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## **Super-Humeanism: Insufficiently Naturalistic and Insufficiently Explanatory**

Comments on Esfeld & Deckert, *A Minimalist Ontology of the Natural World*

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Systematic metaphysics is largely out of fashion these days. Much of the metaphysics literature is made up of small, targeted interventions into established debates. In this context, Esfeld and Deckert's book is refreshing. It is an ambitious and unified account of the fundamental ontology of the world and of how that ontology relates to some prominent theories in contemporary physics.

The key word in the title that marks out the character of this systematic project is 'minimal'. Esfeld and Deckert identify material points as providing the absolute minimum features necessary to support any kind of manifest world at all, and then they boldly argue that no other existing things beyond material points are necessary to account for all the rest of reality. Fields, spacetime points, wavefunctions, bosons, properties of mass and spin and charge – none of these are real ingredients of the world but rather they are aspects of our picture of the world. They are just parameters we introduce in order to come up with the best systematization of the motion of the material particles.

Needless to say, this approach diverges from a straightforward reading of what fundamental physics tells us. Physicists will not immediately recognise the fundamental ontology they are offered here as the world they were used to theorizing about, but if Esfeld and Deckert are right they can be brought round by careful argument and by exhibition of the parsimonious and elegant nature of this minimalist worldview.

There is much to admire in this book. As a rigorous and systematic physics-oriented presentation of an austere empiricist fundamental metaphysics, it has no real rivals. The clarity with which the overall vision is presented will provide a valuable stalking-horse for those who would defend less austere approaches in the future. Esfeld and Deckert never shy away from the radical consequences of their approach, or try to disguise its revisionary nature.

I also found several points of agreement with Esfeld and Deckert's metaphysical outlook. In particular, I thought their form of structural realism sophisticated and plausible and their application of it to contemporary physics salutary. Fundamental metaphysics would be a more respectable discipline if all of its exponents felt the need to show how their preferred ontology plays out in the context of real physics. These points of agreement noted, I will concentrate in these comments on points where I disagree with Esfeld and Deckert. From my perspective, the metaphysical project of the book is subject to two serious objections: firstly, it remains insufficiently naturalistic and overly a prioristic, and secondly, it drains much of the explanatory power out of fundamental physics.

The first problem is a problem with the primitive ontology of matter particles, and it can be traced back to the considerations by which this primitive ontology is selected. These considerations are epistemological: Esfeld and Deckert insist at several points that all of our evidence ultimately boils down to knowledge of distance relations between objects. Even if this claim of epistemological priority is correct (and I think that it is not) it could not support an argument for the ontological priority. While it would be foolish to deny that epistemology is relevant to metaphysics, this does not establish that the correct ontology is just the one which aligns most directly with the epistemological facts. Rather, ontology is constrained by metaphysics in that the correct ontology is the one which offers the best overall explanation of the facts – including the epistemological facts. Epistemology may be relevant to the competition between overall explanatory theories of the world in at least two ways – as part of the facts needing to be explained, and as a guide to what is a genuine fact that needs to be explained and what is a merely apparent fact that needs to be explained away. It does not enter in via any requirement that the facts to which we have the most direct access must be regarded as the metaphysically fundamental facts.

This privileging of our own epistemological position when shaping a fundamental metaphysics is distinctively Cartesian – a heritage which Esfeld and Deckert are happy to embrace. They talk approvingly of the “sparse Cartesian conception of the natural world as *res extensa*” (p.3), the “Cartesian argument that commitment to extension is the only substantial commitment in an ontology of the natural realm” (p.42), the “Cartesian criterion for matter – namely, extension and motion” (p.47). Setting aside the flawed argument from epistemological priority to metaphysical priority that I've already criticized, Descartes' own arguments for his account of matter are entirely *a priori*, turning on what sorts of scenarios can be clearly and distinctly conceived. While *a priori* arguments for the conception of extension as the fundamental physical quality are not as explicit in Esfeld and Deckert's book, it seems to me that they are doing a great deal of work in the background – and this sits uncomfortably with the naturalistic outlook that the authors espouse.

The *a priori* commitment to spatial relations as uniquely fundamental shapes the project of the book from the very beginning. It comes in with the stated need for a primitive ontology, ostensibly to solve

the measurement problem of quantum mechanics but more accurately to solve the supposed ‘reality problem’ of any physical theory. There is nothing distinctively quantum about the requirement that “for there to be a cat, or a pointer, there have to be basic objects that compose a cat, or a pointer, if they are arranged in the right matter in physical space such that the evolution of such a configuration of basic objects then amounts to the motion of a cat, or a pointer, in space” (p.5). I submit that the only reason to adopt this key requirement is undue deference to our own lack of imagination, our inability to conceive how things could be otherwise. It seems as though Esfeld and Deckert are alive to this concern when they write of their ontological axioms “we are after minimal sufficiency; we make no claims about these axioms being necessary or *a priori*.” (p.22) But in support of the first axiom they treat as unargued premises both *that fundamental distance relations are necessary for a manifest world like ours* and *that nothing but fundamental distance relations are necessary for a manifest world like ours*. And in support of the second axiom, Esfeld and Deckert describe the view that “matter points come into existence out of nothing and are literally annihilated, disappearing into nothing” as “absurd” (p.28), here relying on an argument of Parmenides which is both obscure and apparently in tension with their own denial of the need for ultimate explanations of contingent facts such as matter point distributions across the super-Humean mosaic. Absent persuasive naturalistic arguments for the key axioms, I suggest we ought to view the project of the book as a proof of concept – as a rigorous implementation of a specific but optional choice of austere fundamental ontology (and, if I am to be honest, a somewhat old-fashioned choice!) – rather than as identifying a genuinely minimally adequate ontology for physics.

The second problem I see with the argument of the book is the move from a theory being the most ontologically minimal underlying explanation of some manifest world to that theory being the best explanation of that manifest world. Theoretical entities such as wavefunctions, fields, and spin properties are not included in our physical theories only for their role in saving the appearances, in recovering the empirical observations that we have made. To adopt this view is, it seems to me, just to adopt the sort of instrumentalism that Esfeld and Deckert claim to reject. They say “Super-Humeanism is distinct from instrumentalism about the wave function: the wave function for the universe is the central dynamical parameter, figuring in the law of motion for the particles” (p.50). But for them, a dynamical parameter is indeed an instrument: it is nomological in nature, which is to say that it is an instrument for formulating the best systematization of the facts about relative distances of particles.

According to the truthmaking approach that Esfeld and Deckert endorse, something being the best systematization of particle motions is sufficient to make it true that there is such a thing. So that charge is part of the best systematization of actual particle motions makes it true that some particles are charged. But it seems to me that overlaying these claims about truthmaking onto an instrumentalist position makes that position no less instrumentalist. At best here we have a form of

neo-instrumentalism here, which involves saying all of the same things about properties other than distance relations that a radical instrumentalist would, yet overlaying an apparatus of truthmaking which licenses us to say different and apparently incompatible things. While this truthmaking manoeuvre may distract attention from the implausibility of Super-Humeanism, in the end I think it does not detract from that implausibility. It is still true that – from the fundamental perspective – mass and charge are mere instruments for deducing particle motions. And given that this is still true – from the fundamental perspective – then these properties cannot feature in any genuine explanations – again, from the fundamental perspective.

The (necessary, not sufficient) criterion of genuine explanatoriness I am using here is that explanation must be factive. For P to explain Q, it must be the case that P. But if it is not in fact the case from the fundamental perspective that electrons are charged, then from the fundamental perspective electrons being charged cannot explain anything else at all. All genuine explanations, again from the fundamental perspective, must be given in terms of distance relations. But it is simply implausible that – from any perspective whatsoever – all genuine explanations can be given in terms of distance relations. Consider the question of why salt dissolves in water. No amount of information wholly about distance relations is capable of answering that question. Or consider the question of why like charges attract. Any explanation of this phenomenon must at least mention charge. Accordingly, Esfeld and Deckert are committed to saying that from the fundamental perspective all explanations are of certain facts about distance relations, and given in terms of other facts about distance relations. But not all physical explanations are like that.

A key class of explanations that are not ultimately of relative distance facts by relative distance facts are explanations which appeal to the range of possible states of a physical system. To focus on the quantum context, the Pauli exclusion principle tells us that no two identical fermions can simultaneously occupy exactly the same quantum state. This kind of constraint is not imposed from the outside, but holds in virtue of the kind of system involved: a state with identical fermions in the same quantum state is not part of the state space of quantum mechanics, and so no additional law is required to prevent this state from obtaining. The state space itself explains why, for example, two entangled particles in a spin singlet state must always be measured with opposite spins. Explanations of this sort cannot be properly captured within the Super-Humean framework. Configurations of particles that would correspond to a quantum system with identical particles in the same quantum state are present amongst the possible Humean mosaics, given that Esfeld and Deckert seem to endorse a free recombination principle within the space of possible configurations of distance relations. So, the exclusion of these systems can only be a matter of brute regularities in the actual configuration of distance relations; it cannot be a matter of the underlying state space.

Explanations based on the constraints imposed by the state space of a system are widespread within quantum physics. Candidate examples include the explanation of why neutron stars can resist gravitational collapse, of why atoms have discrete absorption spectra, and of the chemical properties of benzene. These explanations are deeper because they trade on the nature of the underlying physical state space; they are not simply unexplained restrictions on a larger state space. By reinterpreting all such explanations as fundamentally explanations of distance relations by distance relations, Esfeld and Deckert strip them of their distinctive explanatory character. The point generalizes to other state-space theories: for further discussion of the explanatory power of state space theories, see Lyon and Colyvan (2008).

I think the lesson of my second objection is that it is not possible to stay neutral on the metaphysics of modality in a systematic metaphysical project. Esfeld and Deckert announce their intention to remain agnostic about whether there is anything ‘driving the evolution of the *cosmos*’ (p.56). But they are anything but neutral about the basic underlying state space of possibilities – it consists for them of possible configurations of distance relations constrained only to lack some very general symmetries – and this state space that they employ is very different from the basic state space of quantum mechanics interpreted in any non-instrumentalist manner. Their core commitments in the metaphysics of modality therefore close down a whole swathe of possible explanations that fundamental physics appears to fruitfully employ, and hence these commitments cannot be regarded as part of a properly neutral naturalistic methodology.

The world may ultimately be, as Esfeld and Deckert suggest, made up only of a pattern of distance relations that we go on to systematize. But, if so, physics is much the poorer for it.

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