

Book Review  
**The Metaphysics Within Physics**

Tim Maudlin  
Oxford University Press, Oxford, 2007

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Written with a lively and unaffected style, this book by Tim Maudlin weaves a robust web of analyses, which should be of pressing interest both for philosophers of science and metaphysicians, as well as for philosophers *tout court*, since, on the one hand, it upholds a general methodological claim, to the effect that, in doing philosophy, we ought to seriously evaluate the significant implications carried by scientific practice as to the conceptual health of certain notions or principles (such as the notion of metaphysical possibility or the principle of Ockham's razor), while, on the other, it engages in subtle and provocative attacks against metaphysical doctrines, most notably Humean supervenience and traditional accounts of universals, and against philosophical reconstructions of scientific laws, such as Armstrong's (1983), Vallentyne's (1988) and van Fraassen's (1989).

A central place in this web is occupied by what in Chapter 6 is labeled as 'Maudlin's Non-Humean Package', i.e. the idea that both the laws of physics and the direction of time are ontologically primitive (p. 182). Such a twofold ontological primitivism is recognized to be an unpopular view, at odd with influential conceptions of metaphysics and science (especially Lewis's Humeanism, van Fraassen's constructive empiricism and the main interpretations of general relativity), but it develops through sophisticated arguments, with abundant examples and case studies mainly drawn from contemporary physics (quantum mechanics in a strategic way), which give the overall impression that the plan has some big cards to play.

The book divides into six chapters, conceived as independent essays between an introduction and an epilogue. The first chapter, packed with particular discussions that would be hard to even hint at, outlines a 'modest' (in

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Swift's ironic sense) proposal about laws: Maudlin begins with a conceptual analysis of the systematic connections between beliefs about laws of nature and beliefs about possibilities, counterfactuals, and explanations, putting off the problem of ontological commitment, but a decisive metaphysical move has already been made: he radically shifts laws from *analysandum* to *analysans* (p. 45); once we take laws as ontological primitives, we have no reason to accept Armstrong's universals approach (1978 and 1983), at the same time being able (unlike Lewis 1973 and 1986) to distinguish between true and false counterfactuals. For this purpose a three-step recipe is offered (pp. 22-23) as a guide for the evaluation of counterfactuals about the future evolution of physical states. The recipe, based on *fundamental laws of temporal evolution* (FLOTEs) and their adjunct principles, together with Cauchy's surfaces and boundary conditions, is supplemented with a sketched description of how we should conceive of the evolution of stochastic events (i.e. taking into account both *infected* and *uninfected* physical magnitudes: pp. 30-31). The counterfactual is taken to be a function whose first argument is not a proposition, but a *command* (p. 23) providing instructions to generate an altered description of a physical state (in step 2 of the recipe). This threefold procedure is thought to be closer to our psychological processes through which we construct counterfactual situations by means of laws, than some other abstract semantic technique (like Lewis's appeal to judgments of overall similarity between possible worlds). Only FLOTEs (Schrödinger's equation, for instance) are really primitive and basic: other kinds of laws – the *simply* and the *special* laws of temporal evolution, respectively LOTEs and SLOTEs – are parasitic on them. Among the results of ontological primitivism about laws there is also the fact that notions like physical necessity and objective propensity derive from FLOTEs (pp. 19-20).

The second chapter is an exposition of the reasons why one should reject Humean supervenience. Lewis's ideas are dwelled upon in some detail; according to Maudlin, Lewis's Humeanism comprises two logically distinct theses: 1) Separability (we can crumble the whole space-time in pointlike objects, each of which having its own intrinsic physical state, while all the rest supervenes on these material bits laid out in space and time); 2) Physical Statism (the total physical state of a world does entirely determine modal and nomological facts about that world). Concerning Separability, Maudlin maintains that the radical metaphysical innovations stemming from quantum mechanics pose a weighty challenge to the sort of metaphysical

compositionality of properties postulated in a separable universe: notwithstanding Einstein's worries and Lewis's caution, the superposition of the entangled states forces us to give up sticking with the belief in a mosaic of independent objects and events. Concerning Physical Statism, it is a distinctive claim of this book that laws – precisely the FLOTEs – cannot supervene on the total physical state of the world: nothing in the current scientific practice – which Maudlin assumes as a starting point and as a touchstone for a sound philosophy – suggests the possibility of such a reduction. More generally, contemporary physics seems to provide us with new insights in our universe, which run definitely afoul of the desertified picture of reality favoured by many analytic metaphysicians. Not always *less is more* and Ockham's razor does hide an ideological and counterintuitive use, which we ought to deprive it of: 'If the ontology that arises most naturally from reflection on physics is too rich for Ockham or Hume or Lewis, then so much the worse for them. Let others subsist on the thin gruel of minimalist metaphysics: I'll take my ontology *mit Schlag*.' (p. 4).

In chapter 3 we come across a couple of specific tools of contemporary mathematical physics (besides Cauchy's surfaces in chapter 1): gauge theories and fiber bundles. Given the technicality of the issue, suffice it to say here that the main result of this essay is the alleged collapse of the age-old doctrine of substance and attribute together with the traditional theory of universals. Relying on the unnoticed ontological import of fiber bundles, Maudlin holds three strong metaphysical theses (p. 86):

- (i) there are no intrinsic (or 'metaphysically pure') external relations;
- (ii) there are no intrinsic internal relations;
- (iii) there are no intrinsic properties.

According to contemporary physics there can be no fact of the matter concerning whether any two quarks are the same color or different (chromodynamics is introduced for the sake of exemplification: pp. 94, 96). Here one finds the more controversial side of Maudlin's project: a physicalistic elimination of ordinary universals via the application of a mathematical structure. But, to use with a slight modification Maudlin's own words about laws (p. 12), parochial universals ('red', 'blue' etc. as metaphysically pure properties occurring in *human* discourse) are still universals, whose abiding resistance in the face of their absence in mathematical manifolds or electromagnetic fields cannot be dismissed as a short-sighted trust in the folk

ontology delivered by our ‘middle-sized-thing-language’ – let alone the fact that the Author himself (pp. 98, 102) acknowledges the existence of at least one universal: the geometrical structure associated to each fiber.

In chapter 4 both the intuitive idea of the passage of time and the theoretical concept of an intrinsic asymmetry in the temporal structure of the world are defended against the commonly held view, according to which relativity theory states the impossibility of an objective flow of time (Gödel’s view is mentioned by way of example: pp. 115-16). Believing in the reality of both past and future events (thus accepting the metaphor of the *block universe*) is not at all incompatible with the thesis that time passes. Such a thesis has to cope with three types of objections (logical, scientific, and epistemological), to each of which a separate and careful discussion is devoted. Even granted that the physical laws are Time Reversal Invariant (p. 117: but this is not the case, in the Author’s opinion: see the phenomenon of the decay of the neutral K meson), such an invariance just presupposes a temporal direction; furthermore, it is difficult to see how a hypothetical time-reversed human *Doppelgänger* could be conscious and even intelligible in its anti-thermodynamic behaviour (p. 125). Among the strategies carried on by the deniers of the passage of time there is the ontological reduction of the direction of time to the entropy gradient; Maudlin contends that the entropy gradient is, on the contrary, explained through the asymmetrical treatment of the boundary conditions of the universe (recall the recipe in Chapter 1), an asymmetry which in its turn is ‘a reflection of the fact that time passes’ (p. 131): there is a preferred direction (an arrow) of time, and there is an entropy increase, only because time intrinsically passes – such a primitive truth pertains both to our scientific image and, less problematically, to the manifest one.

Chapter 5 is a thorough critique of the counterfactual analysis of causation. In all the attempts to secure the causal arrow through counterfactual dependencies there is a third fundamental factor, linking causes and conditionals, to be traced: the law of nature. The need for a third factor arises when we consider, on the one hand, the possibility to have knowledge of causal connections without knowing any Humean counterfactual (‘If *C* had not occurred, *E* would not have occurred’, when both *C* and *E* did actually occurred: p. 143), as the example of a Newtonian particle collision (with monitoring devices and potential back-up particles) shows. On the other, we consider also the inverse possibility: having knowledge of counterfactuals

without knowing causal connections. In the first possibility the key point is that laws in our world suffice to determine causes without the aid of Humean counterfactuals, and it is because he has implicitly picked up the real cause of an event that the counterfactual analyst can keep improving his theory. As to the second possibility, Maudlin sketches a modified version of Conway's game of Life (p. 149) and argues convincingly that in this hypothetical world even a detailed knowledge of all counterfactuals cannot settle the question of its causal structure, as well as the question of what are the laws operating there. A complete about-turn is needed: an alternative account in which laws will play a key role in the identification of causes, thereby figuring in the very truth conditions for causal claims. It is in this crucial passage that we find the notion a particular set of laws, called 'quasi-Newtonian' (p. 156), which represent the way we ordinarily think of the world and the objects therein. These laws consist in inertial laws (describing the initial, unaltered behaviour of some entities), extended with laws of deviation (describing how the inertial behaviour undergoes changes); in contexts of such a sort it is quite natural to identify what, as a perturbing factor, causes what. Our cognitive performances, however, are not entirely based on the assumption of quasi-Newtonian laws and, *a fortiori*, on FLOTEs: in our special sciences we usually employ lawlike generalizations (although we expect these too to be quasi-Newtonian), contriving taxonomies that could hardly be explained using the vocabulary of physics, in their carving the world at its joints (here comes an instructive treatment of an example from McDermott 1995: pp. 161ff.).

Chapter 6 lingers over other critical aspects of Humean supervenience and focuses by contrast on further merits of the non-Humean package: in particular on the notion of a 'productive explanation' (p. 175), which does justice to the asymmetrical order of physical events (the meaning of Bromberger's flagpole is remembered for the adequacy of the syntactic structure of D-N explanations). But, were not for the primitive asymmetry engendered by the passage of time, the very idea of a production would be completely out of range: it is not by chance that only fundamental (non pragmatic) productive explanations involve a FLOTE (p. 178).

Readers looking for the metaphysical import of physical theories like general relativity and quantum mechanics can gain precious insights from this book: its suggestions are innovative, though non always immediately clear in all of their implications. And readers persuaded that there is, beside physics,

much more than mere ‘stamp-collecting’, will find in it stimulating challenges to face.

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