Chapter 10
Ontological Priority: The Conceptual Basis of Non-eliminative, Ontic Structural Realism

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> *. . . she looked up, and there was the Cat again, sitting on the branch of a tree. . . this time it vanished quite slowly, beginning with the end of the tail, and ending with the grin, which remained some time after the rest of it had gone.*
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> *"Well, I've often seen a cat without a grin," thought Alice; "but a grin without a cat! It's the most curious thing I ever saw in my life!"*
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> — *Lewis Carroll, Alice's Adventures in Wonderland*

10.1 Clarifications Ab Initio

Realisms and antirealisms in the context of discussions of scientific knowledge have had a knack for reinventing themselves, and this is potentially a good thing. Though some despair at the prospect of seemingly perennial debates, the glass half full is that new insights are often provoked by means of these novel formulations. In this paper I consider a recent formulation of scientific realism, the core of which amounts to a provocative metaphysical doctrine. The family of views to which this innovation belongs is called "structural realism" (SR); the relevant genus within this family is now commonly referred to as "ontic structural realism" (OSR); and the novel species under consideration here is something that I will call "non-eliminative OSR", to contrast it with its older and more widely problematized sibling species, eliminative OSR. I will argue that the core metaphysical doctrine underlying non-eliminative OSR, advocating an "ontological priority" of the relations of objects and properties over the objects and properties themselves, is no less problematic. The result is a dilemma for those who would subscribe to OSR in either its eliminative or non-eliminative forms, in hopes of finding a promising way forward for realism in the context of scientific knowledge.

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I will begin with a brief sketch of the idea of OSR, in order to foreground the metaphysical issues under consideration here. SR is the view that insofar as scientific theories offer approximately true descriptions of things in the world, they do not tell us about the underlying nature of reality—that is, about the qualitative natures of things underlying observable phenomena. Rather, they tell us about the *structures* of things.

The position comes in two broad flavours: epistemic (ESR); and ontic. ESR places an epistemic restriction on scientific knowledge in response to sceptical concerns arising from the history of theory change in the sciences. It holds that we can know structural aspects of unobservable parts of the world, but nothing about the natures of those things whose relations define these structures in the first place. The history of scientific change has surely taught us, so the story goes, that the objects themselves and their first-order properties are simply beyond our grasp, but that structural knowledge is likely to be preserved in some form over time. OSR, more radically, began as the view that at best we have knowledge of structural aspects of the world, because there is in fact nothing else to know. The idea that there are objects, for example, conceived of as things that stand in relations to one another, is according to this view a vestige of an outdated metaphysics. The motivation for the revisionary metaphysics of eliminative OSR has its source in modern physics. Quantum mechanics, for example, appears to underdetermine the nature of subatomic particles with respect to the question of whether they are individuals or not, thus generating the possible worry that our best physics does not yield any definitive picture of their ontological status. As James Ladyman [17, p. 420] put it: "it is an *ersatz* form of realism that recommends belief in the existence of entities that have such ambiguous metaphysical status".[1]

That was then. Since the initial formulation of OSR in these eliminative terms, the position has been the subject of serious scrutiny and a number of challenges, commonly premised on variations of the following observation: given the way "structure" is usually understood, in terms of relations between certain relata, it seems peculiar to say that there are structures in world, but nothing that is structured per se. The intelligibility of the position thus remains, in the eyes of many critics, a promissory note at best; the promise is to make intelligible the notion of concrete, causally efficacious things made up of nothing but structure. What if it were possible, however, to reconceive OSR in less radical terms, avoiding the commitment to the seemingly paradoxical notion of concrete relations in the absence of relata? It is this prospect, the prospect of a non-eliminative OSR, that several advocates of the position have put forward more recently, not least as a means of evading the recurring metaphysical worry facing its original formulation. It is this new non-eliminative position that is the primary subject of the following discussion.

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[1] In the contemporary debate, ESR is canonically associated with Worrall (e.g. [31], and OSR with French [13] and Ladyman [17]). Both positions have attracted a variety of adherents and critics since, however. For a comprehensive summary of the literature, see [18].

Before delving into the details, it will prove useful to clarify some of the central concepts on which this discussion will rely. At the heart of OSR there is one thing on which all proponents of different stripes can agree: an emphasis on structures or structural relations at the expense of things putatively standing in those relations—their relata. This broad agreement, however, masks a lack of clarity regarding the central issue of how key terms such as "structure", "relation", and "relata" are to be understood, so let me clarify how these terms will be used here. Firstly, what of the term "structure"? Consider a set of elements and various relations defined over them. We might identify structure with the higher-order logical or mathematical properties of those relations, as we do when we say that the structure of the set is shared by others that are isomorphic to it. This is a relatively abstract conception of structure. On the other hand, we might identify structure with the specific relations between the elements themselves, which is to think of structure less abstractly and more concretely. The concept of *concrete* structure, as I intend it here, applies to first-order relations between specific kinds of relata. For example, take an equation describing relations between the magnitudes of certain properties, such as the ideal gas law. Here we have a representation of concrete structures, *viz.* first-order relations between specific kinds of relata, the properties of pressure, volume, and temperature. By "structure" I will intend concrete structure henceforth.[2]

What about the term "relata"? This is especially important, in part because there is a significant degree of ambiguity regarding this term in the literature on SR. The relata that most philosophers have in mind in this context are putative objects: fermions; molecules; human beings; etc. And one can offer canonical examples of these things for illustrative purposes: the electron; the hemoglobin molecule; Socrates. Though there is nothing wrong with the common practice of taking the putative relata in these debates to be objects, it is also potentially misleading. Commonly, when speaking of objects, we have the referents of count nouns in mind—things that can be counted, or individuals. In the context of structuralism, however, this common conception of objects is too narrow, because the putative relata of scientific relations are often not associated with count nouns at all, but mass nouns—things that cannot be counted but merely quantified, like plasma, or kinetic energy.

If OSR is to be a compelling view, it must apply to both individuals and non-individuals, count nouns and mass nouns alike. Thus, for the purposes of this discussion, I will leave aside the issue of whether or not there are individual objects, which confuses much of the literature; the relevant contrast here is between structures and non-structure, or relations and relata, not between structures or relations on the one hand, and individuals on the other. I will construe the term "object" broadly here so as to include all sorts. An object is anything associated with a group of properties that cohere at a location. As a final clarification, let us note that the relata of scientific relations are often not objects at all, but rather properties of objects, as in the example of the ideal gas law.

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[2] For a more detailed discussion of the notion of concrete structure, see [6, e.g. pp. 40–41].

10.2 Theories of Object Ontology

With these clarifications of the concepts of relation and relata in hand, let us now return to the idea of OSR in more detail. Recent work, particularly in the philosophy of physics, has fuelled an impressive proliferation of positions claiming to be versions of OSR. My present aim is to construct a general argument regarding this class of views as a whole; thus it will serve us to begin with a rather general characterization of it in order to collect all of the members of this class together. Taking into account the various options now proposed, Ladyman [18] describes OSR generically as follows: "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." Objects and properties are often and traditionally described as having a kind of basic or primary ontological status, whereas relations and the structures they compose have a derivative status. OSR broadly construed, however, seeks to reverse this thinking: it treats structural relations as primary, and objects and properties as derivative (at best).

This raises many questions, but to begin, note how much broader this formulation is in comparison to the original description of OSR in eliminative terms. According to eliminative OSR, there are structures in the world, but nothing that could be correctly described as objects or properties standing in structural relations. This take on OSR is certainly consistent with the newer, broader formulation, but it would appear that it is not unique in this respect, prima facie. "Inflating the ontological priority of relations" here means inflating the priority of relations relative to that of their putative relata, and clearly, denying the existence of the relata altogether is one way to achieve this. There would seem to be other, less strong medicines, however, with which to produce the same result, for at first blush, the idea of greater "priority" is *also* consistent with the idea that one thing is ontologically more basic or fundamental than something else whose existence is not in question. The standard metaphysical test for determining how fundamental something is, relative to something else, is to think about relations of dependence that may exist between them. Individual birds are ontologically more basic than populations of birds, for example, because populations depend for their existence on the organisms that compose them, and not vice versa. I will have more to say about the crucial idea of ontological priority momentarily. For the time being, however, let us proceed with the idea that, on its newer and broader construal, OSR would seem to include any form of SR according to which the relata are in some sense ontologically dependent on relations involving them.

In order to consider the full range of conceptual possibilities for OSR thus broadly construed, let us start by imagining an ontological spectrum of conceptions of the relata, ranging from "thick" conceptions at one end to "thin" conceptions at the other. Figure 10.1 represents a comprehensive mapping of theories of object ontology along this spectrum. At the thick end we have metaphysical theories that give high ontological priority to objects, and relatively less priority to the relations in which they may stand. In the limit at the thick end we have realism about substance: a metaphysical commitment to brute, primitive principles of objecthood. Typically
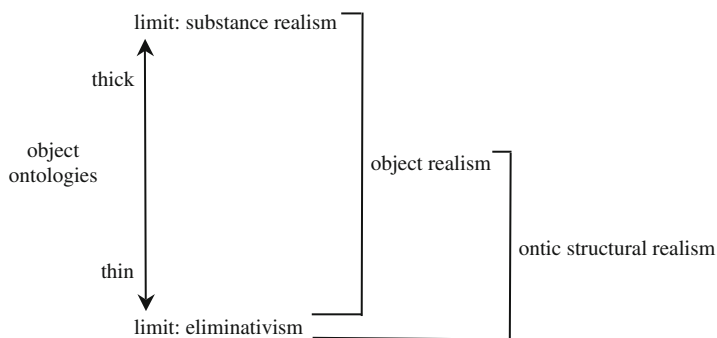
Fig. 10.1 Object ontologies and the ostensible boundaries of OSR broadly construed

on such views, objects are composed of bare substrata, the very concept of which defies further analysis. Properties inhere in or are instantiated by substrata, forming composites, and relations obtain between these composite entities, inter alia. At the other end of the spectrum is eliminativism, the view that there are no such things as objects (or properties) at all.

As noted above, OSR was originally identified narrowly with eliminativism, according to which the notion of an object is simply a kind of metaphysical illusion, to be jettisoned once we have a better understanding of the fundamental nature of reality as revealed by physics. It is for this reason that in these earlier days, Stathis Psillos [23, pp. S18–S19] labelled the position "eliminative structural realism", in contrast to the label "restrictive structural realism", which he gave to ESR. Still true to the spirit of pure eliminativism is Steven French [15], for whom talking about objects is simply a *façon de parler*, a useful manner of speaking forced on us by the subject-predicate form of our natural and standard logical languages. This form is misleading, he maintains, and the putative relata of structural relations are merely artefacts of this manner of speaking. Today, however, on the broader construal, OSR has diversified; the position now includes but is not restricted to eliminativism. A number of authors including Simon Saunders [26, p. 163], Tian Yu Cao [5, p. 41], John Stachel [29, pp. 52–58], and Ladyman [19] have recently suggested that things such as space-time points, quantum mechanical particles, and other putative objects really are objects, but objects whose natures depend on and are determined by the relations in which they appear. It is the relations that have ontological priority.[3]

In the following two sections, I will examine the spectrum of theories of objects mapped in Figure 10.1, from thick through increasingly thin conceptions, with the aim of determining which if any hold promise for a defensible account of non-

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[3] Ladyman and Ross [20] are clear that their position is a form of eliminative OSR, endorsing the thesis that "there are only relations, and no relata" (e.g. pp. 151–152). As we shall see, however, they sometimes appear to endorse non-eliminative OSR. Some authors advocate forms of non-eliminative OSR on which neither relations nor relata have ontological priority. I will consider this possibility in Section 10.5.

eliminative OSR. This promise, as we shall see, turns on the issue of whether an appropriate understanding of ontological priority can be made to fit the bill. Let us turn to this issue now.

10.3 Establishing the Ontological Priority of Relations

The idea of ontological priority is at the very heart of distinctions between various forms of OSR, and also a point of contention between OSR and more traditional views of both scientific realism and the metaphysics of objects. Ontological priority is supposed to concern how basic or fundamental something is relative to something else, but what does this mean, more precisely? Recall the suggestion earlier that the standard test for determining how fundamental things are with respect to one another is to cite relations of dependence between them. This is an unhelpfully vague suggestion as it stands, however, because it is not entirely clear in this context what the relevant relation of dependence *is*. Indeed, we commonly speak of different kinds of metaphysical dependence—most commonly mereological, modal, causal, and supervenient—as being variably exemplified in different contexts. Thus, in order to understand more clearly here what it means for one thing to have ontological priority over something else, we had better be explicit about the specific relation of dependence that is relevant to the context of non-eliminative OSR. The clarification required thus takes the form of (1) below. Taking R to be an appropriate relation,

> (1) x is less fundamental than y with respect to R iff x depends on y with respect to R and not vice versa.

The clause "and not vice versa" appears in the second part of the biconditional in order to rule out cases in which y also depends on x with respect to R, in which case it would seem correct to say that neither x nor y has ontological priority relative to the other. In the example I gave earlier, the fact that populations are less fundamental than organisms—with respect to the relation of composition—can be inferred from the fact that populations depend on organisms with respect to composition and not vice versa. Populations are composed of organisms and not the other way around.

The present investigation concerns the relative ontological priority of scientific relations and relata. What is the relevant relation (or relations) of dependence according to which priority should be assessed in this context? This, I submit, is not a question with an obvious answer. On the eliminativist approach to OSR, there is of course no need to answer this question, because on this approach there are simply no objects to be considered more or less ontologically fundamental than relations. By eliminating objects from their ontology, proponents of eliminative OSR are spared the task of specifying R in (1), but as noted previously, at the cost of having to meet another serious challenge: that of making intelligible the idea of concrete relations in the absence of relata. The non-eliminative approach to OSR, conversely, ostensibly escapes the challenge of having to make sense of concrete relations without relata, because it admits the relata into its ontology, but then must face up to the question just posed: in what sense are relations more fundamental? Scientific theories

quantify over a staggering range of objects and properties, and clearly not *all* of the relations between these entities are mereological, or modal, or causal, or relations of supervenience. Is there any relation of dependence that is sufficiently general to serve as *R* in (1) for non-eliminative OSR, or is its thesis of ontological priority inevitably highly disjunctive?

As it happens, there is at least one relation that would appear to be adequately general here. If there is a common thread running through the literature on non-eliminative OSR, it is the idea that the *identities* of scientific relata, whether objects or properties, are in some sense determined by the relations that obtain between them. That is to say that the natures of the relata—whatever it is that makes them what they are—are not properly understood in terms of their intrinsic features, if indeed they have any. Rather, their natures are a function of purely extrinsic features: their relations. As Saunders [26, p. 163] describes it, it is often reasonable to say that "a particular body is no more than a particular pattern-position"; or in the words of Ladyman and Don Ross [20, p. 131], "there are objects in our metaphysics but they have been purged of their intrinsic natures, identity, and individuality, and they are not metaphysically fundamental". Despite their differences, the various proponents of non-eliminative OSR thus appear to share the view that "all there is" to certain objects are the relations in which they stand. The relation of dependence relevant to the context of non-eliminative OSR is thus the relation of (what I will call, somewhat awkwardly) the determination of identity: certain relations described by scientific theories determine the identities of at least some of the objects or properties that stand in those relations. To put this into the form sketched in (1) for understanding the notion of ontological priority, let me render the idea as follows:

> (2) The relata are less fundamental than their relations with respect to the determination of identity iff the relata depend on their relations for the determination of their identity and not vice versa.

With this explication of ontological priority in hand, let us now consider more precisely the sense or senses in which the identity of an object or property might be determined by its relations. To begin, recall the space of conceptual possibilities mapped in Fig. 10.1. Starting at the thick end of the spectrum, it is immediately obvious why theories of object ontology positing substances are incompatible with OSR. Historically, the concept of the bare substratum was introduced inter alia for the express purpose of accounting for the identities of objects. Properties and relations may come and go, but the anchor of identity, on this view, is a primitive feature of the bare substratum: its haecceity or primitive thisness. Having no qualitative natures, haecceities are truly mysterious; they are purely and simply principles of identity. The thoroughly opaque nature of these principles, being as they are impervious to scientific or other empirical investigation by definition, has long been cited as a reason for dismissing the plausibility of theories invoking them. The important point for present purposes, however, is simply that any such theory is incompatible with OSR, because on such a view, objects have too high a degree of ontological priority. On such a view, concrete relata cannot be less fundamental with respect

to identity than the relations in which they may stand, because their identities are completely independent of such relations.

Let us thus move along the spectrum presented in Fig. 10.1, away from theories of substance, in the direction of metaphysically thinner views of the nature of objects. Object ontologies that repudiate substances are generally versions of the bundle theory: the idea that objects are simply groups of properties that cohere at locations in space-time. From the perspective of non-eliminative OSR this is certainly an improvement, but it does not yet go far enough, for although on such a view we have now set aside the notion of substrata and their intrinsic principles of identity, we have not yet gone so far as to refrain from emphasizing intrinsic natures. As bundle theories are usually interpreted, the properties of an object that are taken to determine its identity, though not inhering in a substratum, are nonetheless intrinsic to the bundle constituting it. Thus, here again we find the relative ontological priority of relations and relata skewed in favour of the relata, for again, the identities of objects are determined by something intrinsic, as opposed their extrinsic features, *viz.* their relations. What is required for the purposes of non-eliminative OSR is an account of the relata that emphasizes their relational features, and this requires a move to an even thinner conception of objects. In the next section, I consider one such possibility.

10.4 Thinning Out with the Dispositional Identity Thesis

The task before us is to come up with a coherent metaphysical picture of objects whose adoption would shift some significant ontological weight—as much as possible, for the sake of non-eliminative OSR—from objects to the relations in which they stand. The only well-developed option among extant views that places significant emphasis on relations in connection with questions of identity is what I will refer to as the dispositional essentialist view of properties; it is sometimes called a "structural" view.[4] The basic idea is as follows. Consider the nature of physical or causally efficacious properties of concrete objects, as opposed to logical or mathematical properties. To say that an object has a property of the former sort is to say that it is disposed to behave in certain ways in certain circumstances. That is, in the presence or absence of other properties and objects, it will stand in certain *relations*. A property on this view is identified as the property that it is in virtue of its possible relations to other properties. The conjunction of all possible relations thus comprehensively describes the natures of all properties.

A clear statement of the general idea of dispositional essentialism is given by Sydney Shoemaker [27, p. 133], who claims that "the identity of a property is completely determined by its potential for contributing to the causal powers of the

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[4] This account of the nature of properties can be traced to Shoemaker [27] and Swoyer [30], and has been discussed in significant detail more recently by a number of authors, including (for example) Hawthorne [16], Bird [3], and Chakravartty [6, chapter 5].

things that have it". The term "causal power" here is for all intents and purposes synonymous with what I intend by the term "disposition" (the differences are minor and in any case, immaterial presently). I call this view dispositional essentialism because it maintains that what makes a property the property that it is, or in other words, what constitutes the essence of a property, are the dispositions for relations it contributes to the objects that have it. It is now obvious, perhaps, why such a view might be tantalizing for a structural realist concerning scientific knowledge, and more specifically, for an advocate of non-eliminative OSR. If we were to marry this structural view of properties to the view that objects are simply groups of properties that cohere (that is, if we combine it with a rejection of substances), we would then have the makings of an account of properties and objects that emphasizes relations very significantly in giving an account of identity. On this combined view, the very natures of properties are understood simply in terms of potential relations, and objects are simply groups of properties.

The main alternative to the dispositional essentialist view of property identity is what David Armstrong [2, pp. 26–27] calls a "categoricalist" theory of properties, according to which they have "a nature of their own" quite independently of anything having to do with their relations. The idea of a primitive principle of property identity, or quiddity, is analogous to the idea of haecceity or primitive this-ness in connection with the notion of bare substrata. Just as in the case of haecceities, many have argued against quiddities on the grounds that they are fundamentally mysterious and entirely impervious to scientific or other empirical investigation. To be fair, Armstrong [1, pp. 168–169] explicitly denies that quiddities are required to account for property identity on his view. Instead, he maintains, one may simply stipulate that different properties are numerically distinct. It is arguably unclear, however, how brute numerical difference is any less mysterious than difference by quiddity (Armstrong suggests that one might think of the former as "a difference in another 'dimension', orthogonal to the dimensions of spacetime"). In any case, given the current task of scouting potentially compatible accounts of objects for non-eliminative OSR, and given that in this connection we have already rejected substances and primitive identities, it seems we have no choice but to reject categoricalism about properties too, for much the same reason: it adopts a principle of identity that is incompatible with the idea that relations have greater ontological priority than their relata.

The turn to a structural or dispositional essentialist understanding of the natures of properties emphasizes the relations in which they stand, and it is for this reason that one might reasonably think it suitable for a non-eliminative, ontic structuralist conception of objects. Now the bad news: the compatibility of this view of properties and non-eliminative OSR, it turns out, is only skin deep. For while it is true that dispositional essentialism emphasizes relations as opposed to primitive and mysterious intrinsic features in giving an account of property identity, it does not emphasize relations in quite the right way for OSR. On the dispositional essentialist view, it is not relations per se that determine the identities of properties, but rather the generally intrinsic *potential for* relations. That is what a disposition is: it is a causal power, and the causal powers investigated by the sciences are generally

intrinsic properties.[5] Of course, we often *describe* dispositions in terms of their manifestations—that is, in terms of relations—but it would be a mistake to conclude on this basis that such relations constitute their conditions of identity. The intrinsic dispositions of objects exist quite independently of whether or not they are manifesting—in other words, independently of whether they or the objects that have them are standing in any particular relations at any given time. Therefore, on this view, it is simply incorrect to say that the relata depend on their relations for the determination of their identity, and thus, recalling (2), we are not entitled to infer that the relata are less fundamental than their relations.

So close, and yet not close enough. The lure of dispositional essentialism is certainly seductive for the non-eliminative approach to OSR. Indeed, this view of properties places so much emphasis on relations that it engenders a kind of holism regarding the natures of properties. If the identity of a property is determined by certain dispositions for relations with other properties, it would seem that the natures of properties taken as a whole are constituted by a vast network of potential relations. The natures of individual properties are thus linked to one another via loops of potential relations. Despite the appeal to relations in giving this account of property identity, however, it remains the case that on this view, identity is determined by the potential for such relations, not the relations themselves. The potential for relations is encapsulated in the concept of a disposition, which here applies to intrinsic properties of objects. On this view it is simply not the case that the identities of objects depend on the relational structures of which they are part, or as Michael Esfeld [9, 10] puts it, that object identity is determined purely by means of relational properties. The dispositional essentialist or structural view of properties and objects is not thin enough for non-eliminative OSR. We must get even thinner.

10.5 Exclusive Disjunction: Eliminativism or Intrinsic Identity

The goal from the outset has been to identify an account of object ontology that would serve to make sense of OSR without lapsing into eliminativism, but the conceptual space in which to locate such a view has been shrinking with each successive consideration. It would seem that the only course remaining is to explore the space left, in Fig. 10.1, between two possibilities. The first is the possibility we have just considered, *viz.* the combination of a bundle theory of objects and a view of properties that describes their identity conditions in terms of dispositions for relations. The second possibility is the limiting case of thin accounts of objects itself: eliminativism. In this penultimate section I will argue that having come this far, we have simply run out of room—what little conceptual space there remains to explore in Fig. 10.1 provides no refuge for non-eliminative OSR.

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[5] There are also such things as extrinsic dispositions, but their existence is inconsequential to the point here. I consider this issue in Section 10.6.

To recall the desiderata, we are attempting to identify a theory of properties and objects that is compatible with the view that these entities are ontologically less fundamental than their relations. A theory meeting this description should entail that the relata depend on their relations for the determination of their identity. In light of considerations outlined in the previous section, we also know that the theory we seek must link the identity conditions of properties and objects to the relations in which they stand even more directly than the link described by the dispositional essentialist view of properties. Throughout this discussion a particular difficulty has persisted: an inability to liberate objects from their intrinsic properties. So long as this difficulty persists, the prospects for non-eliminative OSR seem grim, for so long as the relata of the relations described by scientific theories have genuinely intrinsic features, it seems impossible to satisfy the second part of the biconditional in (2). Recall that this part asserts that the relata depend on their relations for the determination of their identity and not vice versa. So long as the relata *have* genuinely intrinsic features—qualitative properties, dispositions, what have you—this condition remains unsatisfied, because these intrinsic features keep popping up as plausible candidates for determining their identity. On the various accounts of object ontology we have surveyed, there is no respite from the intrinsic.

Thus, let us slim down even further and consider the possibility of an ontological theory of the relata according to which they have no intrinsic features at all: no qualitative intrinsic properties; no intrinsic dispositions; nothing intrinsic that would admit of any sort of description on the basis of scientific or other empirical investigation; and no haecceities or quiddities either. This is to imagine the possibility of a theory permitting nothing in terms of which object identity could be determined intrinsically. But now, I believe, it should be clear that we have come too far, because an object with no intrinsic features at all, whether knowable or unknowable in principle, is not an object at all. Lacking *anything* intrinsic—no substratum, no properties, no primitive principles, or what have you—there is simply nothing left to stand in any sort of relation. In the attempt to locate a metaphysical theory of objects that is compatible with non-eliminative OSR, we have crashed with a bang into the limit of eliminativism, and there does not appear to be any way to apply the brakes sooner. Concrete objects that have no intrinsic features are not anything, and once we have gone this route, we have embraced eliminativism. I suspect that this contention will seem intuitively obvious to some, and generate worries about begging the question in others. Let me elaborate the contention below.

The idea that object identity is purely extrinsic has a natural home in the philosophy of mathematics, and the hope that this idea can be pressed into service in connection with concrete objects appears to be a consequence, in at least some cases, of a conflation of the objects of mathematical and scientific investigation. Randall Dipert [7], for example, argues for the purely extrinsic identity of objects on the basis of his conviction that the world *itself* is a mathematical object. Echoing the arguments of structuralists about mathematical entities, he contends that if one accepts that the world is a mathematical structure, the identities of the objects and properties populating it can be analyzed perspicuously using graph theory. Graphs are mathematical structures composed of two things: nodes (or vertices); and edges

between nodes, which can be taken to represent relations. These relations may be directed, in which case the relation between two nodes joined by an edge is taken to be asymmetric, or undirected, in which case such relations are symmetric. Graphs may be labelled or unlabelled; in the former case linguistic or numerical labels are assigned to the nodes. The interesting point for present purposes is that some graphs are themselves asymmetric: they are arranged in such a way that each of their nodes is related to the others in a unique manner, thus facilitating wholly extrinsic assignments of identity. "In an asymmetric graph, it is possible to give a unique, purely structural description for each vertex" [7, p. 348]. In Dipert's view, the world is an asymmetric graph.

Is this at all convincing, or is it procrustean? Structuralism is a subject of debate even where it is most plausible, regarding mathematical entities in the philosophy of mathematics, and its adoption in that context is by no means universal, but let us leave this point aside here. Granting for the sake of argument that purely extrinsic identity is an ultimately defensible view in the philosophy of mathematics, are there grounds for thinking that the world is an asymmetric graph? No such grounds have emerged. What would be required, in the first instance, is a compelling argument to the effect that reality as we know it is a mathematical object, and in the second instance, one might reasonably require a compelling argument to the effect that this reality is correctly described as an asymmetric graph. But arguments for the thorough-going Platonism or Pythagoreanism exemplified by the first proposition are subject to long-standing objections, generally regarded as fatal, and non-eliminative OSR issues no new arguments on its behalf. As an *assumption* about the nature of the world of the concrete offered *ex cathedra*, the view is thus rather lacking in motivation. Though we rightly entertain lively debates about what it is to be (for example) a subatomic particle or an organism, in the sense of having a defensible ontological theory, any view so amazing as to entail that particles and organisms (for example) are purely mathematical entities, in the absence of strong motivation, presents itself as a *reductio*.[6]

Ladyman [19] also appeals to graph theory, as an analogy, in hopes of motivating the idea of objects whose identities depend solely on the relations in which they stand. Figure 10.2 depicts a labelled, asymmetric graph whose properties he considers (p. 36). Each of its nodes can be uniquely identified purely on the basis of its relations to other nodes, and they are labelled so as to illustrate this in the following way: each node is described by a list of numbers, one number for each node to which it is directly related; the particular number assigned is given by the number of nodes to which the latter is or are related. Consider the node uppermost in Fig. 10.2, for example. It is directly related to three other nodes, hence its label consists of three numbers. The node beneath it towards the left is related to two others, the node beneath towards the right is related to three others, and the node

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[6] Aware of this difficulty, Ladyman and Ross [20, p. 158] thus reject the mathematical characterization of concrete reality. But their rejection goes only so far: "What makes the structure physical and not mathematical? That is a question that we refuse to answer."
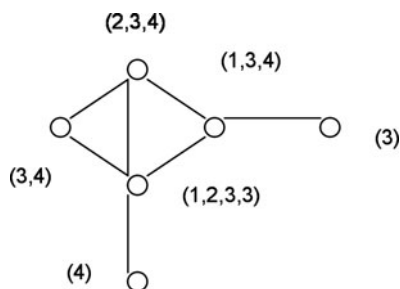
Fig. 10.2 An example of extrinsic identity from graph theory

directly underneath is related to four others, generating the label "(2,3,4)", which is unique to the uppermost node.[7]

Now let us pose the question the analogy suggests: does this mathematical object constitute a model that might help to clarify the idea of purely extrinsic identity in the natural world, the world of concrete objects and property instances described by the sciences? In the absence of something like the thorough-going Platonism or Pythagoreanism of Dipert, the answer, I submit, is no. Let us imagine that we were able to draw the diagram of a graph purporting to represent the relations between a number of objects or property instances constituting a target system of interest in the natural world. Let us also assume that each of the nodes of this graph is uniquely identifiable purely on the basis of the structural features of the graph as a whole. Even with these riches in hand, we would not then have a principle of extrinsic identity on the basis of which to make sense of non-eliminative OSR, and the illustration in Fig. 10.2 is helpful in facilitating a demonstration of why this is so.

Absent Platonist or Pythagorean extremism, there is a crucial difference between a graph *qua* mathematical entity and a graph *qua* representation of some aspect of the natural world, and this difference fatally undermines the analogy of graphs to concrete systems with respect to identity. Unlike the case of graphs considered abstractly in purely mathematical terms, when graphs are employed to represent the concrete, their nodes are occupied, ex hypothesi, by objects and/or property instances. That is to say, they denote other things, external to themselves. But the labels in graphs such as the one illustrated in Fig. 10.2 do not furnish identity criteria for objects or properties that might *occupy* their nodes in such a representation; they simply identify *locations* in a structure! There is a crucial difference between identifying a location in a structure and constituting the identity of something that occupies that location. Graph labels may furnish extrinsic identity for locations in mathematical structures, but this does not by itself suggest anything at all about the identities of the sorts of things that stand in most structural relationships of

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[7] The analogy here suggests viewing objects or properties as individual nodes. Alternatively, Dipert [7] holds that an object is "a subset of the vertices of the world graph" (p. 352), and that even fine-grained entities such as subatomic particles are not vertices but "composite entities, subgraphs of the world graph" (p. 356).

interest to the sciences. Unlike nodes, such objects are generally described as having intrinsic properties, which present themselves as plausible aspects of identity. Graph theory would only provide a helpful analogy here if we were to think of the world as exhaustively comprised of purely mathematical entities such as nodes. But alas, absent Platonist or Pythagorean extremism, concrete objects and mathematical objects are different in kind, and the sciences are interested in the former and not merely the latter.

Where does this leave us? The recent evolution of OSR as a proposal for scientific realism has led inexorably to an interesting but conceptually fraught disjunction. On the original, eliminative formulation of OSR, the ontology of objects and properties is of little concern, since on this view, there are no such things. Indeed, nothing I have said in this essay tells against eliminative OSR, but the challenge facing this position, to make intelligible the idea of concrete relations in the absence of ontologically significant relata, remains. The revisionist metaphysic according to which such relations may be viewed as ontologically subsistent in their own right, many suggest, has not yet arrived.[8] On the other hand, the non-eliminative position evades the challenge of explaining how there can be concrete relations without relata, but consequently faces another challenge—that of making intelligible the idea that such relata have less ontological priority than the relations in which they stand. I have argued that the analogy to the notion of extrinsic identity in the context of mathematical entities offers no help in this regard. The upshot of these considerations is, I believe, an important conclusion about the prospect of a tenable OSR: apparently one cannot deny eliminativism *and* a role for the intrinsic in the analysis of identity in connection with the relata of scientific discourse; if we deny one, we are stuck with the other.

Is there any way of escaping this dilemma by weakening OSR further? Some recent proponents of OSR have suggested yet another interpretation of the view, according to which structuralists should both grant the existence of objects and *relax* the condition that they have less ontological priority than the relations in which they stand. This relaxation cannot extend so far as to give greater ontological priority to objects, of course, on pain of dispensing with OSR altogether, but why not, so the suggestion goes, afford relations and relata the *same* ontological status, granting neither ontological priority with respect to the other?[9] Given that traditionally, relata are usually understood to have greater priority, it would seem that this prescription also satisfies, if only just, the broadest construal of OSR with which we began, which embraces any form of SR based on an ontological thesis that "inflates" the ontological priority of relations with respect to their relata. It should be clear immediately,

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[8] For critical discussions of eliminative OSR, see [4, 24], which express different concerns regarding Platonism in that context inter alia, and [6, pp. 70–85]. For more recent developments of the view, see [15].

[9] French [14] traces this idea as a proposal for OSR to Eddington's view of subatomic particles (the only alternative Eddington considers is an object ontology involving substances). A similar view is described by Pooley [22, p. 98], and endorsed by Esfeld [9, 10], Rickles [25, pp. 188–191], Esfeld & Lam [11], and Floridi [12, pp. 235–236].

however, that this suggestion can fare no better than the version of non-eliminative OSR we have already considered. For insofar as it attributes nothing intrinsic to the relata of scientific relations, it slips without acknowledgment into eliminativism: lacking anything intrinsic, there remains nothing between which relations could obtain. If instead one attributes intrinsic properties (or other intrinsic features) to the relata, the intrinsic then constitutes a plausible determinant of their identity. Lacking an account of extrinsic identity for concrete objects, there is simply no metaphysical space, it seems, capable of sheltering a non-eliminative OSR.

Earlier I suggested that stripping objects of every vestige of intrinsicality (primitive attributes, qualitative properties, and so on) is tantamount to eliminativism, and that while this contention will seem intuitive to some, it may appear question begging to others. For why not simply accept, the latter might contend, that an object can have only extrinsic properties? This, I submit, will not do. There is an important conceptual asymmetry between the intrinsic and the extrinsic in this regard. As they are usually parsed, intrinsic features are, in the jargon, ones that are possessed independently of accompaniment or loneliness. To put it figuratively, they are "contained within" an object, and thus (in part or wholly) constitute it. In contrast, an extrinsic feature is one that is possessed by an object in virtue of its relation (or relations) to some other thing (or things), and therein lies the rub. What is the "it" in the phrase "its relation to some other thing"? If the answer is to be given purely extrinsically, one is left with a circularity or regress. For then, in order to comprehend what the "it" is in the context of this purely extrinsic characterization of the object, one has no option but to appeal to the extrinsic once more. And so on. In order to break this cycle and thereby give content to the notion that there is something that has the relevant extrinsic properties, one must first grasp the idea that there is a something that may enter into a relation, before then proceeding to entertain the idea that it does. The very attribution of an extrinsic property assumes that one has a prior grasp, ontologically speaking, of what it is that stands in the relevant relation or relations.

There is no parallel difficulty in the context of intrinsic features, since here the "it" is simply the collection of these features, which can be understood to stand in relations to external things with no threat of circularity or regress. Extrinsic properties thus cannot by themselves constitute objects in the way intrinsic properties do, and the notion of an object consisting solely of extrinsic properties is, at the very least, a serious conceptual puzzle. Perhaps this puzzle can be solved, but in the meantime, it would seem that if non-eliminative OSR is to adopt the view that objects are purely extrinsic in nature, the conundrum it faces is no less profound than that facing eliminative OSR. Indeed, as I have suggested, it amounts to the same thing. On this interpretation the position is thus a version of eliminativism, sharing whatever promise or difficulties the latter view engenders.

10.6 Extrinsic Dispositions and Lessons from Physics

Thus far, the argument of this paper has been conceptual. The literature advocating non-eliminative OSR is rife, however, with claims to the effect that plausible interpretations of our current best theories in physics *demand* that one accept the ontological priority of non-eliminative structural relations over their relata, or the no-priority thesis—precisely the views I have dismissed on conceptual grounds. A detailed refutation of each of these more specific claims would, in fairness to them, require a series of essays engaging the case studies in which they are immersed. Nevertheless, in this final section, I will offer some principled reasons for thinking that all of these more specific claims are, quite generally, susceptible to the arguments I have outlined above.

First, let me set one important issue, which inevitably arises in this context, to one side. Arguments for the view that plausible interpretations of modern physics point towards non-eliminative OSR focus specifically on interesting facts about quantum theory and general relativity. It is commonplace among philosophers of other sciences to wonder why these studies should be thought to yield *general* morals regarding ontological priority, not least because objects and properties in other domains of scientific theorizing, though subject to interesting philosophical puzzles of their own (including ones concerning identity), do not seem to require or even suggest any deep revisions to our views regarding the relative ontological priority of objects and properties on the one hand, and relations on the other. Suggestions to the effect that basic physics provides general morals of this sort must, it seems, appeal to forms of reductionism that many find implausible ("there are no objects or properties other than those described by basic physics"), or arguably beg the question [20, p. 44] ("primacy of physics constraint": "Special science hypotheses that conflict with fundamental physics. . . should be rejected for that reason alone."). I am sympathetic to these concerns, and suspect that neither reductionism nor assuming the primacy of physics amounts to a compelling basis for arguments about ontological priority across the board, but let us leave these issues to one side for present purposes.

My reasons for not entering into debates about the ultimate scope of lessons from basic physics here are twofold. For one thing, though they are interesting in their own right, these debates are couched in discussions of rather different issues than those I have considered here, including disputes about reductionism and the unity of science. Secondly and more importantly, entering into these debates in the present context is supererogatory, metaphysically speaking. For even the restricted domains of physics within which arguments for non-eliminative OSR arise are subject to the philosophical considerations I have marshalled above. Since claims about how physical descriptions of the nature of quantum particles and space-time points lead irresistibly to non-eliminative OSR are *themselves* mistaken, there is no question of extending the moral of non-eliminative OSR to other regions of the sciences. I will comment briefly on these claims in turn, considering first the argument from quantum theory, and then the argument from space-time physics.

To begin, let me recall part of the discussion in Section 10.4 concerning the dispositional essentialist or structural view of properties. Given the emphasis this

view places on the potential relations of objects in providing an account of property identity, it seemed initially to offer some support for the idea that objects depend for their identity on the relations in which they stand. This promise was short-lived, however, in light of the observation that property identity on this view is not conceived in terms of relations per se, but rather in terms of dispositions for relations, which are generally described as intrinsic properties where scientific entities are concerned. There are, however, such things as *extrinsic* dispositions, and this might be thought to open the door a crack to the possibility of non-eliminative OSR as an appropriate view of at least some scientific objects. If it could be shown that there are objects whose properties are described exclusively in terms of extrinsic dispositions by the relevant branch of physics, one might then at least have a pressing motivation to overcome the conceptual puzzle described at the end of Section 10.5, regarding the idea of purely extrinsic identity.

An extrinsic disposition is an extrinsic property: one whose possession by an object depends on something (or things) external to itself; it is possessed in virtue of some relation or relations to that thing (things). Of course, establishing that a disposition is in fact extrinsic is not always straightforward. Since we routinely describe intrinsic dispositions in terms of possible manifestations in certain circumstances—circumstances that are usually extrinsic to the object in question—a great deal of description of that which is external to an object may be applied in ascribing even its intrinsic dispositions. Consider the intrinsic disposition of solubility. This is an intrinsic property of solutes, but it is usually described in terms of its characteristic manifestation, dissolving, which occurs in some external circumstances (being placed in an appropriate solvent having an appropriate degree of prior saturation at an appropriate temperature, and so on) and not in others. Many of what might at first glance appear extrinsic dispositions are in fact intrinsic; their possession by an object is independent of its external circumstances, though their manifestations are not.[10]

Quantum theory provides an example of what may be interpreted as genuinely extrinsic dispositions, and this is what fuels the claim that a plausible interpretation of the theory supports a version of non-eliminative OSR. Particles (two electrons, say) described by the theory as entangled bear relations to one another that, on an orthodox interpretation of the theory, do not supervene on any intrinsic properties of the particles themselves. These relations of entanglement are interestingly correlated with measurement outcomes for the values of certain properties such as particle position, momentum, and spin. Quantum theory does not ascribe determinate values of these properties to the particles, but rather describes only correlations between them by means of a joint probability distribution determined by their joint state. Thus, here it seems we have a prima facie case for a disposition of an object—to be measured as having certain values for certain properties—that is wholly independent

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[10] See [21] for a defence of the idea of extrinsic dispositions. Though some of the examples presented are arguably intrinsic dispositions described in terms of extrinsic manifestation conditions, others are clearly extrinsic.

of its intrinsic properties: an extrinsic disposition. There are other interpretations of quantum theory that describe relations of entanglement as supervening on intrinsic properties, each of which comes with the price tag of an arguably unpromising metaphysical supposition (the existence of superluminal interactions, backwards causation, and other possibilities), but let us grant for the sake of argument here the orthodox interpretation according to which quantum particles have relations that cannot be analyzed in terms of anything intrinsic. Would this demonstrate that the identities of these objects are extrinsic, in the manner suggested by the ontological priority thesis of non-eliminative OSR?

The answer, I suggest, is no. In order for the appeal to extrinsic dispositions in this context to offer any support to non-eliminative OSR, it would seem that one of the two following conditions should obtain. Either it should be the case that not just some, but *all* properties of the particles described by quantum theory are extrinsic, or it should be the case that whatever intrinsic properties the theory does attribute to them do not determine their identity. If either of these conditions were to hold, purely extrinsic identity might seem a natural hypothesis to explore, and the moti-vation to overcome the conceptual difficulties presented by non-eliminative OSR would intensify. But neither condition obtains. While some properties are described by quantum theory in terms of relations of entanglement, others are not. Mass and charge, for example, are state-independent intrinsic properties of subatomic parti-cles, whose attribution thus violates the first condition that all properties be extrinsic. Furthermore, if such entities are to be the sorts of entities they are, they must instan-tiate particular values of these properties, thus violating the second condition that intrinsic properties do not determine identity. The identity of quantum mechanical entities is thus not extrinsic. Much is made in debates surrounding OSR of the pecu-liarity that quantum particles cannot be individuated on the basis of their intrinsic properties, but to cite this as evidence in favour of non-eliminative OSR is to conflate individuation with identity, and this is at best controversial. The individuation of quantum particles is a thorny issue, but whatever one makes of it, the fact remains that wherever one applies the concept of a particle, the theory presents descriptions of what appear to be intrinsic properties which are constitutive of their identity.

Similar considerations apply to the case of space-time physics, the other arena in which some have argued in favour of augmenting the ontological priority of relations with respect to their relata.[11] One might wonder, for example, whether space-time points are objects, and if so, whether they have identities that can be understood purely extrinsically, in terms of spatio-temporal relations. Esfeld and Vincent Lam [11] answer yes to both questions and offer this as a version of non-eliminative OSR, according to which "an object as such is nothing but what bears the relations" (p. 31). But again the question arises: what is the "what"?—that is to say, what is the thing that bears the relations? If there is nothing intrinsic, there would appear to be

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[11] There is no consensus among structuralists regarding how to apply SR to general relativity. Distinct from the approach of non-eliminative OSR considered here, for example, Dorato [8] views SR as furnishing a third option in debates about relationism and substantivalism, and Slowik [28] sees it as a means to avoiding these debates altogether.

nothing relative to which anything could be extrinsic. An answer to this conundrum is owed, but none is presently forthcoming on behalf of non-eliminative OSR. On the assumption that space-time points are objects, there is a fact of the matter about whether these objects have intrinsic properties or other intrinsic features. If they do, then it is reasonable to suppose, as in the case of quantum particles, that their identities are not purely extrinsic, quite independently of the question of whether their individuation requires recourse to various relations.

Lest the arguments of this paper be interpreted too strongly, let me close by noting that there may well be instances of extrinsic identity in special cases. For example, according to the phylogenetic species concept, what makes me a member of the species *Homo sapiens* as opposed to the species *Homo neanderthalensis* is a particular relation of descent I bear to a particular hominid ancestor; this is constitutive of my identity as a human being. This makes the prior assumption, however, that there is such an object as me—recall that the attribution of an extrinsic property, such as being descended from an early hominid, assumes some prior ontological grasp of that which stands in the relevant relation, on pain of circularity or regress—and this presupposition is generally explicated in terms of my intrinsic properties, differences in which help to distinguish me from my colleagues down the hall. Similarly, what makes something a space-time point (if there are such things) as opposed to a subatomic particle is a function of some important intrinsic differences, even if it turns out that in order to individuate one space-time point as distinct from another, one must rely on their extrinsic properties. The existence and role of the intrinsic in constituting the identities of objects is evident at all levels of scientific discourse, including that at which theories describe the entities of fundamental physics. As a consequence, non-eliminative OSR cannot yet be regarded as furnishing any conceptual advance on eliminativism as a proposal for structuralism in the philosophy of science.

References

1. Armstrong, D.M. (1997) *A World of States of Affairs*. Cambridge: Cambridge University Press.
2. ——————— (1999) The Causal Theory of Properties: Properties According to Shoemaker, Ellis, and Others. *Philosophical Topics* **26**: 25–37.
3. Bird, A. (2007) *Nature's Metaphysics: Laws and Properties*. Oxford: Oxford University Press.
4. Busch, J. (2003) What Structures Could Not Be. *International Studies in the Philosophy of Science* **17**: 211–225.
5. Cao, T.Y (2006) Structural Realism and Quantum Gravity. In D. Rickles, S. French, and J. Saatsi (eds.), *The Structural Foundations of Quantum Gravity* (pp. 40–52). Oxford: Clarendon.

6. Chakravartty, A. (2007) *A Metaphysics for Scientific Realism: Knowing the Unobservable*. Cambridge: Cambridge University Press.
7. Dipert, R.R. (1997) The Mathematical Structure of the World: The World as Graph. *Journal of Philosophy* **94**: 329–358.
8. Dorato, M. (2000) Substantivalism, Relationism, and Structural Spacetime Realism. *Foundations of Physics* **30**: 1605–1628.
9. Esfeld, M. (2003) Do Relations Require Underlying Intrinsic Properties? A Physical Argument for a Metaphysics of Relations. *Metaphysica* **4**: 5–25.
10. ——————— (2004) Quantum Entanglement and a Metaphysics of Relations. *Studies in History and Philosophy of Modern Physics* **35**: 601–617.
11. ——————— and V. Lam (2008) Moderate Structural Realism About Space-Time. *Synthese* **160**: 27–46.
12. Floridi, L. (2008) A Defence of Informational Structural Realism. *Synthese* **161**: 219–253.
13. French, S. (1998) On the Withering Away of Physical Objects. In E. Castellani (ed.), *Interpreting Bodies: Classical and Quantum Objects in Modern Physics* (pp. 93–113). Princeton: Princeton University Press.
14. ——————— (2003) Scribbling on the Blank Sheet: Eddington's Structuralist Conception of Objects. *Studies in History and Philosophy of Modern Physics* **34**: 227–259.
15. ——————— (2006) Structure as a Weapon of the Realist. *Proceedings of the Aristotelian Society* **106**: 167–185.
16. Hawthorne, J. (2001) Causal Structuralism. *Philosophical Perspectives* **15**: 361–378.
17. Ladyman, J. (1998) What is Structural Realism? *Studies in History and Philosophy of Science* **29**: 409–424.
18. ——————— (2007) Structural Realism. *Stanford Encyclopaedia of Philosophy*. : http://plato.stanford.edu/entries/structural-realism/.
19. ——————— (2007) On the Identity and Diversity of Objects in a Structure. *Proceedings of the Aristotelian Society Supplementary Volume* **81**: 23–43.
20. ——————— and D. Ross (2007) *Everything Must Go: Metaphysics Naturalized*. Oxford: Oxford University Press.
21. McKitrick, J. (2003) A Case For Extrinsic Dispositions. *Australasian Journal of Philosophy* **81**: 155–174.
22. Pooley, O. (2006) Points, Particles, and Structural Realism. In D. Rickles, S. French, and J. Saatsi (eds.), *The Structural Foundations of Quantum Gravity* (pp. 83–120). Oxford: Clarendon.
23. Psillos, S. (2001) Is Structural Realism Possible? *Philosophy of Science* **68**: S13–S24.
24. ——————— (2006) The Structure, the Whole Structure and Nothing But the Structure? *Philosophy of Science* **73**: 560–570.
25. Rickles, D. (2006) Time and Structure in Canonical Gravity. In D. Rickles, S. French, and J. Saatsi (eds.), *The Structural Foundations of Quantum Gravity* (pp. 152–195). Oxford: Clarendon.
26. Saunders, S. (2003) Indiscernibles, General Covariance, and Other Symmetries: The Case for Non-Reductive Relationalism. In A. Ashtekar, D. Howard, J. Renn, S. Sarkar, and A. Shimony (eds.), *Revisiting the Foundations of Relativistic Physics: Festschrift in Honour of John Stachel* (pp. 151–173). Dordrecht: Kluwer.
27. Shoemaker, S. (1980) Causality and Properties. In P. van Inwagen (ed.), *Time and Cause: Essays Presented to Richard Taylor* (pp. 109–135). Dordrecht: D. Reidel.
28. Slowik, E. (2005) Spacetime, Ontology, and Structural Realism. *International Studies in the Philosophy of Science* **19**: 147–166.
29. Stachel, J. (2006) Structure, Individuality, and Quantum Gravity. In D. Rickles, S. French, and J. Saatsi (eds.), *The Structural Foundations of Quantum Gravity* (pp. 53–82). Oxford: Clarendon.
30. Swoyer, C. (1982) The Nature of Natural Laws. *Australasian Journal of Philosophy* **60**: 203–223.
31. Worrall, J. (1989) Structural Realism: The Best of Both Worlds? *Dialectica* **43**: 99–124.

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