The Architecture of Authority: The Spatial Nexus of Law and Science[1]

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(forthcoming, The Place of Law, edited by Austin Sarat, University of Michigan Press 2002).

excerpt

I. Introduction

A doctor, a lawyer and a scientist were having a discussion about whether it is better to have a wife or a mistress. The lawyer claimed that it is much better to have a mistress than a wife; if the relationship went sour, there were fewer legal complications. The doctor said that was all wrong. It is better to have a wife than a mistress, less threat of a heart attack from the greater sexual passion with a mistress. The scientist intervened saying they both were wrong. He wanted both a wife and a mistress. He could tell his mistress he was with his wife, tell his wife he was with his mistress, then go to the lab and work without interruption.

This joke circulates among physical and biological scientists, displaying with unmasked pride a different sort of pleasure than offered by wives and mistresses: pleasure taken in a professional, albeit comic, identity as a single minded pursuer of abstract truths rather than sensual desire, pushing back the frontiers of knowledge by working on a noble and selfless quest. Of course the joke is sexist, but so too is modern science. Of course

1 This paper was first prepared for presentation as a Keck lecture at Amherst College, Department of Law, Jurisprudence and Social Thought, November 6, 2000. We wish to thank Karina Coombs and Ayn Cavicchi for their extensive help collecting materials on the history of laboratory construction, and on the contemporary legal regulation of laboratories. We are also indebted to colleagues who have been generous with their time and comments, helping us to navigate unfamiliar terrain and saving us from egregious errors. We are particularly grateful to Jack Balkin, Paul Berman, Kristin Bumiller, David Delaney, Brian Glenn, Douglas Goodman, Jim Kinsey, Laura Beth Nielsen, Jason Owen-Smith, Tanina Rostain, Austin Sarat, Joseph Swingle, Alison Young, and the members of the Amherst Seminar on Law and Popular Culture, for their helpful critiques.

too, science is hardly selfless, and, whether it is noble is for others to say. Our focus is, unfortunately for those misled by our introduction, not about sex, wives, or mistresses, but about space, science and law.

Our subject is the significance of laboratory space as the habitat of the research scientist, the place of law in those scientific spaces, and the provenance of truth they provide. Our thesis is simple: As the laboratory has been transformed over the centuries from a private place of gentlemanly inquiry to an open and accessible public arena, the forms of regulation governing the processes of production and certifying the knowledge produced therein have also shifted. As the capacities and authority of science have grown, it has become increasingly subject to legal constraint and regulation. The regulation of science is, however, "from a distance." Rather than directly controlling the behavior of scientists, science is more often regulated through the design and monitoring of the spaces of science. What had been governed primarily by conventions among gentlemen and the prerogatives of class and aristocracy has been replaced by the techniques of modern regulation and governmentality. Rather than the scientist inviting acquaintances to his[2] home and relying on conventional morality to secure trustworthy witnesses to scientific experiments, the contemporary research laboratory is a space governed by a network of laws, regulations, and rules helping to produce a specific kind of subject: a particular kind of scientist and a particular kind of science.

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Our work shows that the scientific life is not immune from the consequences of the social technologies science has spurred. Specifically, we see that as the law operates on the spaces and the forms within which science takes place, it contributes to the production of a distinctive content: a particular kind of science and a particular kind of scientist, the content of knowledge claims and the daily practices of scientists. By helping to constitute more separated spaces for science, environmental and safety regulations work to push the private lives of scientists out of the labs, stripping scientific practice of some of its more personal and idiosyncratic aspects. As scientists are forced to segment their lab and non-lab activities, they become increasingly fragmented, just like other modern social subjects. Ironically, as the scientists conform to standardized practices, becoming

2 We will vary the gender of the pronoun between "he" and "she." We note, however, that science has remained a gendered occupation to a greater degree and far longer than many other professions.

more like everyone else, their claims to extraordinary objectivity and authority increase.

We will illustrate the mutual constitution of science and law through the construction and regulation of laboratory spaces in three parts. First, we provide a short tour through the history of laboratory construction. We will reference the distinctive and personal places whose design was engendered by the need to provide authority and provenance, as Gieryn and Brain (1999) call it, for the knowledge produced there in. We show, relying on the work of Shapin (1988), Lynch (1991), and Gieryn (1998, 1999), how what was private and personal, identified with and occupied by a specific, socially located individual becomes over time and with the collaboration of public authorities more accessible, in a sense democratized, standardized, and relatively indistinguishable from other similar spaces. This transformation of the laboratory into an anonymous and standardized space imparted to the laboratory an epistemological authority that differs radically from its pre-modern antecedent. Without repeating the familiar history of enlightenment liberalism, the invention of the liberal subject, and the development of democratic cultures, we will suggest some ways in which the development and standardization of scientific laboratories is part of and mimics that political story in terms of science's invocation of some of the central norms of liberal democracy (Merton),. We will identify some ways in which legality[3] has played a role in this history of the research laboratory.

In the next part of the paper, we will examine the processes of regulation that have emerged to define scientific practice. In particular, we will explore the ways in which the constitution of space has emerged as a principal modality of governance. The creation, design, and surveillance of space has, we argue, become increasingly important in a world of autonomous subjects. Since it does not directly challenge the autonomy of

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[3] "Legality" is a term we use to designate the meanings, sources of authority, and cultural practices that are commonly recognized as legal, regardless of who employs them or for what ends. Legality is an analytic term we use to name that which native actors understand as part of law whether it "really" (doctrinally or organizationally) is so associated. We use the term "law" to refer to aspects of legality as it is employed by and attributed to formal institutions and their actors. See Ewick and Silbey, 1998, The Common Place of Law (Chicago: University of Chicago Press), and Ewick and Silbey, 2001, "The Structure of Legality: The Cultural Contradictions of Social Institutions," in Legality and Community: Essays in Honor of Philip Selznick, eds. Robert A. Kagan, Martin Krygier, and Kenneth Winston (Berkeley: University of California Press). Habermas refers to law in a manner similar to our use of the term legality to refer to any discourse about law.

liberal subjects, the control of space operates obliquely, side-stepping issues of subject freedom even while the spaces thus constituted come to define and shape subjectivity and practice. In the final section of the paper, we illustrate these processes with ethnographic data collected in a major research university. These data show that scientific spaces are defined around the contradictory issues of danger and democracy, or interdiction and access.

II. The Moral and Epistemological Significance of the Laboratory: The Invention of Show and Tell.

Over the course of the past four centuries, science has faced a formidable epistemological dilemma. From its inception, science's claims about an objective, law-like, natural world, directly challenged religious truth. Whereas religious truth is based on faith, scientific knowledge derives its legitimacy from empirical observation. In other words, scientific authority has always been based upon a claim that seeing is believing. Yet very few people actually see a gas turn into liquid under pressure, or directly see the molecular structure of ribonucleic acid. Thus, although science is offered as a direct challenge to a system based on faith and trust, there is, Steven Shapin (1988:374) says, an ineradicable problem of trust at the heart of science. "Why ought one to give one's assent to experimental knowledge claims?" Why believe what one has not and often cannot see?

A solution to this problem required that science engage in a project of self-presentation. Scientific practice had to discover ways of demonstrating or representing its found truths to a public in order to obtain the legitimacy and deference, and thus effectiveness, it sought. The various solutions that have been adopted have all implicated a particular power optics, involving a designation of who can see and what can be seen. And at the centerpiece of this history is the laboratory. As Lynch (1991:1) has observed, "There can be no doubt about the moral and epistemological significance of ... the 'physical place' of the scientific laboratory. "[4]

Up until the 19th and 20th centuries, the laboratory was a "truth spot" (Gieryn 1999), a place in which the empirical truths of science were revealed

[4] Inquiry into the epistemological and moral significance of space is growing. See for example John Brigham's forthcoming study of courthouse architecture.

to a select audience of gentlemen (Shapin, 1988). The particular location, configuration, ownership, and design of the laboratory was available—to that select audience – for inspection. The legitimacy of scientific claims about the world were dependent upon the idiosyncrasies of place and the particularistic relationship that existed between the scientist and his audience. Knowledge and truth were thus inscribed onto the laboratory and the social ties that connected scientists, their laboratory spaces, and their public.

Today the laboratory remains a context for scientific discovery, but it is not seen as integral to the scientific truths it yields. In modern scientific practice, the validity of a claim is made and evaluated through replication, claimed and certified through writing, peer review, publication, and circulation. Truth transcends its place of discovery.

Scientific knowledge has become democratized in that scientific knowledge is no longer denied anyone according to her social status. Although spaces of scientific research are no longer governed by the prerogatives of class and aristocracy, the laboratory remains inaccessible. However, the rationale and the consequence of this inaccessibility have changed. Housed in massive buildings, shrouded in signs warning of danger and contamination, the laboratory is no longer the place where truth is lodged. In the epistemology of science, the laboratory has been demoted to a backstage. In the history that follows, we argue that this alteration in the role of the laboratory reveals a much broader transformation in the role of science in society in general, and in the relationship between law and science in particular. These changes involve: (1) the regular drawing and redrawing of boundaries separating the public and private spaces of science; (2) issues of autonomy associated with the role of government and private philanthropy in creating scientific spaces; (3) conceptions of danger in, from, and to scientific spaces; and (4) questions of scale impinging the legal regulation of science. These issues concerning public/private boundaries, patronage, danger and regulation combine in diverse ways and work interactively to build the credibility and authority of science literally into the brick and mortar of laboratories.

A Brief History of Scientific Spaces. In the 16th century when modern science was emerging , it was shrouded in secrecy, or as Owen Hannaway suggests, "aristocratic aloofness" (1986; cf. Shackleford 1993). No scientist represents this more clearly than the Danish astronomer and chemist, Tycho Brahe. About 1570, King Frederick II of Denmark gave Brahe an island in the Danish sound to establish an observatory, a grant for construction costs, and the taxes collected from the island's inhabitants for the running of the lab. Already sounds familiar, no? With this support, Brahe established a fortress. He built a castle with a large observatory, as well as workshops for the construction of instruments. He built large walls around the castle and placed dog kennels on the corners or the rooftop; the barking dogs would announce the presence of strangers. Only his students and laboratory assistants were housed within the castle. Servants' quarters were in a separate facility, separating science from domesticity, a distance that would not always be maintained. In addition to the observatory, Brahe constructed a chemistry laboratory below ground; chemistry represented "terrestrial astronomy" and should therefore, he reasoned, be below the earth's surface. For Brahe, then, neither scientific knowledge nor its physical production was to be shared.

By the 17th century, we begin to see private research laboratories become slightly more public and accessible.[5] The German chemist Andreas Libavius resented the secrecy surrounding the work of Brahe, and as a result designed a research facility - something he called The Chemical House - that would be open to the public, and not solely the elite. As a humanist, Libavius believed that scientific endeavors should not overwhelm the scientist's responsibilities and position in society. To a degree, Libavius represents the emerging politics of the enlightenment, the liberalism it would generate, and its accompanying legal regime. Nonetheless, Libavius believed that the scientist should never forget the being a "gentleman" was of utmost importance, a theme we will expand in a moment. A gentlemen had moral obligations. He believed that Brahe's greatest failure was being a "bad citizen," refusing to be social.[6]

Libavius never realized his architectural plans for the Chemical House. Nonetheless, it is worth noting some of the features he had inscribed in its plans. Chemical House was designed with open spaces for visitors so

[5] On the topic of secrecy as opposed to open laboratories, medical science may have been, in places, an exception. Many medical schools had dissection auditoriums at a fairly early stage (e.g. the Gustavianum at Uppsala University was built in 1622-25). There was, of course, clandestine dissection as in Edinborough.

[6] The social responsibilities of science and scientists have been consistently important issues in the history of science, culminating perhaps in the second half of the twentieth century with the scientific community's role in initiating the development of nuclear weapons, and the subsequent efforts to seek forgiveness and retribution (see Bulletin of the Atomic Scientists; Gusterson 1996).

that they could view science in progress. Using the ancient symbol for Mercury, the hieroglyphic monad, Libavius arranged the furnaces that would be essential for his research around the space so that the observers could follow the path of research and experimentation, with the main furnace at the end of the room. Although Libavius believed that science should be part of the public domain, the plans for The Chemical House also included a secret laboratory for himself, asserting that only those "closest to perfection" could assist the "master" with his work, exemplifying the class relations within the emerging democratic ethos that the characterized the early development of science.

These class relations, the prerogatives and disadvantages they endowed, were physically contained within the scientific laboratories that, up through the 19th century, were housed in the private homes of European gentleman: in garden houses, basements, kitchens, specially built and jerry rigged facilities. The physical contours and social conventions of these places provided the needed credibility for the emerging sciences by securing assent to empirical knowledge when direct observation and sense data were not publicly available. In a canonical account of the fusion of domestic and work spaces of Robert Boyle, Robert Hooke, and the Royal Society, Shapin (1988) describes what he calls the "venues of knowledge," and what Gieryn (1999) subsequently called "authenticating places" or "truth spots."

Robert Boyle conducted most of his experiments in his family's estate, in his rooms taken in an apothecary's residence in Oxford, or in sister's home in London. The special places constructed in the developing colleges were few and far between, more often designed for demonstration than experiment. Thus, Robert Hooke, upon leaving Boyle's service and residences, lived and worked in Gresham College in London as a fellow of the Royal Society. Unlike the comfort in which Boyle lived and worked, Hooke was not the son of landed gentry and lived "like a Bohemian scientific fellow in a college." Typical for the period, living like a Bohemian fellow meant living in college with mistresses, maids, nieces (who were also his mistresses), and technical assistants, all sharing rooms and laboratory spaces. Gresham College is not to be confused with a modern college, or a laboratory (a word largely unknown, Shapin tells us, before 18th century). It was in its basic form and use a typical English college, a mixture of spartan, almost ascetic physical conditions with an abundance of human labor in service to the gentlemen. In this heterogeneously occupied place, Robert Hooke experimented on elasticity and the observed relationship between springs and forces. The Royal Society, that home and patron of natural science, also conducted its public business “largely within places of private residences” (381).

Familiar places with long standing conventions of access and deportment, those private homes provided a happy solution to the basic epistemological dilemma: to secure witnesses to insure the credibility of scientific claims. Relying on the protocols normally operating in those places, Boyle, Hooke, and the members of the Royal Society could both regulate access and yet develop the credibility upon which science’s authority would rest. To the English experimental philosophers, as to the German Libavius, Tycho Brahe’s guarded castle was incompatible with the quest for objective knowledge. “In contrast, spaces appropriate to the new experimental program were to be public and easy of access… The legitimacy of experimental knowledge, it was argued, depended upon a public presence at some crucial stage or stages of knowledge making” (Shapin, 1988: 378,384). Genuine knowledge had to be observable; but, in 17th century Europe, certainly not everyone’s observations were credible. Those who were employed could not be trusted because their opinions were necessarily purchased and thus not free. And, just anyone off the street might be an mass of prejudice and misperception, and thus an unreliable witness.

Relying on the supposed impartiality and honor of gentlemen, Boyle and others, secured a community of witnesses whose veracity and trustworthiness was assured simply by their social status as gentlemen. People known to Boyle by sight, by reputation, or through an introduction by someone known to Boyle by sight or by reputation, were admitted to the experiments as they would be to Boyle’s home. Similar customs and punctilio operated in the Royal Society. Social standing gave access, access gave permission to witness, and the social etiquette of gentlemen created trust in the testimony.

Notably, Shapin reports, “those granted entry were tacitly enjoined to employ the conventions of deportment deemed appropriate, “not only to gentlemen, but “to the experimental enterprise” as well. The experimental enterprise was markedly different from the hermetic, contemplative practice of the rationalist or metaphysical philosopher; it demanded engagement and participation. Because witnessing was effectively limited, participation in the experimental enterprise was critical and that participation involved reporting out - testifying to a larger audience - what was seen. Thus, the gentleman visitors to the home laboratories assumed a responsibility to tell the world (primarily other gentlemen) what they saw there.

Shapin concludes that the boundaries that separated the private and public worlds of the gentleman were transits whereby scientific experiments and knowledge circulated from the private to the public, from personal observation to objective truth. By locating the house of experiment within the house of the gentleman, problems of access, credibility, and communication were resolved in a compromise whereby testimony was limited to gentleman who shared traditions of discourse and trustworthiness. Experimentation, conducted a gentlemen's house, could go on virtually unobserved but would nonetheless become public within the appropriately circumscribed community.

The results of experiments were not only reported second hand. Experiments that were conducted in private were later demonstrated in public venues. Codes of gentlemanly conduct governed the display of the experiments, as it did access and testimony about the same. One's standing in the community, that of being a gentleman, was of utmost importance in this stage as well. It was, for example, considered insulting and bad taste for any scientist to perform an experiment publicly that had not been perfected first at home. Yet, because the materials had to be prepared for travel, it was often the case that following transport; the experiments would fail, seals would crack, calibrations would become undone, when the experiments were publicly displayed. Consequently, not only would the scientists be embarrassed and their intellect challenged, but insofar as the failure constituted an insult to the audience, the scientists' status as gentlemen would also be suspect.

Slowly, however, the venues of science changed. By the end of the 18^{th} century, the universities of Italy, France, Germany, Holland, and England - - then several hundred years old - - all had chemistry departments with small laboratories. These laboratories, however, were reserved for the "personal needs" of the chair of the department; there was no large-scale use by anyone else " (Servos 1990:9). In the university of the enlightenment, science did not have the status associated with it today. Greater emphasis was placed on classical education – languages, history, philosophy – which did include mathematics. The academic institutions were not anxious to develop laboratory science, for in the 19^{th} century we still see laboratories in private homes of notable scientists, Darwin being a particularly well known example. The 18^{th} century, like the 17^{th}, still found scientists struggling with the distasteful notion of science as an occupation.[7]

The 19^{th} century marks the transition from private kitchen and garden facilities to modern scientific laboratories in universities and industry. Gradually, the university laboratories of the professors evolved into [the] instruments for grooming research scientists" as well as spaces for invention that they are today. Most historians attribute this development to "Justus von Liebig, who, in the 1820s at the University of Giessen, molded together the elements of the first modern research school: a teaching laboratory, a journal, a set of techniques competent to generate significant new knowledge, and a body of students who, for reasons that are not entirely clear, were ready to participate in the process of creation. The developments in Germany had effects elsewhere." (Servos 1990:9). By the end of the 19^{th} century, every major university, and most colleges, had extensive scientific laboratories.

The proliferation of laboratories should not, however, be taken to suggest that their development was met with unmitigated enthusiasm by educators, or by state authorities who were often asked to support their development, especially in Europe. Those without independent financial means to construct laboratories had to accept whatever type of facility the state would offer, and usually it was not much. Louis Pasteur worked out of two small attic rooms in the Ecole Normale. Later, he would restore a university pavilion into a laboratory, but for the lack of space, had to place his drying stove under the staircase making it accessible only if he crawled on his hands and knees. Pierre and Marie Curie discovered radium in an abandoned tool shed on the grounds of the University of Paris. The shed had no floor, the roof leaked, and there were too few tables and benches for equipment so they were forced to hang much of it on the walls. Because there wasn't any ventilation in the shed, the couple would carry their equipment into the courtyard when working with noxious fumes. If it rained, they would drag it back into the shed again and leave the window open.

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7 The low status of science as a cultural product and as an occupation continued until the middle of the twentieth century when we find C.P. Snow (1963) bemoaning the divide between the cultures of humanistic and scientific inquiry. Post World War II British gentleman, according to Lord Snow, shunned science as uncultured and vulgar and as a consequence, he feared, would forfeit power and control in a world increasingly dominated by science.

By the end of the twentieth century, laboratories developed into vast, prototypical, universal products with interchangeable parts and equipment, unremarkable in the ease with which they are reproduced and installed in very different physical conditions and cultural locations. Their contents have been so standardized that contemporary laboratories are designed and built *LEGO* style: a pattern module is composed of stock materials, then arranged in various configurations, most often in rows and bays, to fit a building's dimensions and each research group's desired social organization.[8] Some laboratories emphasize unfettered correspondence from one group to another, creating open passages between the rows and bays; others limit communication but nonetheless create some passages to insure safety exits. Some labs build in sets of shared, communal equipment in order to leave more space for individual work benches, while other labs replicate each instrument, machine, and facility for every work group in order to avoid dealing with differential work and housekeeping habits (Gieryn 1998).

The fact that one laboratory is just like another, with small but inconsequential variations in building materials, facades, sequences and arrangements of otherwise standard rooms and technology has important consequences for the legitimacy and authority of science.[9] Where the credibility of science in the 17th century rested on public demonstrations and access to private homes, the public part of science is no longer a performance in the Royal Society or a visit to a researcher's lab. It is a publication. The text becomes the new public space, open and accessible to all, in and through which the provenance of science is established. Rather

[8] The standardization of modern laboratories should not be exaggerated to suggest that there is no variation among individual labs or between different fields of science. Our reference to lego style is meant to highlight the fact of sufficient standardization such that the pieces that are put into most labs can be purchased from catalogs of mass produced items that are then assembled to constitute this particular lab. Some subjects, for example, organic chemistry and many areas of bioscience, are much more standard than others because the tools of these fields are fairly universal and interchangeable. Thus, our reference to "lego" style. Physical Chemistry and Physics labs tend to be more idiosyncratic, some might say chaotic, in their layout and instrumental than arranged in rows and bays. Here the construction of the equipment is often a major part of the scientist's invention rather than the physical matter under the constructed "lens." Thus the standardization may be more in the parts of the building than in the contents, but as we said, this varies by fields and is more so when a field is developing new instruments and techniques. More about this below, see fn 9.

[9] The uniformity among laboratories is evident not only in the architecture but also in the network of rules and regulations governing the construction and practices within those spaces. We turn to these regulations below.

than seeing the experiment, we see the report of it. We defer to the report because of what Shapin calls the “literary technology” of the scientific journal: peer review and critique, “a highly stylized machine for manufacturing credible knowledge.” In short, because the laboratory has become standardized in its construction and composition, it can disappear as an epistemological marker; we can take it for granted because it is constant and universal.

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