

Tools of the Trade: Thought Experiments Examined

By Tamar Gendler

At the end of the last century, Ernst Mach coined a term to describe a particular technique of scientific investigation, a mental analogue to physical experiment which he dubbed "*Gedankenexperiment*."¹ According to Mach, this method is central to the history of science; its greatest practitioners include Aristotle and Galileo, and its careful employment "led to enormous changes in our thinking and to an opening up of most important new paths of inquiry."²

In the century that followed, Mach's term (and its English translation) showed up occasionally in the philosophy of science literature, most notably, perhaps, in Karl Popper's "On the Use and Misuse of Imaginary Experiments, Especially in Quantum Theory,"³ and in Thomas Kuhn's, "A Function for Thought Experiments."⁴ Discussions of the technique — in science and in philosophy — made sporadic appearances on the pages of philosophy journals, each year's *Philosophers' Index* sporting some dozen entries under "Thought Experiment." Then, in the mid-1980s, the *Zeitgeist* smiled upon thought experiments; they were explicitly recognized as a central technique in analytic philosophy, and self-conscious philosophical scrutiny was directed upon them.⁵

In the Spring of 1986, Tamara Horowitz and Gerald Massey organized a conference at the University of Pittsburgh on "The Place of Thought Experiments in Science and Philosophy." The papers given at that conference, along with several others inspired by it, are collected in *Thought Experiments in Science and Philosophy*, published in 1991. A year later, Roy Sorensen published his *Thought Experiments*, a detailed ten-chapter discussion of thought experiments in philosophy and science, in which he defends their continuity with physical experiment, and adduces numerous arguments in favor of their philosophical legitimacy.

Sorensen's style is chatty and unpretentious, full of striking turns of phrase and colloquialisms: "I am bullish on the comparison;" "this prototype gives us a bum steer;" "Wittgenstein discourages fascination with mental freak shows;" "traditional metaphysicians scoffed at Meinong's

BOOKS REVIEWED

Thought Experiments in Science and Philosophy.
Tamara Horowitz and
Gerald Massey, eds.
Savage, MD: Rowman and
Littlefield, 1991. (335 pp.)

Thought Experiments
by Roy Sorensen
New York: Oxford, 1992.
(318 pp.)

forays into the ontological nightlife." This makes his book generally fun and refreshing to read but occasionally it becomes exhausting.

If anything, Sorensen's book is too comprehensive. The book begins with a presentation of examples of thought experiments in philosophy and science, then puts forth and counters the main arguments that have been advanced against thought experiment as a technique. This is followed by chapters on Mach and Kuhn, then by Sorensen's own attempt to reconstruct the logical structure of thought experiments and taxonomize them accordingly. The final chapters of the book explore vagueness, experiment, and fallacies.

Sorensen writes for a lay audience (defining such symbols as "□" and "◇" and providing identifying epithets for philosophers such as Descartes and Leibniz), but he tries at the same time to keep a level of sophistication that will satisfy the professional philosophical reader. As a consequence, one sometimes has the feeling of riding with an adolescent driver in a new Porsche: hurtled from zero to sixty in a single paragraph. In six pages, for instance, Sorensen surveys the main arguments for and against the views that conceivability implies possibility and vice versa; in four pages, he runs through the issues concerning experiment. One wishes he would slow down a bit, since the book is replete with suggestive reconceptions and reconstructions of standard arguments. But Sorensen romps through field after field, stopping sometimes to give an extended example, but then, impatiently, dashing off to the next topic.

Many of the themes raised by Sorensen are discussed by authors in the Horowitz and Massey volume.⁶ Heeding Mach's recognition that "thought experiments are important not only in physics, but in every field,"⁷ Horowitz and Massey gather contributors from physics, biology, mathematics, and linguistics, as well as the history of ancient, medieval, and early modern philosophy, and philosophy from both the analytic and continental traditions. As is to be expected in such a collection, the philosophical quality of the contributions varies tremendously. A number of the papers in this volume are not by trained philosophers, and some seem, as a consequence, philosophically rather slender. But because the book is so interdisciplinary, one stumbles over insights even when wading through the less stimulating entries, and when strolling among the more impressive articles, one is even arrested by them.

The anthology's twenty-one papers have been divided into four sections: Thought Experiments in the History of Science and Philosophy;⁸ Thought Experiments in Logic and Mathematics;⁹ Thought Experiments in the Sciences;¹⁰ and Thought Experiments in Philosophy.¹¹ Since the book begins with a thirty-page introduction by the editors that provides competent page-long summaries of each of the articles included in the volume, I shall not attempt to be comprehensive here. Rather, I will confine myself to the patterns I found most striking, and the insights I found most intriguing.

Approximately half of the contributors provide some definition of what they take "thought experiment" to mean. These range from the evocative:

Thought experiments are performed in the laboratory of the mind. Beyond that bit of metaphor it's hard to say just what they are. We recognize them when we see them.¹²

to the technical:

A thought experiment is an ordered pair $\langle \phi, \vartheta \rangle$ where ϕ is a set of persons (audience and/or presenter) and ϑ is a set of statements $\{T, P_1, P_2, \dots, P_n, Q\}$ where:

- (1) T is a description that is not in fact true (because it is idealized) of any experiment in this world;
- (2) Members of ϕ believe that P_1, P_2, \dots, P_n are scientific laws or principles;
- (3) Members of ϕ believe that $\exists x(Tx) \& P_1 \& P_2 \& \dots \& P_n \Rightarrow Q$.¹³

Interestingly, few of the philosophers attempt such definitions.¹⁴ Maybe there is a lesson in this; can philosophical thought experiments be sharply distinguished from other philosophical techniques? Perhaps not. In this volume, Nicholas Rescher argues that much Presocratic reasoning can properly be understood as thought experimentation; Peter King contends that medieval treatises on *obligationes* (formalized debates or disputes) represent "a developed body of reflection on the method of thought experiment;"¹⁵ Rolf George argues that thought experiments are a defining feature of early modern epistemology; J.N. Mohanty suggests that the Husserlian technique of eidetic variation is basically that of thought experiment; and Gerald Massey argues that thought experiment is contemporary analytic philosophy's main *modus operandi*, the modern surrogate for meaning analysis. If thought experiment is so central to philosophy,¹⁶ it is no wonder it should prove so challenging to define.

Still, many of the issues raised by the definitions in the "Sciences" sections have important implications for philosophy. Perhaps the most interesting of these definitions is John Norton's, taken from his subtle and illuminating article:

Thought experiments are arguments which:

- (i) posit hypothetical or counterfactual states of affairs, and (ii) invoke particulars irrelevant to the generality of the conclusion."¹⁷

Although Norton thinks all thought experiments are actually arguments, and thus in principle reconstructible as such, he makes a fascinating comment in a footnote: "In principle, there could be a case in which a thought experiment could not be reconstructed *explicitly* as an argument, because the thought experiment invokes some acceptable, inductive moves, to which we only assent because of the suggestiveness of the thought experiment format."¹⁸ That is, there may be forms of reasoning which we would consider legitimate within the frame of the thought experiment, but not outside of it. The question then arises: should we consider the within-frame reasoning to be applicable to the actual world?

A common line of criticism against philosophical thought experiments is that the imagined scenario is underspecified with regard to relevant detail. This argument is often made by feminist critics, who charge that philosophers have canonized the tenets for correct moral reasoning without considering the real complexities of our moral practice.¹⁹ A parallel problem is raised by Barbara Massey, Tamara Horowitz, and Richard Gale, each of whom argues that a par-

ticular thought experiment has been insufficiently "filled-in." Frege's thought experiment about the non-logical tribe, Newcomb's problem, and thought experiments from the personal identity literature are criticized by these authors respectively on the grounds that their standard readings fail to recognize the ways in which human beings are actually motivated to reason, to make decisions, or to apply concepts. Joseph Camp's parable against drawing conclusions from overly limited imaginary situations also falls in this category.

The remaining philosophical pieces discuss the relation of thought experiments to other central philosophical concepts. Lilli Alanen looks at the issue of conceivability in Descartes, and Stephen Cade Hetherington explores the relation between conceivability and modal knowledge. Both of these pieces are hard going. Of the scientific pieces, the Norton and Lennox are worth reading closely; the Thomason, Forge, and Janis also struck me as interesting.

One of the virtues of the Sorensen volume is its excellent bibliography; its indexes (one by subject, one by name), have proven accurate, as have its numerous references. By contrast, the Horowitz and Massey shows signs of careless editing. Internal cross-references to page numbers are almost always unreliable; and in several cases, references are made in footnotes and texts to documents whose citation information is not given in the bibliographies. Both, I suspect, are a function of the book's status as an anthology, as is its lack of any sort of index or comprehensive bibliography.

Both the Sorensen and the Horowitz and Massey volume are available only in hardcover, and thus purchase seems out of the question except for the specialist. But both should be widely available at university libraries, and if Harvard University's Widener Library is any example, both should be in frequent circulation. φ

ENDNOTES

¹Ernst Mach, *The Science of Mechanics (6th American edition)*, trans. Thomas J. McCormack. La Salle, IL: Open Court, 1960. (First published as *Die Mechanik in Ihrer Entwicklung Historisch-Kritisch Dargestellt*, 1883).

²Ernst Mach, *Knowledge and Error*, Trans. Thomas J. McCormack and Paul Foulkes. Dordrecht: D. Reidel, 1976, p. 138. (Originally published as *Erkenntnis und Irrtum*, Leipzig, 1905.)

³Karl Popper, *The Logic of Scientific Discovery* New York: Routledge, repr. 1992, pp. 442-456. (Originally published as *Logik der Forschung*, Vienna, 1934/35.)

⁴Thomas Kuhn, *The Essential Tension*, Chicago: University of Chicago Press, 1977, pp. 240-265.

⁵In addition to the books mentioned below, discussions of thought experiments from this period include much of Daniel Dennett's *Elbow Room* (Cambridge: MIT Press, 1984); David Cole's "Thought and Thought Experiments" (*Philosophical Studies* 45 (1984):431-444); Jonathan Dancy's "The Role of Imaginary Cases in Ethics" (*Pacific Philosophical Quarterly* 66 (1985):141-153); Gilbert Harman's "Moral Explanations of Natural Facts — Can Moral Claims be Tested Against Moral Reality?" (*Southern Journal of Philosophy* 24 suppl. (1986)); Mark Johnston's "Human Beings" (*Journal of Philosophy* 84 (1987):59-83); Mason C. Myers's "Analytical Thought Experiments" (*Metaphilosophy* 17 (1986):109-118). Three book-length treatments of the subject appeared slightly later: Kathleen Wilkes's *Real People*:

Personal Identity without Thought Experiments (Oxford: Clarendon Press, 1988); James Robert Brown's *The Laboratory of the Mind* (London: Routledge, 1991); and Sorensen (1992).

⁶There was little direct influence either way, since the Sorensen volume came out long after the Pittsburgh conference, and the proceedings of that conference were not generally available until their publication in 1991. An exception is the essay by John Norton, which seems to have circulated widely in manuscript.

⁷*Knowledge and Error*, p. 144.

⁸Including Nicholas Rescher's "Thought Experimentation in Presocratic Philosophy," Peter King's "Medieval Thought Experiments: The Metamethodology of Medieval Science," and Lilli Alanen's "Descartes, Conceivability, and Logical Modality."

⁹Including D.A. Anapolitanos's "Thought Experiments and Conceivability Conditions," and Barbara Massey's "Do All Rational Folks Reason as We Do? Frege's Thought Experiment Reconsidered."

¹⁰Including Allen I. Janis's "Can Thought Experiments Fail?," James Robert Brown's "Thought Experiments: A Platonic Account," John Norton's "Thought Experiments in Einstein's Work," Andrew D. Irvine's "On the Nature of Thought Experiments in Scientific Reasoning," Ronald Laymon's "Thought Experiments of Stevin Mach and Gouy: Thought Experiments as Ideal Limits and as Semantic Domains," Mark Wilson's "Reflections on Strings," John Forge's "Thought Experiments in the Philosophy of Physical Science," James G. Lennox's "Darwinian Thought Experiments: A Function for Just-So Stories," and Sarah G. Thomason's "Thought Experiments in Linguistics."

¹¹Including J.N. Mohanty's "Method of Imaginative Variation in Phenomenology," Rolf George's "The Tradition of Thought Experiments in Epistemology," Gerald Massey's "Backdoor Analyticity," Richard M. Gale's "On Some Pernicious Thought Experiments," Tamara Horowitz's "Newcomb's Problem as a Thought Experiment," Stephen Cade Hetherington's "Conceivability and Modal Knowledge," and Joseph L. Camp's "The Ballad of Clyde the Moose."

¹²James Robert Brown, *op cit*, p. 122.

¹³Ronald Laymon, *op cit*, p. 168.

¹⁴Indeed, even the intrepid Sorensen doesn't define the expression until two-thirds of the way through the book, and even there contents himself with defining "experiment," and then adding: "a thought experiment is an experiment that purports to achieve its aim without the benefit of execution." Sorensen, *Thought Experiments*, p. 205.

¹⁵King, *op cit*, p. 44.

¹⁶There is an alternative hypothesis. Since many of these papers were written especially for the conference, there might have been a tendency among participants to construe modes of thought that might otherwise not be classed as such as thought experiments. So perhaps the reason the philosophers have such trouble producing a definition that includes a particular case is that the term is misapplied to that case.

¹⁷John Norton, *op cit*, p. 129. Norton notes that these conditions are necessary but not sufficient.

James G. Lennox offers an interesting variation of Norton's definition: "Thought experiments are: (a) tests of a theory's explanatory potential which (b) posit hypothetical or counterfactual test conditions and (c) invoke particulars which are irrelevant to the generality of the theory, and which (d) are selected to instantiate features of the theory under special consideration." James G. Lennox, *op cit*, p. 236. Lennox discusses the differences between his and Norton's views at 241-242.

¹⁸Norton, *op cit*, p. 142.

¹⁹Sorensen discusses this criticism, among others, in his second chapter entitled "Scepticism about Thought Experiments."