Thought Experiments Outside Science

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The collection, edited by Katerina Ierodiakonou and Sophie Roux, is the result of a workshop on thought experiments that took place in Athens in 2007. The blurb of the book promises the essays in this collection to be results of the systematic debate concerning the epistemological status of thought experiments that started in the early 1990s, and to improve on this debate by "taming" the "contemporary wild usage of this notion" through historical analysis of thought experiments of different periods. After reading the volume, I doubt that most of the articles in it are continuous with the contemporary systematic debate on thought experiments, and neither do they seem to successfully 'tame' the usage of term 'thought experiment', especially since the focus of almost all papers seems to be on 'thought experiments' outside the habitat of the central cases that the 'wild' contemporary use departs from, i.e. modern (post-Galilean) science. Instead, the articles in this volume mainly look at thought experiments in antiquity (Ierodiakonou, Lautner), the Middle Ages (Grellard, Knuutila and Kukkonen, Palmerino), or philosophy (Virvidakis, Engel, Goffi and Roux). But this, at worst, should just mean that these essays broaden our conception of 'thought experiment' and thereby our horizon of cases we should consider when developing a systematic account of the epistemology of thought experimentation.

Indeed, I believe, there are plenty of valuable insights and observations in these articles, on some of which I hope to touch in this review. My occasional critical remarks should not belie my general impression that this volume is valuable read for everyone who studies the history and nature of thought experimentation.

The volume begins with Sophie Roux' well-informed introduction "The Emergence of Thought Experiments", which argues that the history of the notion of 'thought-experiment' is a history of "misunderstandings and omissions" (p. 4), and that the main characteristics of thought experiments, namely their counterfactuality, their involvement of concrete scenarios, and delimited cognitive intention are difficult to conciliate, which in turn is supposed to account for the philosophical controversies the notion has stirred (ibid.). After the introduction, the book is divided into three parts. The first "Historical Uses of Thought Experiments" looks at thought experiment episodes in antiquity and the Middle Ages, the second, "The Possibility of Thought Experiments" on methodological discussions of thought experimentation (even if not by that name) in the works of Averroes, Aquinas, Buridan, Galileo and Kant, and the third part "How do Thought Experiments Work?" systematically approaches the use of thought experiments in philosophy and (to some extent) the sciences.

Katerina Ierodiakonou's paper "Remarks on the History of an Ancient Thought Experiment" is the opener of the first of these three parts. Ierodiakonou focuses on the career of one particular thought experiment, of the man who stands at the edge of the universe and extends his hand or stick, presumably originally intended to prove the infinity of the universe. The thought experiment is assumed to originate in the 4th century BC, in the writings of Archytas of Tarentum (428-347 BC). Archytas' thought experiment was widely used subsequently (even up to Newton), but Ierodiakonou is interested in particular in the use Hellenistic philosophers made of Archytas' original argument. Firstly, she wants to see whether the later use was significantly different from the original case, secondly she is interested in whether that thought experiment can teach us something about the general characteristics of philosophical thought experiments in antiquity (p. 38).

Ierodiakonou argues that the later Stoic use of that thought experiment was in at least two respects different from the original use. On the one hand, the Stoics used it to prove a different result (that there is void outside the heavens instead of establishing that the universe is infinite), on the other hand, they argued to that goal in a different way, by taking the option that the man at the edge of the universe can not extend his hand, more seriously than Archytas had taken it (p. 43).

Concerning the common features of thought experiments we can generalize from Archytas' example, Ierodiakonou argues that neither the form of a *reductio ad absurdum*, nor the counterfactuality or impossibility of the hypothetical scenario (e.g. a man standing at the edge of the universe, extending his arm) is a common and thus necessary feature of all ancient thought experiments.

Peter Lautner suggests in his "Thought Experiments in the De Anima Commentaries" to consider as thought experiments "in a weak sense" (p. 53) also arguments that refer to ordinary general (but not concrete actual) cases. This would include for example the case of seeing in the dark, which Pseudo-Simplicius seems to refer to in order to explain in what way sense perception is self-reflective (since seeing in the dark would be a case in which the sense perception informs us that we are seeing (rather than being blind), although we are not seeing *something*). Why such arguments referring to ordinary cases should be considered thought experiments, remains a bit unclear from Lautner's argumentation. Lautner seems to suggest that otherwise we would miss an important difference between metaphysics on the one hand and philosophy of mind on the other, since the latter just would not allow for thought experiments involving "strongly" counterfactual considerations:

> "If we construe thought experiments to discuss problems concerning mental processes, it might be fairly difficult to devise counterfactuals that in fact cannot happen. Application of strong counterfactuals would mean that we have to figure up such mental processes that cannot occur at all. This would amount to something like imagining the unimaginable." (p. 57)

However, in light of the fact that some of the fancier scenarios in philosophical thought experimentation stem from the philosophy of mind, this does not seem to be

a plausible explanation. If there are not many thought experiments in the *De anima* commentaries, then this seems to require a different explanation, and should not be a reason to stretch the already overused notion of thought experiment.

Christophe Grellard's paper "Thought Experiments in Late Medieval Debates on Atomism" concludes the first part of the collection with an interesting case study of two thought experiments by Henry of Harclay (1270-1317) that were intended to establish atomism. After reconstructing and analysing the argumentation presented by Harclay, Grellard systematizes the strategies anti-atomists used to fend off the thought experiments. Grellard identifies three different strategies: either anti-atomists tried to find a flaw in the logic of the argumentation, or they denied the physical adequacy of the thought experiment, suggesting further physical factors that prevent the conclusion, or, finally, granted the conclusion, but restricted it to the conceptual/mathematical realm, and hence inapplicable to the physical world of real objects. As Grellard suggests in the conclusion of his essay, this case shows how medieval natural philosophy was struggling with the relation between the mathematical and the physical realm, and although the medieval should be credited for bringing thought experiments to the discussion of physical phenomena, they ultimately failed to "use them as a simplified model for depicting a complex natural reality" (p. 79).

The second part, concentrating on historical reflections on aspects of thought experiment-like argumentations, takes off with Simo Knuuttila's and Taneli Kukkonen's paper "Thought Experiments and Indirect Proofs in Averroes, Aquinas, and Buridan". Their discussion focuses on the struggle of early and late medieval commentators to explain Aristotle's use of impossible premises in *reductio* proofs.

Carla Rita Palmerino's fascinating "Galileo's Use of Medieval Thought Experiments" shows that Galileo's brilliant proficiency in the art of thought experimentation developed from critical reflection on and his engagement with medieval thought experiments.

In "On Kant's Critique of Thought Experiments in Early Modern Philosophy", Stelios Virvidakis assesses the potential of a transcendental perspective for developing general criteria for the evaluation of thought experimentation.

The third part of the collection eventually turns to systematic discussions of the method of thought experimentation. Pascal Engel follows Timothy Williamson in analysing thought experiments in philosophy as special kinds of modal arguments, which crucially involve counterfactual thinking (in particular the evaluation of certain counterfactual conditionals). Although Engel discusses several objections to Williamson's main thesis, i.e. that the relevant modal reasoning involved in philosophical thought experimentation is reducible (in a sense) to ordinary reasoning with counterfactuals, he eventually seems to endorse Williamson's "counterfactuality thesis" with the proviso that philosophical thought experiments can sometimes be dealing with conceptual modalities as well, not merely metaphysical ones (as Williamson claims, cf. Williamson 2005 and 2007; some of Engel's critical points are discussed in more detail in Jenkins 2008). Engel's latter point seems right to me, but I guess it is worth noting that Engel can't have it both. If the counterfactuality thesis is right, then the endorsed formal account of thought experiments (p. 153) is simply invalid for conceptual modalities. This can be easily seen from the following example (the argument is taken from Williamson 2007, modified to instantiate the argument form endorsed by Engel):

$$(\text{T}) \quad (Hesperus = Hesperus) \rightarrow \Box_C (Hesperus = Hesperus)$$

$$(\text{P1}) \quad \Diamond_C (Hesperus \neq Phosphorus)$$

$$(\text{P2}) \quad (Hesperus \neq Phosphorus) \;\Box\!\!\rightarrow\; (Hesperus \neq Hesperus)$$

$$(\text{C1}) \quad \Diamond_C (Hesperus \neq Hesperus)$$

$$(\text{C2}) \quad (Hesperus \neq Hesperus)$$

Let the boxes and diamonds with subscript C express conceptual modality, and the box-arrow in (P2) the counterfactual conditional. (T) is the thesis targeted (and plausibly true for friends of conceptual necessity), (P1) an assumed conceptual possibility (and plausibly true for friends of conceptual possibility). (P2) is true due to the logic of identity and counterfactuals, and the truth of 'Hesperus = Phosphorus', (C1) follows from (P1) and (P2), and (C2) follows from (T) and (C1). However, (C2) is false. Thus, if our evaluation of modal claims is ultimately based on our ability to evaluate counterfactuals like (P2), then reasoning with modal premises weaker than

metaphysical modality will lead to contradiction. In other words, making room for conceptual modality as the subject matter of philosophical thought experimenting requires abandoning Williamson's counterfactuality thesis or a different reconstruction of the modal argument involved (or a different interpretation of the conditional, cf. Häggqvist 2009).

Jean-Yves Goffi and Sophie Roux try in "On the Very Idea of a Thought Experiment" to formulate necessary conditions for successful thought experiments. From the discussion and analysis of Galileo's famous falling bodies and Thompson's famous violinist, they abstract the following three conditions: (i.) thought experiments "deal with" beliefs, (ii.) they require contexts of shared assumptions, (iii.) these shared assumptions are organised in a hierarchical structure (p. 180). Depending on how widely one is ready to interpret these conditions, one can surely agree with them. Certainly thought experiments "deal with" beliefs (for example by testing theories), they certainly require some shared assumptions to be dialectically successful, and the Duhem-Quine problem, i.e. knowing, when faced with recalcitrant evidence, which prior belief 'has to go', needs to be solvable in a uniform way for the thought experiment to reach a particular dialectical aim (e.g. to refute a specific theory). Understood in a narrower way, the three conditions might seem less plausible; as Williamson (again in 2007) argues, thought experiments in philosophy "deal with" metaphysical facts, not with our beliefs about them or our concepts of them. Likewise, the shared hierarchical structure of our background assumptions is a subtle matter. Stevin's chain doesn't work because the addressees of the experiment believed in the general impossibility of perpetual motion. As is observed in (Kühne 2005) this assumption is not necessary for the argument. What is clear to every addressee of the thought experiment is that you cannot build a perpetuum mobile simply by putting a chain around a prism. Stevin could know that his contemporaries would arrive at the same judgment, but this is hardly thanks to any sort of prior hierarchical ordering of beliefs. Before Stevin's thought experiment presumably nobody ever put much thought into what a chain would do if put around a prism.

The last paper of the collection, John Zeimbekis' "Thought Experiments and Mental Simulations" is my favourite paper in the volume. Well-informed about the relevant philosophical and methodological literature, Zeimbekis carefully distinguishes

different forms of mental simulations and determines the proper place and the explanatory/justificatory potential for mental simulation in thought experimentation. It turns out that much talk of mental simulation is misplaced. Thought experiments in physics do not simulate physical processes, but rather simulate perceptions of physical states. In the case of moral thought experiments, where the target processes themselves are mental and we thus *can* mentally simulate what is relevant, their epistemology is, however, still objectionable. This is, Zeimbekis argues, because those mental-mental simulations might be biased towards sentimentalist moral theories. All in all, this collection presents us with nine thought-provoking essays on thought experimentation and other argumentative strategies from antiquity to today. A good read for anyone interested in the history of philosophy and science and the methodology of thought experimentation in either discipline.

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