STS C200, Week 6:
History of Science and Social Constructivism

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1 Galileo the Emblem Maker / Mario Biagioli [1]

In the very first week of this semester, we encountered Galileo and his *Sidereus Nuncia* in our reading of Koyré [2]. This week, Biagioli shines the spotlight at Galileo from an entirely different perspective than Koyré's history of ideas. In *Galileo the Emblem Maker*, Biagioli presents Galileo as a courtier rather than a "pure" scientist; he analyzes how Galileo represented his discoveries in the Medici court, and his patronage strategies in general. Through these, he tells a story of early modern science and its struggle for social legitimacy.

Far from a revisionist, Biagioli makes the case that it was Galileo himself that actively transitioned from academia to the court, in a strong sense. Galileo sought not just the material amenities available from patronage, but also social legitimacy from a powerful ruling class. At that time, mathematicians held an inferior position to philosophers in the academic hierarchy. In particular, mathematicians were barred from reasoning about some aspects of the natural realm (see also Section 2).[1] If Galileo was to legitimately present physical findings such as the discovery of new celestial bodies, he had to adopt a new title or find a new home. He did both.

Unlike most Italian mathematicians at the time, Galileo had a good understanding of courtly affairs. He was not born to a wealthy family, but his upbringing provided him with another valuable resource: access to the Florentine court and an education in courtly etiquette. Galileo was shaped to be a man of culture, trained in rhetoric and literature (in addition to mathematics, of course). It was this aspect of his upbringing that formed the foundation of his effective patronage strategies that stand at the heart of Biagioli's analysis.

Galileo's courtly competence allowed him to identify an opportunity for legitimizing his discoveries via the Medici court. In their rule of Florence, the Medici made extensive use of a mythology based in the Greek pantheon and celestial objects. That is, the Medici portrayed their rule as "natural" by associating themselves with natural objects. Conveniently, the emblematics of Cosimo I had motifs of Jupiter – namesake to the planet around which Galileo's eventual discoveries shall orbit.

Biagioli highlights an impresa proposed by Galileo in 1608 as a turning point in his patronage strategies. The impresa, which capitalized heavily on the cosmological symbolism in Medici emblematics, was a (proposed) gift directly praising the Medici and their image. This is as opposed to previous gifts offered by Galileo, whose value was due to mechanical ingenuity (e.g., a military compass). Such 'mechanically-motivated' gifts were appreciated, but did not result in the social promotion that he was hoping for.

The impresa is notable not only in Galileo's personal progression, but also in his attempt to legitimize scientific discoveries as a whole. Key to the impresa's imagery was a lodestone and its physical properties: as the lodestone attracts iron, so does Medici power attract their Florentine subjects. Had the impresa been accepted, the representation of a scientific object would have been tied to that of Florence's powerful rulers. The impresa was ultimately rejected due to its obscurity, but the strategy of an apparent empowerment

[1] One cannot help but notice a similarity to a much later demarcation, in which sociologists of knowledge were, in some sense, barred from examining mathematics itself [3].

of the Medici that indirectly serves to legitimize science made a second and (somewhat) more successful appearance, as we shall now see.

In *Sidereus Nuncius* ("Starry Messenger"), Galileo reported on the imperfect surface of the moon, hundreds of newly identified stars and, most relevant to our context, four moons circling Jupiter.

Crucially, Galileo did not frame the moons of Jupiter as his own scientific discoveries, but rather as a confirmation of Medicean mythology. He was not acting as a mathematician or astronomer, but as a *messenger*; indeed, he attempted to weaken his connection to the discovery so that he could legitimate it as a philosopher. In doing so, he gained oracle-like status, a "midwife in the astrologico-dynastical encounter" in which Cosimo II inherited virtues from his father via Jupiter. This masterfully-crafted strategy granted him his long-sought material and social position. But our story does not end here.

As discussed earlier, Galileo's strategy was bi-directional: power moved from discovery to the court, and then from the court to the discovery and the scientific process as a whole. This second direction affected (and even delayed) the legitimacy of the soon-to-be Medicean moons. The court was not quick to tie its reputation with the new findings, and initially avoided confirming the existence of the moons.

Galileo was annoyed by the lack of Medici approval, and this reveals what is, in my opinion, Biagioli's strongest argument for viewing Galileo as a courtier rather than a scientist (or, as he puts it, "a socioprofessional hybrid"). At that point, Galileo's findings were already endorsed by Kepler, a renowned astronomer and scientific authority. Why, then, did Galileo continue to seek approval from the Medici court? The answer is that Galileo was not a scientist undergoing peer-review, but an emblem-maker that needed approval from his prince!

Note that Biagioli's claim is not that Galileo discovered the satellites *because* he was a client of the Medici. Rather, Biagioli wishes to highlight Galileo's unique strategy that married revolutionary technical novelties with elegant sociopolitical considerations. Like artists of that time, Galileo had to mask the transactional relationship between his product and the court; he had to mediate between his discoveries and the court, but could not be the discoverer himself. This paradox is why he ultimately failed to harness the power of Medici towards scientific legitimacy of Copernicanism and the mathematical analysis of nature, concludes Biagioli.

2 Leviathan and the Air Pump / Steven Shapin and Simon Schaffer [4]

Shapin and Schaffer explore the scientific paradigm of experimentation through Robert Boyle and his air-pump. They take the relativist approach of giving full and genuine consideration to a notable alternative paradigm to experimentalism, namely, Thomas Hobbes's demonstrative natural philosophy.

Hobbes's attack on Boyle's approach has two main components: technical and epistemological. Technically, Hobbes suggested that the outcome of Boyle's experiments were inconclusive. Indeed, the authors confirm that Boyle's air-pump experiments did not lend themselves to reproducibility. Hobbes also noted that, well, Boyle's air-pump leaked.[2]

The second component of Hobbes's attack is a rejection of experiments as means of generating knowledge. Per Hobbes, knowledge was to be certain, and knowledge generation was the work of philosophy. Experiments cannot provide the certainty required for a hypothesis to become fact; that is, to join the set of agreed-upon shared knowledge. The authors explore Hobbes's totality by a re-reading of his Leviathan as an epistemological text (rather than its usual political interpretation).

Shapin and Schaffer propose that Boyle dealt with his critics (importantly, Hobbes) *within* the paradigm of experimentalism. Rather than debating on the epistemological level, Boyle took criticism as opportunities to improve his experiment, thereby demonstrating how disagreement can be handled by the experimentalist paradigm.

The crux of the work is in the authors' connection of Boyle and Hobbes's epistemological dispute to the political turmoil of Restoration-era England. In fact, they claim that the history of science and the history

[2] In fact, Boyle improved his design based on this criticism. Popper would be pleased at this gradual improvement that follows a falsified theory...

of politics are inherently entwined. Scientists have their own political sphere, their work affects the wider political map, and the politics of science has a conditional relationship with the politics of the state.

Questions and topics for discussions

- What is Social Constructivism? How is it demonstrated through this week's readings?
- Based on Shapin and Schaffer's analysis, what led to the victory of Boyle's experimentalist paradigm?
- As we have read this week, mathematicians of 17th century Europe were not permitted to produce legitimate knowledge about naturel. Compare this to Bloor's observation that late 20th century sociologists of knowledge were not permitted to reason about the contents of mathematics itself [3].

References

[1] Mario Biagioli, 'Galileo the Emblem Maker', Isis, 1990, 81:230-258.

[2] Alexandre Koyré, From the Closed World to the Infinite Universe [1957]. Baltimore: John Hopkins University Press.

[3] David Bloor, Wittgenstein and Mannheim on the Sociology of Mathematics, Studies in History and Philosophy of Science, 1973, 4:173-191.

[4] Steven Shapin and Simon Schaffer, Leviathan and the Air-Pump: Hobbes, Boyle and the Scientific Life, Princeton: Princeton University Press, 1985.