124.

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Department of Philosophy
University of York, York
Y010 5DD, UK
twcs1@york.ac.uk