

Leviathan and the Air-Pump

by Steven Shapin and Simon Schaffer

Understanding Experiment

Their objective is understanding experiment and its products.

Their questions are epistemological: How experiment arose, how it was institutionalized, and which of the matters of fact it produced came to be foundations for scientific knowledge.

Their methods are historical: they deal with the historical circumstances in which the development of the experimental project took place, alongside the social context in which scientific practices were embedded.

To this end, they focus on the Boyle-Hobbes controversy regarding proper knowledge in natural philosophy.

Their view is that there is nothing self-evident about the judgments that led to the acceptance of experiment in the production of matters of fact. Rather, convention, practical agreement, and labor play a fundamental role.

It is a matter of language-games and forms of life.

Solutions to the problem of knowledge are embedded within solutions to the problem of social order.

Seeing and Believing: Boyle's case

Boyle's experimentalist method is thought of as self-evident. It is accepted unreflectively. This is so because it's part of our own culture.

The matter of fact is seen as a mirror of nature, as produced by nature in absence of human intervention, and as the most solid and permanent item of knowledge.

So, they ask: How did this come to be? Which technical, literary, and social practices generated, and validated, matters of fact?

Experimentalism:

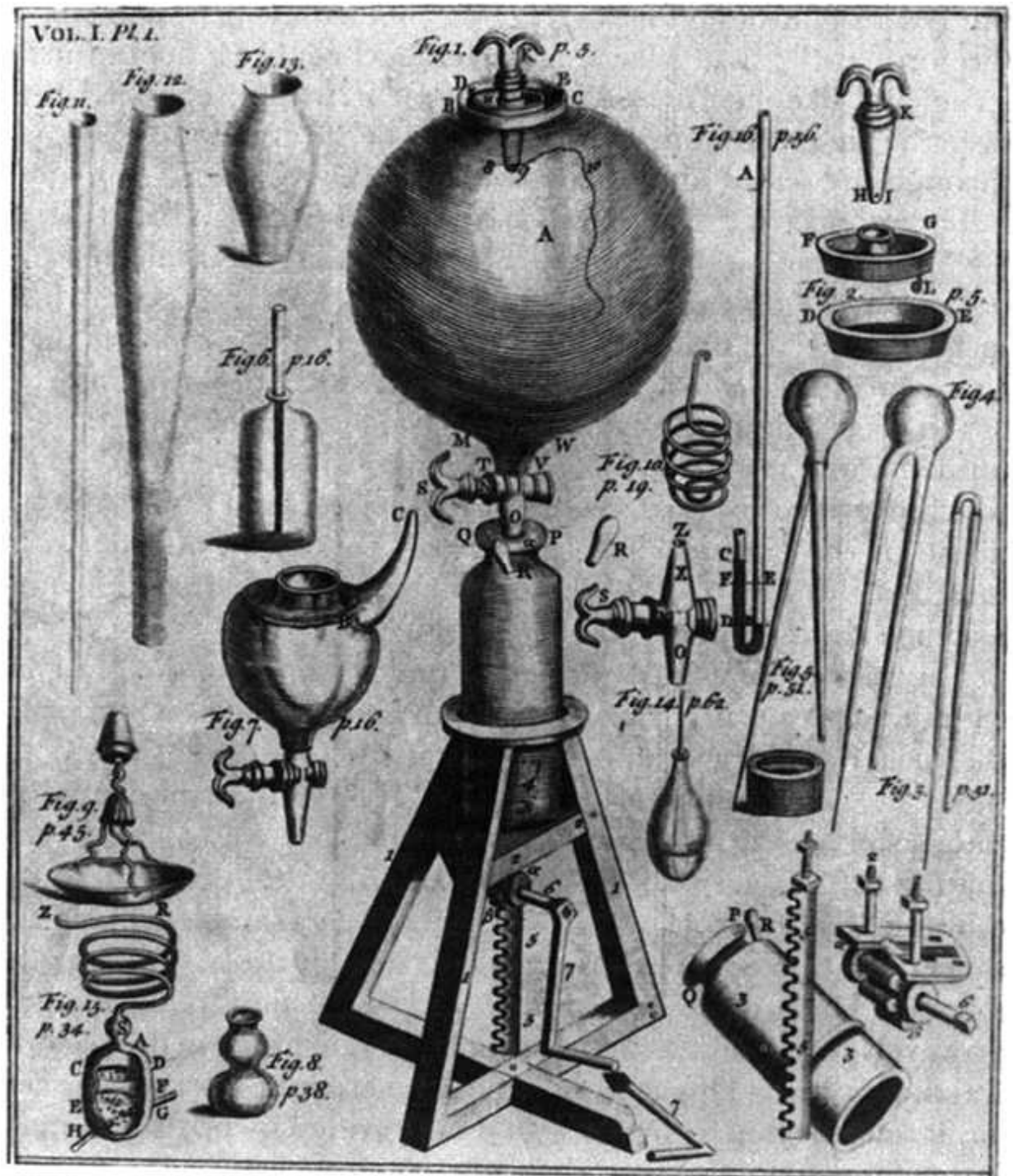
All that can be expected from physical knowledge is probability.
Universal assent through demonstration is a failed project. We can only
aspire to moral certainty.

What we can moral certainty about is the fact. We can know what we
perceive, but not the underlying mechanisms.

Matters of fact are established by aggregation of beliefs. So,
multiplication of witnessing is fundamental.

Three technologies essential to Boyle's program:

- Material
- Literary
- Social



Robert Boyle's first air-pump, as it appeared in an engraving in *New Experiments Physico-Mechanical* (1660).

Importance of material technology (the Air-Pump) in terms of the proper interpretation of facts.

Only that which is observable through experiment is proper natural philosophy, the underlying cause is dismissed as metaphysics. Thus, he separates categories such as vacuum from its metaphysical implications and adopts it as experimental space.

This is a drawing of boundaries for Boyle's language-game between experimental facts and their ultimate causes.

Such a drawing of boundaries is implicit, and is only exemplified. The form of life itself is its justification.

How to multiply beliefs and witnesses?

1. Laboratory as (restricted) social space.
2. Replication of experiment.
3. Virtual witnessing

This is where literary technology comes in.

- Use of mimetic imagery
- Elaborate sentences with circumstantial detail.
- Reporting of failed experiments
- Shows of modesty

Social technology:

Production of knowledge as collective enterprise in a public space, towards a public constitution and validation of knowledge (against both the private work of alchemists, and the individual dictates of systematical philosophers).

Sets right rules of discourse necessary for establishing and justifying matters of fact. Also, which is the language of theory which is inadmissible as natural philosophy.

Flexibility: Agreement about causes is not necessary. From within natural philosophy all that matters is facts.

Seeing double: Hobbe's Philosophy

Philosophy of material monism.

Ontology:

- Plenist
- Causal
- Material

For Hobbes, explicitly, social order is a fundamental problem.

He viewed experimentalism as not only incapable of producing assent, but as dangerous to social order. Boyle's project would guarantee disorder.

Proper metaphysical language was the only way to ensure social order. So, he denied Boyle's cooptation of "vacuum" as experimental space.

Three exercises in the Leviathan:

Ontological

The cause of the different positions among vacuists and plenists (which were not only two camps) was absurd metaphysical language.

As a mechanist, he thought motion could only take place by contact. So vacuum, as part of a notion of immaterial substance, could not exist.

No existing experiment could support the idea of a vacuum.

Epistemological

Definitions allow us to avoid absurdities, and reason is the correct method to move from definitions to consequences.

Political

For this political project, what knowledge is, is as important as what nature is. It is the grounds for assent and order.

The cooptation of the term "vacuum" by Boyle was dangerous, as it was illegitimately used to subvert the authority of the state.

The vacuum must be eliminated. And only then can it be called proper philosophy, which contributes to public peace.

It is necessary to collapse dualisms of matter and spirit to eliminate the double tribute to state and clergy.

Reason and behavior are in the public domain, and it is there that order must be established.

Proper use of reason precludes private belief. As such, this belief takes an opposing role for Hobbes and Boyle.

Certainty is the aim of reason, not probability.

In the language-game of Hobbes, there is a sharp boundary between knowledge and opinion which is inadmissible to cross.

The Polity of Science

Generating and protecting knowledge is a political problem.

Hobbes and Boyle specified rules and conventions for differing forms of life.

The history of science occupied the same terrain as the history of politics.

“We see that both games proposed for natural philosophers assumed a causal connection between the political structure of the philosophical community and the genuineness of the knowledge produced.” p.339

“As we come to recognize the conventional and artifactual status of our forms of knowing, we put ourselves in a position to realize that it is ourselves and not reality that is responsible for what we know. Knowledge, as much as the state, is the product of human actions. Hobbes was right.” p.344



Otto von Guericke's first pump demonstrated before witnesses. From Schott's *Mechanica hydraulico-pneumatica* (Wurzburg, 1657), p. 445.

Questions

If the authors are right in their analysis of literary technology as deployed by Boyle, what are the implications of the types of visual aids we use in scientific discourse today?

Given the uses of the term throughout the book, what do the authors understand by technology? What is its role in human affairs?

If discourse of knowledge is political, then why do the authors claim, explicitly, to be aiming at understanding (p. 3), and that their purpose is not “evaluative”, but “descriptive and explanatory” (12)? In other words, what is the political project behind this very text?

