Ontic Structuralism: the Worst of Both Worlds

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In a recent book (*Every Thing Must Go*, OUP 2007), James Ladyman and Don Ross argue that most of contemporary metaphysics is fundamentally msiguided and that contemporary science, if "taken seriously" and suitably interpreted, shows that the true metaphysics of the natural world is that there is no matter, no objects, no things and that everything there is is "structure". Against what they call the "philosophy of A-level chemistry" (2007: 24), they embark on a "mission of disciplinary rescue" (2007: 27) because "quirks in the history and structure of the modern academy have encouraged crazy activity and hidden [the] absurdity" (2007: 57) of what they call "strong metaphysics". The metaphysics they coutenance ("weak metaphysics") is the "articulation of a unified world-view *derived from* the details of scientific research" (my emphasis 2007: 65)[1] and it is the only one that in their view deserves to be called "'scientific" – "scientific" in the sense of being able to figure in a "grant proposal to a 'serious' foundation or funding agency"[2], where fundability is "suggested as a proxy indicator (in the economist's sense) of what is likely to be scientifically interesting" (2007: 34)[3]
This is strong stuff. In my talk, I first try to clarify the two central claims of Ladyman and Ross, namely that there are no objects and that there is only structure: it turns out that by "structures" their mean mathematical representations of the world and that their view is a very strong form of idealism. I then examine the principal motivations given for ontic structural realism: (i) the pessimistic meta-induction; (ii) entanglement in quantum mechanics and (iii) automorphisms in general relativity. I argue that none of the motivations given even comes close to supporting their strong claims. Focussing on their concept of "structure", I then conclude that the ontic structuralists' metaphysics is naïve and does not meet up to the scientific standards of contemporary research in metaphysics. Rather than reconciling what's good in both realism and anti-realism (what Worrall (1989) hoped for structural realism), they combine the anti-realist rejection of physical objects with realism about Pythagoreanism about mathematics.

What is claimed?

"There are no objects":

1. They argue for "the wholesale abandonment of the ...intuition that there must be something of which the world is made" (Ladyman and Ross 2007: 12).
2. "...what physics has taught us is that matter in the sense of extended stuff is an emergent phenomenon that has no counterpart in fundamental ontology" (Ladyman and Ross 2007: 20)
3. "The elements of fundamental physics are not basic proper parts of all, or indeed of any, objects.

[1] Sometimes, they are a bit more careful. They say that their metaphysics is "consistent with and motivated by" (2007: 2) science and "vindicated" by its success (2007: 7), and that science "provides evidence" for some positive metaphysical theses (2007: 27), even though they admit that science – "usually and perhaps always" – underdetermines metaphysics (2007: 9). At some points, they even admit that the "idea of a world of distinct ontologically subsistent individuals with intrinsic properties" is consistent with physics, but still maintain that physics "puts severe pressure on such a view" (2007: 154).

[2] The immediately following footnote – reading "We invite the reader to imagine a physicist, fresh from reading Nolan (2004), writing a grant proposal to investigate the idea that the universe is made of hypergunk." – makes it clear that the grant proposal is supposed to come from physicists applying for funding of physical research. After all, Daniel Nolan got a number of grants ...

[3] One is led to wonder how the juries determine who gets the funding – a question which becomes all the more pressing because they want to exclude "non-standard sources" funding creationist research (2007: 36). They seem to get the direction ofexplanation wrong in this case: research projects receive funding because they are scientifically interesting, not the other way round.

(Nor is there any motivation for supposing that the fundamental structures describe gunk.)" (Ladyman and Ross 2007: 44)

4. "we should not interpret science [...] as metaphysically committed to the existence of self-subsistent individuals" (Ladyman and Ross 2007: 119)
5. "objects are pragmatic devices used by agents to orient themselves in regions of spacetime, and to construct approximate representations of the world" (Ladyman and Ross 2007: 130)
6. "there are objects in our metaphysics but they have been purged of their intrinsic natures, identity, and individuality, and they are not metaphysically fundamental" (Ladyman and Ross 2007: 131)
7. "Individual things are locally focused abstractions from modal structure. By modal structure we mean the relationships among phenomena (tracked or located [...] as things, properties, events, and processes) that pertain to necessity, possibility, potentiality, and probability." (Ladyman and Ross 2007: 153–154)

"Everything is structure":

1. "...'structures' are to be understood as mathematical models – sometimes constructed as axiomatized theories, sometimes represented in set theory – that elicit thinking in the formal mode" (Ladyman and Ross 2007: 119), which contain embedded data models representing relations among results of physical measurements (the "phenomena").
2. "When we go on to deny that, strictly speaking, there are 'things', we will mean to deny that in the material world as represented by the currently accepted scientific structures, individual objects have any distinctive status. Some real patterns, we will argue, behave like things, traditionally conceived, while other behave like traditional instances of events and processes. In a PNC-motivated metaphysics these distinctions lose all significance except purely practical, book-keeping, significance for human beings in certain sorts of special circumstances. From the metaphysical point of view, what exists are just real patterns." (Ladyman and Ross 2007: 121)
3. "mathematical or structural" (Ladyman and Ross 2007: 93)
4. "those [three theories of 'Newtonian gravity' which are strongly empiricially equivalent but differ with respect to their spacetime symmetries and their boundary conditions] have the same dynamical symmetries and so a structural realist who regards dynamical structure as what is physically real should regard them as different ways of describing the same structure" (Ladyman and Ross 2007: 83)

The pessimistic meta-induction

The argument given by Laudan (1981) is reformulated as follows by Ladyman and Ross (2007: 84):

1. there have been many empirically successful theories in the history of science which have subsequently been rejected and whose theoretical terms do not refer according to our best current theories;
2. our best current theories are no different in kind from those discarded theories and so we have no reason to think they will not ultimately be replaced as well.

From this, a certain type of "pessimism" is supposed to follow:

> "So, by induction we have positive reason to expect that our best current theories will be replaced by new theories according to which some of the central theoretical terms of our best current theories do not refer, and *hence*, we should not believe in the approximate truth or the successful reference of the theoretical terms of our best current theories" (Ladyman and Ross 2007: 84, my emphasis)

Put in non-probabilistic terms: because truth and reference is not a necessary condition for predictive success, predictive success does not have to be explained by truth and reference (Ladyman and Ross 2007: 84–85):

> "The argument from theory change threatens realism because if what science now says is right, then the ontologies of past scientific theories are far from accurate accounts of the furniture of the world. If that is right, [*then*] even though they were predictively

> successful then the success of our best current theores does not mean they have got the nature of world right either." (Ladyman and Ross 2007: 92, my emendation)

But the italized "hence" and "then" are non-sequiturs: that our best available theories are fallible (and hence that we may imagine them to turn out false) does not give us reason not to hold them. For this, we would have to have an idea about *how* they might turn out to be false.[4]
That most people are liable to probabilistic fallacies does not give me a reason to mistrust my own probabilistic judgments.

Entanglement in Quantum Mechanics

Two electrons in the orbital of a helium atom: same energy eigenstate, same position state, opposite spins. Can we infer that "entangled states are not constituted by the entities that enter into them" (Ladyman and Ross 2007: 41, n. 40)?

> "If two electrons really are two distinct individuals, and it is true that they share all the same properties, then it seems that there must be some principle of individuation that transcends everything that can be expressed by the formalism in virtue of which they are individuals." (Ladyman and Ross 2007: 135)

Two questions here:

1. Does there have to be such a principle of individuation?
2. If there has to be such a principle of individuation, does it have to be transcendent?

In both cases, the answer is no.

1. There is nothing wrong about brute numerical diversity as in the case of Max Black's indiscernible spheres. There is a problem about truthbearers, but perhaps some considerations about naming can help.
2. The two electrons satisfy the irreflexive relation expressed by "x is of opposite spin to y". Contra Russell,[5], purely relational individuation is possible. There is a problem about matching up of structures, but perhaps some considerations about the successive 'enlargement' of our ontology of arithmetics might help.

Additional worry: what is purely structurally individuated? particles or their states? Cf. what Kripke says about dice worlds:

> "The thirty-six possibilities, the one that is actual included, are (abstract) *states* of the [two] dice, not complex phyiscal entities. Nor should any school pupil receive high marks for the question 'How do we know, in the state where die A is six and die B is five, whether it is die A or die B which is six? Don't we need a "criterion of transstate identtiy" to identify the die with a six – not the die with a five – with our die A?' The answer is, of course, that the state (die A, 6; die B, 5) is *given* as such (and distinguished from the state (die B, 6; die A, 5)). [...] The 'possibilities' simply are not given purely qualitatively (as in: one die, 6, the other, 5). If they had been, there would have been just twenty-two distinct possibilities, not thirty-six. [...] Nor, when we regard such qualitatively identical states as (A,6; B, 5) and (A, 5; B, 6) as distinct, need we suppose that A and B are qualitatively distinguishable in some other respect, say, color. [...] Finally, in setting up this innocent

[4] Consider an analogy from mathematics: having closely checked a mathematical proof, I am within my epistemic right to believe the theorem it purports to prove. It is, of course, possible that someone more intelligent, knowledgeable or attentive than me might still spot a mistake in the proof. But this possibility alone does not give me *any* reason not to believe the theorem.

[5] "[I]t is impossible that the ordinals should be, as Dedekind suggests, nothing but the terms of such relations as constitute a progression. If they are to be anything at all, they must be intrinsically something; they must differ from other entities as points from instants, or colours from sounds. What Dedekind intended to indicate was probably a definition by means of a the principle of abstraction...But a definition so made always indicates some class of entities having ...a genuine nature of their own." (Russell 1903: 249)

> little exercise regarding the fall of the dice, with possibilities that are not described purely qualitatively, we make no obscure metaphysical commitment to dice as 'bare particulars', whatever that might mean." (Kripke 1980: 17–18)

He adds in a footnote:

> "With respect to possible states of the entire world, I do not mean to assert categorically that, just as in the case of the dice, there are qualitatively identical but distinct (counterfactual) states. What I do assert is that *if* there is a philosophical argument excluding qualitatively identical but distinct worlds, it cannot be based simply on the supposition that worlds must be stipulated purely qualitatively. What I defend is the *propriety* of giving possible worlds in terms of certain particulars as well as qualitatively, whether or not there are in fact qualitatively identical but distinct worlds." (Kripke 1980: 18, n. 17)

Importantly, we are talking about the individuation of physical states, not physical objects.

Automorphisms in General Relativity

Within the standard geometric (tensor) formulation of general relativity, space-time is represented by an (equivalence class of) pairs (M, g) where M is a 4-dimensional differential manifold and g is a Lorentz metric tensor field (satisfying the Einstein field equations). Distributions of properties over this field are physically significant only if they are invariant under diffeomorphism: $Diff(M)$ is a gauge group. If (M, g) satisfies the Einstein field equations, then any (M, d^*g, d^*T) represents the same physical situation (d^* induced by the diffeomorphism: $d : M \to M$).

Is e.g. direct reference theory refuted by general relativity? Two questions:

1. on the level of the description: structures are Ramsey sentences. But we can constrain them by a naturalness predicate. Even if we don't, Ramseyian humility does not follow: that we can only know what affects us does not mean that we only know how we are affected.
2. on the level of what is described: anti-haecceitism / anti-quidditism. But we can learn to live with bundle theories.

Additional worrry: what's wrong about the world being diffeomorphism-invariant?

Two descriptions 'localising' an object in two different 'places' linked by a diffeomorphism are equivalent: they are descriptions of the same thing. Does it follow that it is always false / non-sensical to say that something is at spacetime point A? Or is it rather like saying that there are two numbers 2, red and green, and then ask: if they are the same number, what colour has it?

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