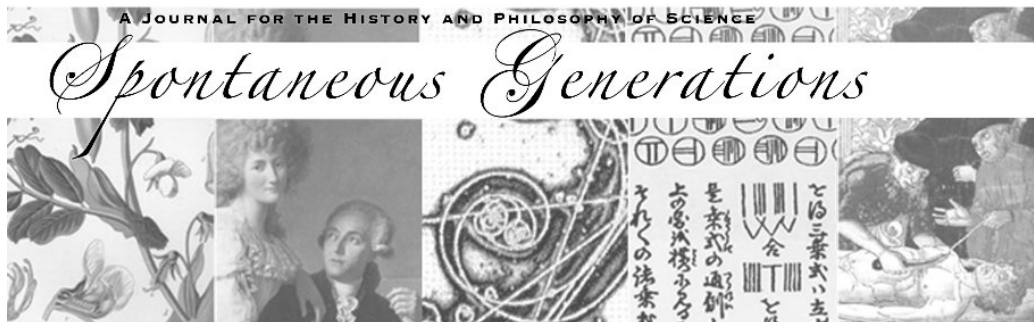




REVIEW: Daniel Rothbart, *Philosophical Instruments: Minds and Tools at Work*

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BOOK REVIEWS

Daniel Rothbart. *Philosophical Instruments: Minds and Tools at Work*. xiv + 138 pp. Urbana: University of Illinois, 2007. *

Isaac Record[†]

This slim volume contains much that is suggestive, but little that is substantive. This is unfortunate, as there is need of a sustained analysis of the epistemology of instruments.

The term “philosophical instruments” comes from Rothbart’s whiggish read on seventeenth century mechanists, who distinguished between the passive measurement devices they called “mathematical instruments” and philosophical instruments, whose nature it is to disturb their target and reveal the inner structure of the world. This conceit underscores the distinction Rothbart finds lacking in traditional epistemology of instruments: In answering the question of why scientists should trust modern instruments to reliably expose unobservable structures, philosophers claim that instruments function to extend our senses, but many modern instruments are nothing like our senses.

Some modern instruments translate information away from direct sensory perception; a photomultiplier readout charts milliamperes rather than presenting the radiant energy in a directly accessible form. The traditional justification for trusting observations made using such instruments relies on reducing the operation of the instrument to two older epistemic worries: sense organs that detect an instrument’s output and a causal chain running from a specimen’s sensory properties to the instrument’s output. (Humphreys’ 2003 *Extending Ourselves* is a nice development of this line of reasoning.) But, Rothbart says, even instruments like microscopes, which do seem to extend the limited sensory capacity of unaided humans, should not be understood as mere extensions. Doing so distorts the theoretical rationale behind modern instruments; they expose a specimen’s underlying physical structure by analogy to the technology of the instrument itself.

The reason we believe instruments to be reliable, according to Rothbart, has little to do with thinking of them as similar to our senses, but rather, thinking of them as similar to mechanisms we already trust. Rothbart’s central thesis is that the design plans for

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instruments predispose scientists to see phenomena in a particular way by invoking analogies to well-known causal processes. Whereas in traditional instrument epistemology, our understanding of instruments necessarily relies on our understanding of the naked senses, Rothbart wants to understand instruments as extending what he calls “material possibility.” In other words, instruments not only enhance our senses but also enable skilful or sensitive manipulation of material. They are channels for commitments about know-how, the knowledge of how to produce effects.

Rothbart’s alternative to traditional epistemology is to leave aside analogies to senses and focus on the technological analogies. It turns out, there is an easy way to find out what those technological analogies are: all we have to do is look at the design plans of instruments. The design process, Rothbart says, embeds epistemic maps into design plans. Through their iconic syntax, such maps invoke analogies to trusted mechanisms and thereby inform virtual witnessing—they invoke idealized experimental ideas not reducible to materiality and physics. Unfortunately, Rothbart’s focus on design plans seriously mischaracterizes the design process. His emphasis on published plans removes focus from the instrument itself. Using the design plans as an entrée to a wider discussion of the design process could be useful, but stopping the analysis at schematics is no better than stopping it at theory. Rothbart’s analysis leaves no room for ‘cut and try’ engineering or for feedback in the design process.

Philosophical Instruments begins well enough. Chapter 1 contains a decent, if brief, historiography of the philosophy of instruments, with each contributor receiving a few sentences. Rothbart convincingly argues that there is more to be said, and he lays out his plan to say it. Unfortunately, the rest of the book fails to bear out the promise of the beginning. Chapters 2-4 deal with how plans reflect engineering knowledge. Rothbart gives a lot of attention to iconographic thinking, which he says integrates experience and hypothesis. That is, symbols in design diagrams carry with them claims about reliability and function and these claims refer to idealized rather than material versions of the components. These early chapters contain more new work than the other chapters, which are largely recapitulations of Rothbart’s earlier publications. Unfortunately, there are some organizational problems. For example, Rothbart discusses the “obvious” features of particular drawings before introducing the notion of a suitably prepared interpreter—and without any discussion of how an interpreter comes to be suitably prepared.

In the second half of the book, Chapters 5-7, Rothbart investigates the ontological claims underpinning design plans, focusing on Hooke’s microscope in Chapter 5 and the scanning tunneling electron microscope

in Chapter 6. His treatment of Hooke's microscope does well to demonstrate why a new philosophical analysis of the epistemology of instruments is necessary, but it lacks the historical rigor needed to rise above a shallow re-reading of mechanist philosophy. Rothbart's discussion of the electron microscope is one of the most useful in the book, although it serves more to illustrate than to demonstrate his themes. He follows Hacking in side-stepping the age-old question about the reality of unobservable entities by redefining "observable" as "experimentally accessible," making the distinction between unobservable (or "theoretical") entities and observable ones "dependent on detection methods available to researchers at a particular time" (p. 82). Continuing with his reconceptualization of instruments, "properties" become "capacities" exercised by properly running apparatus. From them, then, we learn not only about the world, but about the device with which we are intervening in the world. Instrumental advance is a process of removing obstacles and revealing the "concealed capacities" of instrument and specimen. In short, a specimen is a signal-producing machine, and to properly interpret its "message" requires a knowledge of causes, sources, noise, and optimization. Rothbart argues that scientists accomplish this through visualization of iconic modeling and thought experiments. "Noise" is something not in the model of the specimen or detector, but which (cf. Cartwright) we can nonetheless minimize and compensate for (p. 88). This is in part because we assume that the world and instruments operate on the same physical principles, making instruments "nomological machines."

The book's design leaves much to be desired. It concludes rather abruptly with an afterword that reads like an afterthought. Rothbart's endnotes are few and therefore odd to have. He has included a short glossary, a good bibliography, and a very short index. The book contains twenty-nine line drawings to illustrate Rothbart's thesis.

While I credit Rothbart with asking the right questions and recognizing that instruments are performative and not simply constative, his answers seem misguided. His most valuable insights come from a careful study of the design process, not just design plans. Rothbart's philosophy is undeveloped and his historical claims unsupported. Rather than an expansion and synthesis of earlier ideas, *Philosophical Instruments* is largely a re-presentation of work published a decade earlier.

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