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# of Fundamental Material Objects and "Bodies that Surround Us"*

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ABSTRACT: What becomes of our clearest theories of explanation, when faced with the unpalatable quantum phenomena that seem to undermine the direct conceptual connection between the fundamental material entities and the self-standing material objects of everyday parlance? The general explanatory theory advocates unification of explanatory concepts with everyday discourse, identification of essentially similar characteristics between direct experience and the hypothesised explanatory ontology, and a conceptualisation of phenomena in terms of objects enduring causally regulated change. On the other hand quantum theory feeds anti-realist suspicions about the worth of (metaphysical) realist explanatory endeavour with examples of phenomena in which the structure of material separation and individuation based on spatial extension is insufficient for construction of deeper explanatory narratives. An example from history of science, that of Newton's law-constitutive definition of objects in response to Descartes problem of bodies is used to suggest a possible strategy for explanations unifying the quantum and common-sense conceptual domains, provided the anti-realist challenge to such enterprise is read as questioning the epistemological justification of interpretation of experience in both cases.

KEY WORDS: Conceptual framework, explanation, material objects, natural laws, quantum theory, realism.

It was once a rationalist's expectation (and defiance in the face of dogmatism) that it is possible to…

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> arrive at knowledge highly useful in life; and in room of the speculative philosophy usually taught in the schools, to discover a practical [one], by means of which, knowing the force and action of fire, water, air, the stars, the heavens, and all the other bodies that surround us, as distinctly as we know the various crafts of our artisans, we might also apply them in the same way to all the uses to which they are adapted, and thus render ourselves the lords and possessors of nature. (R. Descartes, *A Discourse on Method* (Part VI). 1637. This translation: Project Gutenberg ebook #59)

## Experience of Law-Abiding Generalised Things: A Precarious Situation to be in

Suppose we want to provide a simple realist (in a metaphysical or scientific, not purely semantic sense) strategy for offering an explanatorily superior alternative to anti-realist scepticism concerning metaphysical propositions of the fundamental physics. Such a strategy might rely on the causal-mechanical model of explanation whose fundamental ontological elements are the spatially located particles, the local extended and existing objects of varying scale. Thus the experience of the macroscopic objects is connected to the fundamental ontology through shared essential characteristic of finite spatial extension and propagation of observable interaction across spatial separation.[1] The individuality and identity of the basic particulars of this ontology is expected to conform to the same metaphysical principles as that of the directly observable objects that provide the conceptual foundation of the common-sense conceptual framework, along the lines of descriptive metaphysics charted by Strawson (1959).

Though the macroscopic objects are no longer the physically fundamental elements of the ontology, they are in the final step reduced to the hypothesised fundamental entities, not directly observable, but essentially similar to them: the irreducibly extended objects characterised by respect for objective spatial relations. Though naive and lacking in technical precision, such a "story" presents a foundation for a unified conceptual framework within which to construct causal mechanical explanations of the observed phenomena. A much more refined form of such an attempt at ontological and explanatory (essentially epistemological) unification or generalisation can be found in philosophical positions such as critical realism (cf. Bhaskar, 2010 for a summary overview), though here we shall limit the scope to a simple strategy outlined above. In the "ontological

[1] It is important to stress that this is a deliberately simplified account, one which neglects other potentially fundamental characteristics, so as to paint a clearer contrast between the explanatory strategy and the problems induced by phenomena in the domain of quantum theory. We hold that this simplification does not detract from the truth-likeness of the problem and proposed solutions.

stables" of contemporary physics, as in everyday life, there are extended and spatially located things outside the perceiving observer, existing independently from being observed and entering into complex situations which can be understood (and manipulated) as interactions arising from intrinsic properties and endurance through spatial locations.

In the case of quantum theory, we follow Maudlin's (2007a) suggestion that the conceptual connection between the contemporary physical theories and common-sense must have at least some extended and local objects, the "local beables".[2] This is not to say that it can't postulate any non-local such beable, but merely that for the connection to be established in the most straightforward way it must contain at least some. "We take the world to contain localized objects (of unknown composition) in a certain disposition that changes through time. These are the sorts of beliefs we *begin with"* (Maudlin 2007a: 3160). In principle a theory without local beables could also account for these beliefs, but the construction of explanation from such a theory would prove a much harder task and one ridden with many more frailties, claims Maudlin. And the role of "local beables" is similar to that required of the material structure described essentially in terms of primary qualities, for they allow for a most direct connection between the experience of phenomena and the ontology that explanatorily accounts for them by providing a most commonly agreeable vocabulary, a conceptual framework, through which to account for that connection (Maudlin 2007a: 3160). The formal-quantum-theory response to such a framework is a version of Bohmian mechanics with local particles and the universal non-material law-*like* wavefunction[3] (cf. Goldstein and Teufel

[2] This is a terminology introduced in Bell (1987), where a "beable" is a speculative piece of ontology, something that a theory postulates as being physically real. It is the foundational stone of our constructive approaches, the very construct that the explanation along the causal-mechanical lines rests on. Beables are the physical ontology that a theory postulates to exist. (These will be further explicated in the forthcoming sections.) "Local beables", on the other hand, "do not merely exist: they exist *somewhere*" (Maudlin 2007a: 3157). If local beables are all there is to physical ontology, then we get a Humean Mosaic, a global state of affairs constructed linearly out of a combination of local states, a simple summation of all local beables. Whether this can be done in quantum theory is the contentious issue to be discussed in the thesis.

[3] Though aiming to be a general philosophical text, this article is occasionally littered with seemingly technical concepts from quantum theory or physics in general. We endeavour to discuss their significance for the position expounded here, but for reasons of brevity refrain from describing or presenting each of these in their own right, relying on the widely available internet resources and encyclopaedias to fill any such gaps in introductory description. All of the technical terms are well-presented in resources such as Wikipedia. Also for reasons of brevity and technical-clutter-free flow of the text, a deliberate (but in this context permissible and used in referenced texts) sloppiness in freely shifting between "wavefunction" and "Schrodinger equation" will be employed. It is the equation which more properly has the form of the law, whilst the wavefunction is but its essential component.

2004), or more precisely the equation specifying the evolution of variables in the wavefunction.

To discourage anti-realist criticism that quantum explanatory discourse concerning material microstructure relies on ontological vagueness that undermines the potential for generalised explanatory conceptual unification (cf. "at a certain limit we may have to fall back on stipulation or vagueness [in discourse about reality]"; Pettit 1991: 621) we have to show the possibility and explanatory utility of the conceptual connection from the basic structures of the common-sense conceptual framework to the fundamental ontology of all phenomena experienced in an interaction with the material world. This can be achieved by following a simple strategy of settling on a minimal set of "typings of objects" (Devitt 1997) that are not dependent on human conceptualisation to explain the experiences they produce.[4] Such a conceptualisation is a footing of explanatory strategy, such as is lacking in the all-encompassing anti-realist criticism of explanatory discourse, which does not allow any realist background against which details of competing explanations can be checked. But some physical phenomena from the domain of quantum theory pose problems for this strategy of creating a conceptual connection for they seem to provide an experiential basis for the denial of the realist-style validity of the elements of the common-sense conceptual scheme that we take as the starting point. The worry is then that quantum theory can be drawn upon as an example from science itself, and no less than a metaphysically fundamental segment of scientific practice, for the conceptual vagueness of even that fundamental aspect of the conceptual framework.

It is of course also said that such claims at conceptual unification of quantum theory with the supposed common-sense conceptual framework are nothing but a forcing of a new empirical theory (quantum mechanics) into the shackles of the old (classical mechanics) (Johansson 1992: 143). An example is given of the revolutionary shift from treating inertial motion of macroscopic bodies as an "unnatural or forced state" in Aristotelian physics into treating it as "as natural a state as rest is" in physics of Galileo and Newton. And yet, even Johansson admits that quantum theory cannot stand in an epistemological vacuum but must be combined into the complete knowledge of the universe, which has internal conceptual structure, elements of which appear necessary (1992: 145). But when it collides with those necessary structures, when it endangers the very poten-

[4] Or more precisely, their characterisation as successful explanatory conceptualisations is not dependent solely on individual or enclosed community's choice of conceptualisation, and the typings exhibit enduringly successful explanatory role through increasingly manipulative interaction with the external environment.

tial of our (admittedly highly simplified) strategy for unifying explanatory discourse, then we have to reconsider answering the sceptic.

Supposedly quantum theory presents the most clear example of the conceptual vagueness lodged in the fundamental aspect of the conceptual framework in individuality and temporal identity of objects, given by the constrictions of extension taken as primitive and isomorphic in both the fundamental ontology and the objects of common sense experience, including the role of spatial separation in the conceptualisation of individuality. So as not to block a possibility of a unified explanatory conceptual framework of the everyday experience and the problematic quantum phenomena in terms of fundamental ontology we suggest adding further non-separable elements to the fundamental ontology. Yet that very element, the universal non-separable law seems to play a role more important than a mere non-separability patch. It is outright characterised by *ontological holism* and potentially more important for the desired explanation than the extended material ontology taken to be the fundamental connector between the directly observable and the hypothesised in the phenomena.

Healey (2009) defines ontological holism as a metaphysical situation in which "some objects are not wholly composed of basic physical parts". This is not to say that they are composed of non-physical parts in addition to physical, at least that is not the intention in analyses of quantum theory of this kind (Healey 2009), but rather that when we desire to take some physical entities as "wholly composed of particular set of basic physical parts" quantum theory precludes us from doing so. And though Healey purports that most types of metaphysical holism encouraged in physics are of the *property holism* kind, i.e. they require that some objects have properties that are not determined by physical properties of their basic physical kinds, for our purposes of seeking explanatory conceptualisation in terms of those properties which enable wider explanatory unification this generalises into an *ontological* holism (as presented above). This is because the properties of concern for us here are also taken to be the identity conferring properties (in the Strawsonian (1959) sense) for the basic elements of ontology.

In fact in his subsequent presentation of ontological holism in quantum theory Healey (2009) says as much, with reference to views of Bohr, Bohm and others. With reference to Bohm's (1952) introduction of the field associated with the wavefunction (part of the quantum formalism alongside codification of the selected property-states of particles) that guides the particles' trajectories. Healey concludes that coupled with the ontological assumption that the basic physical parts of the universe are not just the particles it contains, as is proposed by our explanatory unification strategy, Bohm's interpretation and its descendants (as the one

advocated here) establish an ontological holism. Of course, Healey immediately notes, there are alternative views of the ontology of Bohm's theory that are not forced to follow that line, or are constructed specifically so as to exclude it. Further and more forceful routes to ontological holism, and additional coupling with the explanatory unification views presented here, are given by connecting the failure of a principle of separability to ontological holism via, among other technical details omitted here,[5] Einstein's concept of individuation of physical systems by spatial separation. Of course, as Healy notes (following Dickson 1998), theories with such reliance on ontological holism present a highly unsatisfactory explanatory doctrine.

Briefly, violations of separability threaten to knock-down the whole "house of cards" defence from anti-realist explanatory scepticism as given above by denying the sensibility of the foundations of the common-sense conceptual scheme. According to Einstein's staunch conceptualisation of physical reality,[6] the idea of physical things existing and arranged into "a space-time continuum" (Einstein 1948: 321) requires that they can "claim an existence independent of one another, insofar as these things 'lie in different parts of space'" (Einstein 1948: 321). In other words these objects arranged in space, as required by the core elements of our foundational conceptual scheme, ought to have an intrinsic individuality (an "itness"),[7] i.e. whether they are interacting or not they should have separate intrinsic states (Howard 1994). The states can change as a result of interactions, but those interactions can be accounted for again in terms of the local changes in the adjacent regions of the space-time continuum and, provided that the interaction is epistemically accessible in the given small region of space the object occupies, it is always to be separately definable. Furthermore, all composite objects acquire all their properties from the constituents' intrinsic states and locally intrinsic interactions.

Empirically confirmed predictions from quantum formalism (most notably: EPR and teleportation phenomena) seem to deny this property

[5] Namely through the violation of Bell inequalities, cf. Bell (1964); (1987) or Shimony (2009).

[6] Bell (as quoted in Johansson 1992) himself feels that quantum theory's empirically confirmed violations of his inequality constraints have "Nature" proving Einstein wrong, despite Bell's expressed admiration for Einstein's scientific rationality and the conceptualization of reality that he endorses.

[7] This should not be confounded with the notion of primitive thisness and identity as championed most notably in the works of R. M Adams. It allocates a foundational identity, for want of a better term an "itness" (as suggested by D. Lehmkuhl in private correspondence), to the elements of reality but not one they retain independent of their potential for interaction with other elements of reality.

to the objects in the domain of the theory: the supposed constituents of everyday macroscopic objects. This means that either quantum theory is not a fundamental physical theory and is not concerned with fundamental scientific explanatory ontology (a position Einstein advocated), or that we have to find some way of explaining how such separability violations are either benign (to our fundamental conceptual scheme) or just an illusion that does not actually affect the fundamental common sense explanatory conceptualization based on the notion of primary qualities. We have to bear in mind that at least for some properties (and the crucial question is whether for those we are most interested in: the traditional primary qualities) separability is a conceptual prerequisite for this definite object to be said to possess this definite property (Howard 1994), and also to account for the changes of that property through the processes that foundationally rely on the primacy of extension in material world. Most notably, the depth of explanation accounts require a conceptual reconstruction of the phenomena in terms of manipulation of definite object properties. Can we reconstruct explanatory accounts in situations where those properties presuppose adherence to separability to conceptualize the objects in the first place? The problem for unificatory potential is even greater if the microscopic "objects" are fundamental material constituents of the everyday macroscopic ones.

The lessons of the search for deeper explanations[8] (Hitchcock and Woodward 2003; Psillos 2007) coupled with the regulated limitations (i.e. not permitting haphazard unbridled information transmission)[9] of the separability violations inherent in quantum theory (cf. Brown and Timpson 2006) suggest a deep explanation that can still respect the realist strategy of explanatory unification is concerned with the structural constraints which endure despite not being directly epistemically accessible. That is, in the formal quantum presentation the phenomenon is not given by the bare fact of the appearance of the correlations between the macroscopic outcomes of distant measurements, it is given by the whole account of the experimenters' production of the correlations with manipulations of mac-

[8] For reasons of brevity there is no space here to properly present and summarise the discussions concerning depth of explanation, but we must note that depth of explanation is what is valued even in our simple strategy, deeper explanations win the game.

[9] We cannot enter into a broader discussion of these *regulated* violations, but the point here is that though violations of separability occur, they occur (and are predicted by the theory to occur) in such a way as to preclude epistemic access to signals, causal influences or exact unequivocal deterministic predictions prior to local measurement taking place. Brown and Timpson's (2006) discussion referred to above presents a powerful case as to why physics is epistemologically (if not metaphysically) safe from the separability violations inferred from quantum theory.

roscopic equipment as objects in space and time.[10] This requires that the initial conceptualisation of objects contains not just their essential structure (in our simple case, the geometrical structure of spatial extension, cf. Harre, 1996 and a summary below) but respects a wider framework of the interactions and changes those objects can endure (and still be re-identified as the same objects)[11] and the effects we as human agents (and not pure observers) can have on them.

This is asking for a slightly more complex starting point (the common-sense conceptual framework) that is meant to be shared with the anti-realist critic. It is a further task then to illustrate that the additional elements introduced in our solution were always there in the starting point, and have not now been added to save appearances. To that end we note that our experience of interaction with objects is as much as part of our everyday conceptual scheme as is the bare experience of perceiving those objects. If so much is admitted we can add to the essential requirements of isomorphism not just the durability of extended objects but also a notion of regularities of the changes they undergo. The essential structure is given by the objects' shape and the existent laws that it conforms to in the right circumstances. These laws are not observable to us in the same way as individual material entities, but are inferentially no less real than material structure, and cannot be reduced-away in terms of locally (i.e. not a total description) specifiable concurrence of events (though, this is how we at first come to speculate about their existence, to form the required metaphysical projections). We infer, and then empirically test, the effects of the potentially fundamental laws of temporal evolution ("FLOTEs" in terminology of Maudlin 2007b).

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[10] We must be careful though not to get entwined with Bohrian denial of the possibility of construction of causal metaphysics, here. This does not claim that every phenomenon must necessarily include in its description the macroscopic situation and the experimenters' intentions, but that an explanation of the phenomenon that can be unified with the common-sense conceptual scheme need not be constructed solely out of the momentary localized spatial situation of objects and forced between them.

[11] It might be objected that a Strawsonian programme of identifying particulars only requires that a thing be identified by a description and also be given one other independent description. There might be such "particulars" in quantum theory, without satisfying other constraints we have put on them here (namely to be spatially extended objects, most commonly particles). That is certainly true, but the other constrictions are employed here in an attempt to build a conceptually unified explanatory strategy, combined with Strawsonian programme, or its most common result of selecting macroscopic objects as basic particulars of the "everyday" conceptual scheme, for added benefit but not a necessary condition. In any case, basic particulars passing the requirements of the Strawsonian (and apparently Quinean, too) programme only, would not provide the desired unificatory explanatory strategy along the lines of rebuttal of scepticism advocated here.

The advantage of such conceptual construct in Bohmian mechanics is that it allows for regulated separability violations, and subsequent denial of the fundamental metaphysical separability, whilst nonetheless avoiding the threat of ultimate full and complete ontological holism. The latter would provide a non-starter for our defence from antirealist criticism, as it would show even the most basic conceptual framework to be a metaphysical conceptual imposition and invite response-dependency (as in Pettit 1991) for all concepts of the said framework, and thus present serious, if not insurmountable, difficulties for explanatory conceptualisation (cf. Healey 2009). Yet the acceptance of the separability violation is not as threatening to the whole project of physics as Einstein (1971; cf. below) suggested due to limits of knowability, enshrined in the no-signalling theorem, which assure us that even if we could know of the non-separable change of properties, the supervenient (general, but not necessarily fundamental) physical laws we can empirically deduce for our region would not have been different.

Our explanatory conceptualisation includes non-separable changes taking place, but they (due to no-signalling prohibition) do not crucially affect the limited predictions we can make about the behaviour of objects in the said region. They do not affect the possibility of performing manipulative science from which to derive the truth-conditions for the relevant object manipulation on the extended material ontology in the local region. In other words, though our explanatory conceptual framework (in search of explanatory synthesis through retrodiction) must not contain total separability, we can still do science; to the extent that we do in experimental and descriptive employment of the quantum formalism.

But some phenomena in quantum theory (and of course their experimental "reification") still present a problem for our general explanatory strategy. Even when coupled with the universal law that non-separably transmits their interactions, our fundamental ontological elements lose the guarantee of intrinsic individuality and identity over time. Phenomena like the Aharonov-Bohm effect and teleportation, suggest that reference to the non-separable element (the wavefunction understood either as the potential or as the law) is more important in constructing a unified explanatory account than the enduring spatial existence of the particles (the objects or the beables). The latter can be affected, in a way that is not even objectively discernible (in the case of teleportation), so that they lose the characteristics required of the basic conceptual particulars and appear as metaphysical baggage added to the description of the situation for traditionally appealing connection to the everyday objects-in-space discourse. If the empirical access they provide to the independent reality through being parts of the directly observable macroscopic objects can be replaced

with some other explanatory conceptual construct, their very existence could be denied. But then the whole project of explanatory unification based on the irreducibly extended ontology loses its appeal. This is especially acute in the case of teleportation where not only empirical access, but the very enduring existence in a spatial location is denied and objects with different properties are instantaneously swapped without giving rise to locally and objectively detectable consequences (cf. Fuchs 2002).

The question that the teleportation, as the key "troublesome" phenomenon, raises is: given how much of the conceptual framework is relegated to the non-local beable, are the local beables conceptually strong enough to uphold our simple strategy for realist explanation? What kind of entities those particles (as basic physical objects, or beables) are, given that they require constant awareness of the stipulations of the law to provide them with individuality and temporal identity? Devoid of directly perceivable characteristics and more important in explanatory retrodiction than manipulative prediction, can they be fundamental entities at all?

## Alas, a Historical Precursor

Brading (forthcoming) presents an analysis of what might for us be a precursor from the history of science. She presents Newton's solution to the "problem of bodies" that initially plagued Descartes' potential to explain the mechanical phenomena. The problem is to say what the "bodies" to which the laws of motion apply are. Classical mechanics in the exposition of Descartes and Newton is a science of bodies in motion. Bodies are the metaphysical subject matter of this science, but it is epistemically unclear what these bodies are. This is especially acute for Descartes as he argues for the plenum of extended matter, a type of holism if no other empirically accessible characteristics of the plenum's elements are available, whilst the laws of motion apply to (discrete, separable) bodies. The question becomes how we identify the required bodies out of the metaphysical supposition of the continuous material plenum. Descartes is thus required to explain in virtue of what the extended matter is divided into parts such that we can clearly and distinctly perceive and consequently conceptualise it as mechanics of bodies in motion. The solution that Descartes proposes is plagued by circularity, Brading suggests,[12] in that the motion is defined in terms of bodies, whilst bodies are defined (conceptualised) as the division of indefinite matter achieved through the relative motions (of the said divisions).

[12] The problem of individuation of bodies has indeed been a constant theme of Cartesian studies, Alexandrescu (2009: 76).

In our contemporary case, it is the loss of separability in the fundamental ontology that leads to the loss of the fundamental position of the traditional primary qualities, and the parallels with Descartes' case. It is on a tacit assumption of separability that we historically and conceptually build the half-scientific conceptual scheme of objects interacting along identifiable "lines" in space-time. Einstein stresses the importance of the assumption.

> However, if one abandons the assumption that what exists in different parts of space has its own, independent, real existence, then I simply cannot see what it is that physics is meant to describe. For what is thought to be a system is, after all, just a convention, and I cannot see how one could divide the world objectively in such a way that one could make statements about parts of it. (Einstein 1971: 164–165)

Yet the connection between the Cartesian plenum and the situation in quantum theory is not obvious. There is no plenum whose segments need to be individuated into objects. But there is a notion of objects whose very metaphysical individuation or even enduring existence is brought into question because of a metaphysical commitment to the violation of separability, and even instantaneous "location replacement" through the phenomenon of teleportation. If "change in general" is taken to replace "motion" it is easier to see the connection between the Cartesian and contemporary problems: we need a change defined in terms of enduring objects (both for the descriptive metaphysics and as required by notion of deeper explanations) whilst the conceptualisation of bodies is insufficient on the spatial extension (geometrical structure) alone and includes the law-abiding change as part of the definition. The latter bodies (the particles, or beables) need to have the conceptual individuality of the same type as the macroscopic bodies that feature in direct experience of the world. They are in fact expected to be the building blocks of the macroscopic structure participating in the observed phenomena, the conceptual foundation stones of the isomorphic connection (Sellars 1963) between the microscopic and the macroscopic. Change is the rearrangement of the situation of the primary entities, and the primary entities are that which is re-identifiable through change, the enduring isomorphic connectors between the microscopic and the macroscopic. In the version of Bohmian Mechanics (or interpretation of quantum theory) sketched above the law seems to be an important part of the definition of an object.

Brading (forthcoming) aptly separates the historical problem into a metaphysical and epistemological dimension.[13] Thus, at the level of meta-

[13] Alexandrescu (2009) suggests that Descartes himself does exactly the opposite, at least at face value, by making epistemology required by explanation dependent on metaphysics, effectively unifying them. That, however, is not the epistemology of his "practical" physics; which is something Brading (following Newton) requires.

physics the problem of bodies requires a determination of necessary and sufficient conditions for individuality of a body, searching for what makes something a body. There are different examples of attempts to answer this question from the history of philosophy (looking for metaphysical conditions of distinctness, uniqueness of bundles of properties or essential properties and the like). Conditions of enduring identity over time are also required, we must specify in virtue of what an individual is the same individual at another time. On the epistemological side, though, we must answer to what guarantees our access to the individuation and identity features of the objects.

A partial solution to such analysis of the problem of bodies, Brading suggests, is offered by Newton who identifies the abidance of laws as the necessary condition for individuality and identity over time. To be a body is to necessarily satisfy the laws of motion (which are natural laws not empirical generalizations). Of course, Newton's solution is partly aided by not having to overcome the epistemic conditions for the separation of bodies out of an otherwise uniform plenum. Nonetheless, Brading argues, the Newtonian solution to the problem of bodies suggests a law-constitutive understanding of bodies: definition of bodies is incomplete prior to the specification of the laws of nature, and completed by those laws of nature. We must omit the details of Brading's exposition here and focus on distilling the useful parallels from the perspective of explanations between the classical macroscopic and the contemporary (quantum) microscopic case. Most notably, we have to overcome a problem that Brading herself points to, namely what the sufficiency conditions for something to be a body will be. Making the stated necessary condition also one of sufficiency leads to the same kind of circularity that plagues Descartes as suggested above. Brading says that the sufficiency condition remains an open problem for the classical case and calls for a further research programme. But for the purposes of the parallels to be drawn here we can view the calls for a sufficiency condition as the return of the dispositionalist challenge (or we might call it a general anti-realist sceptical challenge) that we must provide necessary and sufficient epistemic conditions for the object-identification to even begin to explain the perceived phenomena.

And the separation of the "problem of bodies" along with the law-constitutive solution into a metaphysical and epistemological part might hint towards a possible solution to the problem of construction of explanations in terms of the said bodies. Namely, it is important how we view the dispositionalist challenge in the explanation-construction case. If it is viewed as a form of metaphysical scepticism it most probably must be taken at face value and left without a solution, such an all-encompassing scepticism cannot be refuted. It immediately brings with it a scepticism

of the epistemological kind, of course.[14] Or, in other words, were the said "scepticism" but an introduction to an alternative metaphysical framework, no comparison between them is to be had, save for an, to use van Fraassen's (1980) terminology, "an aesthetic preference in explanation". But if the initial dispositional sceptical objection is of the epistemological kind, then it is not necessary to proceed immediately to the metaphysical (in this case ontological) scepticism. And if we take the dispositionalists as accepting that there is a structured reality restricting our experience, then their objections can be read as an epistemological scepticism, namely that we cannot know the conditions that justify the interpretation of experience as changes suffered by enduring bodies rather than along the lines of alternative structure.

But in line with Wittgensteinian tradition of avoidance of sceptical challenges (Wittgenstein 1967; Baker and Hacker 1984) we can refuse to accept the epistemological challenge.[15] For the explanatory strategy can draw on the ontological commitment of the conceptual framework we share with the dispositionalist (or general anti-realist sceptic) as one of independently existing objects which can be identified and re-identified. As the existence of something in reality that fulfils the conceptual role of such re-identifiable objects is a pre-condition of the use of the conceptual scheme the scepticism is expressed in, it cannot be doubted in the same breath. To speak of the objects enduring changes through phenomena is part and parcel of the conceptual scheme used to express doubt about the possibility of justification of existence of adequate structures in reality that the concepts of objects could refer to. Thus, Strawson (1959) claims that metaphysical scepticism along those lines is senseless. Even if we don't take Strawson's argument as conclusive in our specific case, we should take it as indicating that the dispositionalist challenge as expressed in the opening sections is one of epistemological kind: we can't know that our interpretation of experience is justified, as we lack explicit necessity and sufficiency conditions. To accept the dispositionalist challenge is to accept that assenting to the conceptual commitments of the common sense conceptual framework involves an interpretation of experience in a certain

[14] In his own presentation of the historical case of Descartes' individuation of bodies, Alexandrescu (2009) suggests that this is the gulf between Descartes on the one side and both Newton and Leibniz on the other. The latter simply had radically different metaphysical frameworks to Descartes' so that no discussion was possible between them at all.

[15] This might be similar to the warning of "epistemic fallacy" in the philosophical position of critical realism, but a further investigation is required to delineate the (in)validity of that point. For our purposes it serves as a mere footnote illustration of potentially similar philosophical positions addressing the same issue (separation of metaphysical and epistemological challenges) from a different perspective, or as a rhetorical trick (in Aristotelian sense) of belabouring the main point.

way. But no such interpretation takes place, so no conditions of correctness of interpretation need to be specified. We do not start with the bare experience in which we search for objects. Newton's job was made that much easier by not starting with the plenum, neither epistemically nor metaphysically, whilst Descartes needs to account for the lack of the epistemic plenum (and the pragmatic use of the mechanics of bodies) whilst maintaining that it exists in the metaphysical sense.

In summary, the requirement for explication of the necessary and sufficient conditions for epistemic identification of the (unobservable) bodies at the level of microstructure, and the situation of empirical equivalence of mechanistic and non-mechanistic interpretations, suggests we are dealing with an epistemic scepticism that can be addressed in the way suggested above. Being an extended part of the macroscopic body is then the suggested epistemic route to the identification of the microscopic body, whilst the identity over time is conceptually dependent on the proscriptions of the universal law as much as on the spatial location. What we accept, though, is that the experience, the starting point of the explanation, often the explanandum itself, is not given in terms of the uninterpreted structure of the physical reality at some given instant, of the "Humean mosaic" (Lewis 1986) of instantaneous facts independent of the conceptual framework. Instead, it is recognised as posed in terms of generalized things (Harre 1996) accompanied by some primitive awareness of space and time. Or in Ryle's (1949) terms: to have an experience, a sensation, is not to be in a cognitive relation to a sensible object that is a wholesome atom of experience. For to talk about, or conceptualise, sense data is to already talk about common objects, to apply learned perception-recipes for the typification of appearances of common objects (cf. Devitt 1997) to whatever one is trying to make out at the moment. We simply have a series of sensible expectation properties fulfilled, we implicitly know what to expect of objects, and can make a further metaphysical projection from that, without having to justify the supposed interpretative process that leads there from the bare sense data.

The suggestion then is to stop the anti-realists at the level of epistemological scepticism, without having to make the further step towards the ontological scepticism; we can accept that we needn't name the necessary and sufficient conditions for individuality and temporal identity of objects to be used by our explanation-generating community, without having to immediately assume that metaphysically such conditions cannot be found.[16] We

[16] Interestingly this actually seems to be aligned with Descartes' explanatory strategy and overall philosophy of physics (which admittedly does not place it on a historically victorious footing), according to Alexandrescu (2009). Descartes also insists that the metaphysical conception should not be reached via the justification tools for the physical/experiential.

can accept the bare community agreement as encoded in the conceptual scheme as the epistemological mechanism, and say that we never needed to provide an *interpretation* of experience that would single out objects, that objects were a part of having an experience in the first place as Ryle suggests above. The unobservable microscopic objects are then an abstraction within the same conceptual framework, requiring only a modification not the abandonment of framework's foundational component. This of course, does not rule out as impossible the metaphysical commitments of different kind, such as generally grouped into Everett-type interpretations, but requires a different strategy of fending off anti-realist sceptical claims.

To avoid having to justify the conceptual framing of experience as interpretation of the bare sense data arising from conceptually radically different ontology, some of which is in-principle epistemically inaccessible, and thus to fend off the slide into excessive dispositionalism (where everything is reduced to the dispositions of the law, but those are unknowable; as in Dürr, Goldstein and Zanghi 1992) we must employ the tried and tested technique of relying on the "geometrical" isomorphism between the common-sense conceptual scheme of re-identifiable objects and the fundamental ontology of spatially situated particles (the local beables). Yet to justify the existence of an external criterion of correctness of explanatory conceptualisations of this reduction of the empirically accessible to the empirically inaccessible, especially with respect to the classically "unexpected" phenomena, we must postulate the existence of the non-local universal law that affects the metaphysical conditions of re-identification of the fundamental ontology. In that, as we struggle to conceptualise the details of a causal connections between separated elements of the fundamental ontology, we must make the universal law primitive and modify the starting conceptualisation of the empirically accessible in phenomena to include both the spatial extension of objects and their subscription to (unknown) law. But this is simply to explicitly recognise Ryle's (1949) requirement to include in the concept of any object an expectation of fulfilment of sensible experiences, in some cases explicitly as stated by the effective derivations of the universal law (and not immediately intuitive).

Alternatively, tackling the sceptical challenge head on (or accepting its metaphysical alternative as a necessary consequence), takes us back to Descartes' circularity trap (from the Newtonian critical perspective, not necessarily the trap Descartes himself would have admitted, cf. Alexandrescu 2009) and makes us unable to account for the external constraints on our explanatory conceptualisation. The problematic phenomena in the quantum domain, those that require abandonment of the expectation of separability then expose the conceptualisation of the separate re-identifiable objects in space as just an illusion imposed by us onto the essen-

tially holistic fundamental ontology of forever epistemically inaccessible world-stuff. Our typification, our carving of the world-stuff into manageable concepts is just an illusion, and any such carving is as good as another: a game of freely constructing the facade before the noumenal world. But on such account all explanations are equally vacuous, as there is no matter of fact as to what explains what. The suggested price to pay to avoid this (in the absence of a satisfyingly primitive account of causation, and verifiable causal account of construction of experience) is to view the world from the outset as characterised not just by momentary spatial relations, but also by the mind-independent (primitively characterised) nomological structure. This mysterious guiding-hand-behind-events requirement may be too much of a price to pay on some worldviews. Especially as the theory itself demands that the universal law behind quantum phenomena (and fundamentally behind most physical phenomena) remains in-principle epistemically inaccessible (Dürr, Goldstein & Zanghi 1992; Goldstein & Struyve 2007).

What this leaves us with is an explicit acceptance of a modification of the starting point conceptual scheme, of the Strawsonian account of basic particulars, but not a modification that is outright unacceptable. We start from arguing for the necessary minimal typification of experience into that of enduring objects. As we cannot take an absolutely preferential external position and certifiably view the world "as it is in itself", it is prudent to start from a shared ground, that of the common conceptual framework. From here we rapidly proceed from accepting that we all have thoughts about material objects to "necessitation" of the commitment to the conceptual scheme that sees the objects as existing independently of us in an objective framework of space and time. This commitment can further be distinguished from a sensorily similar commitment that there appear to be objects existing independently of us by further investigation of how the notion of those objects participates in our objective accounts of the world, including the intersubjective communication.

As we investigate the nature of material reality in greater depth we come to uncover a number of unsubstantiated concepts inherent in the above conceptual scheme, which must be removed from the scheme of what is taken as ontologically basic. Many of the identifying properties of material objects are dispensed with, but the germ of structure immediately evident and independent of our judgment remains, that of the necessary primary quality of extension in space. The identity of objects remains founded in the combination of identities of smaller objects that make them up, all related to each other through definite relations in space. Though our explanations no longer take the material objects as we perceive them as fundamental, they tell us how the appearance of the objects arises out

of their fundamental structure, and the typification that does not slip away along this route is the extended structure of objects as constructed out their constituents. When the structure is subject to change, the varieties of effective changes can be conceptually subsumed under adherence to laws of nature (e.g. Newtonian laws of motion). The germ of the connection between the Manifest and the Scientific images (Sellars 1963) is given in the shared nature of extension and the law-constitutive conceptualisation in both the account of fundamental physical ontology and the directly perceivable material objects. The methodological parallel with the Newtonian (Brading, forthcoming) solution of Descartes' problem of bodies in physics points to further research in this analogy of conceptualisation of reality, especially the pragmatic triumph of Newtonian over Cartesian scheme.

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