

# The Mantis Shrimp

A Simon Schaffer Festschrift



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editors

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Front cover: “Not to be used for navigation”  
stamp for obsolete charts, maker unknown, around 1990.  
Image credit: Megan Barford.

Back cover: An inquisitive peacock mantis shrimp,  
as seen and photographed in the waters of Tofo,  
Mozambique by Jennifer Keeping and Steven Scagnelli.

Design by Éva Lipót

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# ALEXIUS der Frembdling.

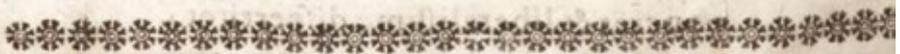
Welchen

Die Adelige studierende Jugend des Erz-  
herzogischen Gymnasij der Societet JESU zu  
Leoben vorgestelt/ vnnnd öffentlich gehal-  
ten hat.

Zu schuldiger Ehr vnd Danc der freygebig  
aufgethailten Præmien

Von dem Hochwürdi-  
gen in GOTT Geistlichen Edlen vnd Hoch-  
gelehrten Herrn/ Herrn Urbano Abbt zu Admont/ 2c.  
der Röm. Kay. May. wie auch Hochfürstl: Salzburg: vnd  
Bambergischen Rath: vnd ainer Löblichen  
Landtschafft in Steyr Verord-  
neten/ 2c.

Den 25. Herbstmonats/ Im Jahr  
Christi 1639.



Gedruckt in der Fürstlichen Hauptstatt Grätz/  
in der Widmanstetterischen Truckerey.

FIGURE 1. • S. Alexius Peregrinus / Alexius der Frembdling  
(Graz: The heir of Ernst Widmanstetter, 1639), title page.

# A Jesuit in a Foreign Land: The True Biography of Simon Schaffer

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DÁNIEL MARGÓCSY

It is said that Simon Schaffer was born in Southampton and spent his early childhood in Australia. Upon his return to England, he first became known as the man who knew everything about the Cambridge luminary Isaac Newton and early modern natural philosophy. This paper argues that there is a simple explanation for Simon's uncanny familiarity with the events of the seventeenth-century. He was born there. As revealed by his initials S. J., Simon is a Jesuit time traveler from the days of Athanasius Kircher. The story of Australia is simply a ruse.

The crucial evidence for my claim comes from a little known Jesuit publication titled *Alexius der Frembdling*, which survives in a single copy in the Bayerische Staatsbibliothek in Munich.<sup>1</sup> Printed in 1639, *Alexius der Frembdling* commemorated the performance of a school play at the Jesuit school of Leoben, an important mining and metallurgical center in Steiermark, Austria. The list of actors included a certain Simon Schaffer, *principista* (ie. a person in the lower classes of the school), originally from the town of Judenburg, some fifty kilometers upriver on the Mur. This is the Simon Schaffer whom we all know.

Simon therefore must have been born in the late 1620s, in the midst of the Thirty Years' War, and it was surely the experience of this war that spurred his explorations of the relationship between military technologies, ballistics and the rise of mechanical philosophy. Growing up in the mining town of Judenburg, he must have heard endless stories about the putatively Roman origins of his home town, which local historians identified with Idunum. He would also have become acquainted with the history of the local mint, which struck one of the earliest Austrian golden florins in the 1300s, the duplicate of the original Florentine coins of equal value.<sup>2</sup> He never forgot the stories of his town, and was later ready to apply their lessons to other contexts. In subsequent writings, Simon made explicit that a study of measurement methods to establish equivalency, whether through assay instruments or through metrology, is also always a study of how one can establish

<sup>1</sup> S. *Alexius Peregrinus / Alexius der Frembdling* (Graz: The heir of Ernst Widmanstetter, 1639).

<sup>2</sup> On Judenburg across the ages, see Johann Andritsch, *Judenburg: Stadtchronik* (Judenburg: Mlakar, 1989).

equivalencies between different peoples across the globe.<sup>3</sup> Historical arguments for a common story of the shared Ancient origins of humankind are also always arguments for establishing consensus about conversions between different methods of measurement.

Judenburg was an inspiration for Simon's work on wondrous marvels, as well. In 1627, the relics of the martyred Saint Cyriacus and Propertius were translated to the local church, but Simon appears to have been more interested in the miraculous workings of machines.<sup>4</sup> Wandering around the town, he must have spent his days admiring the mechanical contrivances of the town's renowned fountains and the impressive clockwork of the fifteenth-century *Glockenturm*. Maybe he even assisted the local craftsman with the regular cleaning of the clock's cogwheels.<sup>5</sup> Or, alternatively, he may have whiled his time away on the banks of the Mur, the river that connected Judenburg to the larger world through trade, rejoicing whenever he found a smoother pebble or a prettier shell in the sand.<sup>6</sup> His interest in global connections probably stems from this time period, as well. He surely visited Graz in October 1629, as a young toddler, to see Don Diego, an Asian elephant traveling through Europe, later immortalized by Gian Lorenzo Bernini. Looking at the elephant and its mahout, Simon must have immediately realized their role as essential go-betweens between Europe and India. And, arguably, it was the elephant's obedience to his trainer that first fired up Simon's imagination about Foucauldian discipline, and also about the role of education in India, later strongly reinforced by the spiritual exercises he had to perform during his own, Jesuit training.<sup>7</sup>

Simon went up to Leoben in his early teens. The school was a stronghold of Jesuit mathematics in the mid-1630s when the optical expert Zacharias Traber taught there.<sup>8</sup> Yet Traber probably left Leoben just before Simon arrived, and it was instead the encoun-

<sup>3</sup> Simon Schaffer, "Oriental Metrology and the Politics of Antiquity in Nineteenth-Century Survey Sciences," *Science in Context* 30 (2017): 173–212; Simon Schaffer, "Golden Means: Assay Instruments and the Geography of Precision in the Guinea Trade," in *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*, ed. Marie-Noëlle Bourguet, Christian Licoppe and H. Otto Sibum (London: Routledge, 2002), 20–50.

<sup>4</sup> For later interests, see Simon Schaffer, "Enlightenment Automata," in *The Sciences in Enlightened Europe*, ed. William Clark, Jan Golinski and Simon Schaffer (Chicago: University of Chicago Press, 1999), 126–65.

<sup>5</sup> "Es hat ferners auch vier schöne Röhrkasten, oder springende Brunnen, in der Statt." Matthaeus Merian, *Topographia Provinciarum Austriacarum* (Frankfurt am Main: In Verlegung Johan Arnold Cholini, 1679), 43. On the clocks of the *Glockenturm*, see Helmut Lackner, *Geschichte des Stadtturmes Judenburg* (Judenburg: Judenburg Museumsverein, 1975). The local clockmaker received an annual payment of 8 pfund for cleaning the machine in 1575.

<sup>6</sup> Simon Schaffer, "Newton on the Beach: The Information Order of *Principia Mathematica*," *History of Science* 47 (2009): 243.

<sup>7</sup> On Simon's elephant, see Louise Rice, "Poussin's Elephant," *Renaissance Quarterly* 70 (2017): 543–93. On Indian education, Simon Schaffer, "How Disciplines Look," in *Interdisciplinarity: Reconfigurations of the Social and Natural Sciences*, ed. Andrew Barry and Georgina Born (London: Routledge, 2014), 57–81.

<sup>8</sup> Anna Ecsedy, "'Tudós építészek': Építészeti tervezés és kivitelezés a 17. századi Magyarországon. Esettanulmány: Lippay György esztergomi érsek építkezései, 1648–58," manuscript (2019), available at [https://nka.meszorg.hu/wp-content/uploads/2020/09/ecsedy\\_anna\\_tudos\\_epiteszek\\_epiteszeti\\_tervezes\\_es\\_kivitelezes\\_a\\_17\\_sz\\_magyarorszagon.pdf](https://nka.meszorg.hu/wp-content/uploads/2020/09/ecsedy_anna_tudos_epiteszek_epiteszeti_tervezes_es_kivitelezes_a_17_sz_magyarorszagon.pdf). Traber's *Nervus opticus* is probably the inspiration for Si-

ter with the mechanical marvels of educational theatre that turned him permanently towards the study of the sciences.<sup>9</sup> His participation in the school performance of *Alexius der Fremdling* also alerted him to some of the major themes in the sociology of knowledge. The Jesuit teachers' decision to stage this play may have been inspired by Pope Urban VIII's commissioning of Stefano Landi's opera of *Sant'Alessio*, performed in 1632 at the newly built *Teatro delle Quattro Fontane* of Bernini, just a few months before the pope would proceed with the prosecution of Galileo.<sup>10</sup> First recorded in the Syriac tradition, Alexius was a Roman youth who ran away from an arranged wedding on a ship. In the play of *Alexius der Fremdling*, the stormy seas brought Alexius first to Laodicea, but then he traveled further onwards to Edessa with a group of shepherds. In Edessa, Alexius lived disguised as a beggar for seventeen years. Then, however, an icon of Virgin Mary miraculously proclaimed Alexius' sanctity, and he decided to flee again to avoid fame. As the Jesuit play's plot summary emphasized, Alexius' aim was Tarsus in Cilicia, but the stormy seas brought his ship back to Rome, instead. Thoroughly changed through the years, not even his parents recognized him. Hiding his identity, he spent another seventeen years back in Rome, sheltering in a dark corner under the staircase of a small house, often ridiculed and tormented by the servants of his former home. In Act V, at the moment of his death, however, Alexius got hold of a writing instrument ("instrumentum scriptorium"), and wrote down the events of his life in a letter.<sup>11</sup> Once he gave his last breath away, a city councillor found and read this letter, which revealed Alexius' true identity. His life and deeds would from then onwards be celebrated to God's greater glory.

The theatrical encounter with Alexius's story must have been transformative for the young Simon, who played the fourth satrap of Laodicea in Act II. The difficulties of Alexius' maritime travels through stormy seas led him to ponder whether more successful methods of navigation, through the determination of longitude, would have changed Alexius' fate.<sup>12</sup> Donning the clothes of a satrap may also have influenced his later decision to dress up as Vermeer's *Girl with the Red Hat* in the BBC film series *Light Fantastic*.<sup>13</sup> And Simon must also have been struck by the play's emphasis on how everyday tools, such as

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mon Schaffer, "The Devices of Iconoclasm," in *Iconoclasm*, ed. Bruno Latour and Peter Weibel (Cambridge: MIT Press, 2002), 498–515.

<sup>9</sup> Simon Schaffer, "The Show That Never Ends: Perpetual Motion in the Early Eighteenth Century," *British Journal for the History of Sciences* 28 (1995): 157–89; Nick Stacey and Simon Schaffer, *Mechanical Marvels: Clockwork Dreams* (BBC 4, 2013).

<sup>10</sup> For Simon's reminiscences of the impact of the Galileo trial on his early years, see Simon Schaffer, "Galilean Perspectives," *Journal for the History of Astronomy* 21 (1990): 359–61. On Simon's later, rekindled interest in early music, see Radha Bêteille and Alan Macfarlane, eds., *Creative Lives and Works: Science and Culture. Lisa Jardine, Jean Michel Massing and Simon Schaffer in Conversation with Alan Macfarlane* (London: Routledge, 2022), 84.

<sup>11</sup> *Alexius der Fremdling*, sig. Bii'.

<sup>12</sup> Simon Schaffer, "Chronometers, Charts, Charisma," *Science Museum Group Journal* 2 (2014): <https://doi.org/10.15180/140203>; Simon Schaffer, "Swedenborg's Lunars," *Annals of Science* 71 (2014): 2–26.

<sup>13</sup> *Light Fantastic* (BBC 4, 2004).



FIGURE 2. ◦ S. Alexius Peregrinus / Alexius der Fremdling  
 (Graz: The heir of Ernst Widmanstetter, 1639), sig. B4<sup>r</sup>.

a writing instrument, can be mobilized to vouchsafe for claims to identity and to truth.<sup>14</sup> In a theatrical performance, where every person on the stage is an actor, and the actor playing Alexius is doubly so in pretending not to be Alexius, how can a piece of writing, whose letters cannot be seen by the audience, and whose letters could not have been read by the mostly illiterate audiences of late imperial Rome, become uncontested proof of

<sup>14</sup> On simple things as tools of scientific inquiry, see Simon Schaffer, "A Science Whose Business is Bursting: Soap Bubbles as Commodities in Classical Physics," in *Things That Talk: Object Lessons from Art and Science*, ed. Lorraine Daston (Cambridge: MIT Press, 2004), 147–94.

the events of Alexius' life?<sup>15</sup> Why would anyone in late Antiquity believe a written note found on the body of a dead beggar? The play does not answer this question with a trite recourse to direct divine intervention. It politically claims that Alexius' letter is trusted because of divine intervention only when that intervention is mediated through the interpretive act of reading by the same literate and elite town officials whose company Alexius shunned by staying with the poor.<sup>16</sup> Here, solutions to the problem of knowledge are solutions that reestablish the social order that Alexius' life had called into question.

Most importantly, it is the concept of the stranger that Simon owes to Alexius, who was first a real stranger in Edessa and then a pretend stranger in his hometown of Rome. Simon's writings repeatedly exhort fellow sociologists of science to "play the stranger" in order to reveal how science really works. This claim is made explicit already in *Leviathan and the Air-Pump*, but also in Simon's review of Latour's theatrical presentation of Pasteur in *The Pasteurization of France*.<sup>17</sup> In that review, Simon critiques the Catholic Latour precisely for playing the insider, and not the stranger.<sup>18</sup> It was Baroque Jesuit theatre that alerted Simon to the intense work that is required for manufacturing knowledge claims, and to the role of performative strategies that are required for uncovering this work.

Life in Leoben was not only about work and theatrical play. One would imagine that the schoolchildren occasionally managed to escape the discipline of Jesuit life. One wonders: would they have been able to quickly run over from school to the local pub at the Arkadenhof on the town square, named the *Black Eagle* (*Schwarzer Adler*)?<sup>19</sup> Or was that too risky an enterprise in case the Jesuit superiors discovered them there, hiding in a dark corner under the arcades? Yet whether in the *Black Eagle*, or within the walls of his school, Simon surely made many friends with other Jesuit teachers and pupils, many of whom would later depart for missions to foreign lands. For instance, Simon overlapped in Leoben in the early 1640s with the somewhat older, globetrotting Johann Grueber, the first European ever to reach Lhasa in Tibet, whose travel accounts were essential for Kircher's *China illustrata*.<sup>20</sup> Grueber and Simon would have become close friends, and Simon may have given him advice on how to carry, use and repair astronomical instru-

<sup>15</sup> On writing devices, see Simon Schaffer, "On Seeing me Write': Inscription Devices in the South Seas," *Representations* 97 (2007): 90–122.

<sup>16</sup> On the relevance of class, see Simon Schaffer, "Newton at the Crossroads," *Radical Philosophy* 37 (1984): 23–28.

<sup>17</sup> Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 2011), 6.

<sup>18</sup> Simon Schaffer, "The Eighteenth Brumaire of Bruno Latour," *Studies in the History and Philosophy of Science* 22 (1991): 183.

<sup>19</sup> The pub's website attests that it was already active in the 17th century, and it definitely served as an inn by the end of the 18th century. See Cajetan Franz von Leitner, *Vaterländische Reise von Grätz über Eisenerz nach Steyer* (Vienna: Franz Joseph Rötzel, 1798), 63.

<sup>20</sup> Bruno Zimmer, "Johann Grueber," in *Neue Deutsche Biographie* 7 (Berlin: Duncker and Humblot, 1966), 183–84. See also ---, "Grueber and Dorville's Journey across Tibet," *The Geographical Journal* 24 (1904): 663–70.

ments to determine the latitude of Lhasa with surprising precision.<sup>21</sup> In later decades, correspondence with friends like Grueber kept Simon abreast with the latest European encounters with the peoples and natures of China, India, or Latin America.<sup>22</sup>

If up to this point this essay has made its case with the help of solid evidence, the remainder of my contribution is pure speculation. The sole surviving copy of *Alexius der Fremdling* is in Munich now, and it is tempting to see this as evidence that it was Simon himself who brought it to Bavaria after finishing school. Bavaria had especially strong links to the Jesuit educational institutions of Liège in this period. Throughout the late sixteenth and seventeenth centuries, the prince-bishops of Liège were members of the ruling Wittelsbach family of Bavaria.<sup>23</sup> It is therefore plausible that, through Bavaria, Simon eventually ended up in Liège, another mining town, where he became associated with the local English Jesuit College.<sup>24</sup> There he would have been working with the expert mathematician Francis Line, an important correspondent of the early Royal Society. He probably spent a happy two or three decades there, helping Line come up with ingenious arguments to counter the newfangled and highly implausible claims of Robert Boyle or Isaac Newton.<sup>25</sup> Yet, when Line died in 1675, Simon must have felt that it was time to go to England to meet his adversaries. He may have hoped to play a role in instigating the Popish Plot of 1678, or he may have simply wanted to refute Newton's *experimentum crucis* with Jesuit miracles of the cross.<sup>26</sup> He got on a ship with the fellow Jesuit John Gascoigne and, not unlike in the case of Alexius, the stormy seas landed him in a time warp that diverted him to the Brighton of the 1960s.<sup>27</sup> Gascoigne and Simon both pretended to be Australians to cover up their tracks, and they would both end up in Cambridge, getting doctorates in historical disciplines to learn what had happened to the world since 1675.<sup>28</sup> Yet the desire to return back to the seventeenth century to challenge the Royal Society remained with Simon for the rest of his career. He has been building time machines ever since.<sup>29</sup>

<sup>21</sup> For Simon's advice on fixing instruments, see Simon Schaffer, "Easily Cracked: Scientific Instruments in States of Disrepair," *Isis* 102 (2011): 706–17.

<sup>22</sup> Simon Schaffer et al., eds., *The Brokered World: Go-Betweens and Global Intelligence, 1770–1820* (Sagamore Beach: Watson Publishing, 2009).

<sup>23</sup> Liesbeth Corens, *Confessional Mobility and English Catholics in Counter-Reformation Europe* (Oxford: Oxford University Press, 2018), 36.

<sup>24</sup> For the classification of the types of coal available in Judenburg, Leoben and Liège, see Friedrich Mohs, *Treatise on Mineralogy, or the Natural History of the Mineral Kingdom*, trans. W. Haidinger, 3 vols. (Edinburgh: Archibald Constable and Co., 1825), III/61.

<sup>25</sup> On Line, see Conor Reilly, "Francis Line, Peripatetic (1595–1675)," *Osiris* 14 (1962): 222–53.

<sup>26</sup> Simon Schaffer, "Glass Works: Newton's Prisms and the Uses of Experiment," in *The Uses of Experiment: Studies in the Natural Sciences*, ed. David Gooding, Trevor Pinch and Simon Schaffer (Cambridge: Cambridge University Press, 1985), 67–104.

<sup>27</sup> On Gascoigne, see Reilly, "Francis Line," and Schaffer, "Glass Works," 88.

<sup>28</sup> John Gascoigne, *Cambridge in the Age of Enlightenment: Science, Religion and Politics from the Restoration to the French Revolution* (Cambridge: Cambridge University Press, 2002).

<sup>29</sup> For Simon's latest attempt at a time machine, see Andrew Smith and Simon Schaffer, *Mechanical Monsters* (BBC, 2018).

EXPERIMENTAL LIVES:  
LEVIATHAN(S)  
AND THE AIR PUMP(S)



FIGURE. 1. • Madrid, September 2015. Simon, Iris, Juan and a freshly defended Cambridge dissertation.

# Simon, *el solidario*

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IRIS MONTERO

Every afternoon Father Nicanor would sit by the chestnut tree preaching in Latin, but José Arcadio Buendía insisted on rejecting rhetorical tricks and the transmutation of chocolate, and he demanded the daguerreotype of God as the only proof. Father Nicanor then brought him medals and pictures and even a reproduction of the Veronica, but José Arcadio Buendía rejected them as artistic objects without any scientific basis. He was so stubborn that Father Nicanor gave up his attempts at evangelization and continued visiting him out of humanitarian feelings. But then it was José Arcadio Buendía who took the lead and tried to break down the priest's faith with rationalist tricks.

Gabriel García Márquez, *One Hundred Years of Solitude*, extract from the epigraph to Shapin and Schaffer, *Leviathan and the Air-Pump*

\*

Coventry, Fall term, 1999. A Mexican woman, age 23, arrives in the UK to start an MA in Social and Cultural History at the University of Warwick. On her first day she is informed that her chosen program will not run that year due to a medical crisis of the coordinator. A graduate in International Relations, she has never studied history from the perspective that the program suggested, never “from below.” The graduate school apologizes profusely. She is told that she will be able to pick from all courses available and create a customized MA curriculum. That same day, she chooses “Science and Medicine in the French Enlightenment” as her first foray into graduate work in history. The first book on the reading list: *Leviathan and the Air-Pump*.

\*

“Our subject is experiment.” Indeed. What a thing, to open a book in the history and sociology of science, a book about “the experimental life” in seventeenth-century England, with a quote from a novel about the transgenerational tribulations of a family in the remote fictional Latin American town of Macondo. What did this mean to me? On the most literal level, it meant that the authors read widely, that they borrowed freely from disparate epistemic traditions and that they loved language. It's true that García Márquez

had won the Nobel Prize for Literature in 1982, during the period when Shapin and Schaffer were writing *Leviathan*. He was in the air and the anglophone world was discovering fiction in Spanish on a new scale with García Márquez as spokesperson. But still, this was not a usual thing. Only in time would it be evident how much this epigraphic practice, more and more common after their example, condensed a whole argument, a whole approach, how much it announced the relevance of contingency in what we value as evidence. In time, it would also be evident how transgressive it was to juxtapose a quotation from Latin American fiction with one from W. Dodd and English worthies through history, to open a book about “the triumph of reason” through the technology of language. Back in 1999, though, my reaction was not rational but visceral. Reading the words of an author from my hemisphere and my language traced a bridge between a somewhat familiar affective world into the great intellectual unknown that lay ahead.

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Mexico City, Spring 2006. An apartment on the fourth floor of a green and yellow building in the neighborhood of San Pedro de los Pinos that is not my own. The phone is about to ring. It is Simon Schaffer, six hours ahead, in Cambridge. I am nervous. This call, a phone interview that could change my life, almost did not happen. My landline was disconnected for lack of payment two days earlier and I had to inform the PhD admissions committee in haste of the change of number. It’s almost time, fifteen minutes to. Suddenly, the sound of trumpets makes the windows vibrate. I remember in a panic that it is Monday and that my friend lives next to a primary school. It is the weekly ceremony of *honorés a la bandera*, where the whole school watches as the chosen six, *la escolta*, martially parade the flag across the patio to then sing the national anthem and swear allegiance to the flag. The noise of the trumpets is unbearable. How long is this ceremony? As a child it felt eternal, particularly when I was the one who had had the “honour” of carrying the flag in fourth grade. Hopefully this patio is smaller. Or the flag girl stronger, faster. Hopefully there are no speeches by an eager principal or patriotic teacher. At some point I notice I can hear my thoughts again. There is silence. It is one to. What a Garcia-marquian moment, I remember thinking. The phone rings. A deep voice answers my greetings on the other side.

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Cambridge felt like a great privilege – a place for exploration, with the time and resources to think about reason and its rhetoric, or its tricks. But this exploration presented a great challenge: how to tell stories relevant to the worlds that mattered to me with the tools I was learning, with tools that felt from elsewhere? Were there daguerreotypes that proved what I intuited happened in my non-textual sources? Could I summon the skills to write not from deficit but from empathy about indigenous Mexico, the Catholic world, Spain? Could I make those worlds commensurable with those better-known using historiographies at the time still so uninfluenced by broader histories of science and knowledge? *Leviathan* famously concluded that “solutions to the problem of knowledge are

solutions to the problem of social order.” Yes. How true. And perhaps also solutions to the problem of global order. To deal with this power asymmetry in the production of evidence, Simon’s suggestion was succinct and poignant: “rarify the familiar” (by which he meant Europe) “and richly describe the unknown” (by which he meant *my* worlds). Gabo, as García Márquez is affectionately known in Latin America, apparently agreed with this Schafferian approach when he said in 1991: “La interpretación de la vida con esquemas ajenos, en cualquier rincón del mundo, sólo puede conducir a un malentendido terrible y hacer a los hombres cada vez más aislados, solitarios y menos libres.”

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Madrid, September, 2015, PhD viva. Juan Pimentel’s *studiolo* at the CSIC. This is it. An examination of ideas and arguments nine years in the making. Simon and Juan are calm, enjoying each other’s company, one more chapter in a long history of mentorship and friendship of which I am the lucky witness. Juan’s books, notes and a huge ship in a bottle surround us. This is a warm space, but also the space of phantoms, the phantoms of Spanish science that Juan is currently writing about, and some of which figure in the history I am about to defend. It makes sense that we are talking about global histories of science here, in this city, in this space, together. Simon opens the session, recites the formalities of the ritual and we talk about the coproduction of knowledge about nature between Mexico and Europe for two and a half hours. By the end, Simon offers a comment I still try to live by, a phrase I aim one day to embody: “The stakes are raised in order to have a conversation with Montero.” That was the generous vision of a mentor who saw promise in the tiniest of topics, in the furthest of fields from the canon of the discipline.

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In my current life as a historian of science in a literary department – a life in no small part indebted to Simon’s sustained support through the years – I teach Gabriel García Márquez almost every year. Each time I come back to *Cien años de soledad*, I find new layers to discuss the legacy of empire in Latin America and the genesis of realities so outrageous they seem magical. Increasingly, I see it as a novel about knowledge, about what is evident but much more about what is occult and unspoken, and about how discovery or discernment can carry at once liberation and destruction. I mostly see it, though, as a work that masterfully deploys the literary technology of objective discourse, that excels at producing not truth, but verisimilitude, by reporting in a disengaged and neutral register the absurdity of the Buendía saga. And I see those features thanks to a book I read 25 years ago in a course I almost did not take. Thank you, Simon! In a profession so plagued with solitude, to me you are *el solidario*. When I think of you, one more of Gabo’s phrases always comes to mind:

La soledad, para mí, es lo contrario de la solidaridad.

*El olor de la guayaba*, 1982

# A dialogue between dialogues

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CHARU SINGH

It would be valuable to have a detailed study of the uses and career of the dialogue form in natural philosophy during the sixteenth and seventeenth centuries ... Literary historians have treated the dialogue form systematically, but have had little to say about its scientific uses ...

Shapin and Schaffer, *Leviathan and the Air-Pump*, 144.

In 1917, long after the dust had settled on the debates between plenists and vacuists in England, the air-pump once more took centre stage in a controversy. A fictional conversation in British India brought together a student, a science professor, and a *shastri* who debated the constitution of the air.<sup>1</sup> The professor and the student performed a series of experiments. They used an air-pump, then a compression device, several chemicals, match sticks, a candle, litmus paper, and a plant. Time and again, they demonstrated through experiments that the shastri's beliefs, grounded in a theory of *tattva*, were false.<sup>2</sup> The sceptical shastri initially expressed doubts. He witnessed the experiments, asked questions, and drew on his own knowledge based in the *shastra*. As the professor explained new matters of fact – that the *tattva* are in fact divisible; that sound cannot travel in a vacuum – the shastri eventually came to express delight and astonishment, and by the end, gave his assent to experimental truths.

This fictional dialogue, “The Five–*Tattva*” was authored by Prem Vallabh Joshi, a university science graduate and teacher in Ajmer, a small town in western India. Joshi was a professor and a “science writer,” and a member of the brahman caste to which shastris also commonly belonged. The dialogue was serialised in three parts in a new science monthly, *Vigyan* published in Hindi from Allahabad, in 1917. Joshi also wrote inventive detective mysteries and popular science articles in *Vigyan*, all of which featured instruments and experiments and taught new readers of the European sciences in Hindi

<sup>1</sup> A *shastri* is a scholar of the traditional Sanskrit sciences, or *shastra*.

<sup>2</sup> The *tattva* resemble the classical elements of European antiquity. The five *tattva* are *prithvi* (earth), *jal* (water), *tej* (fire), *vayu* (air), and *akasha* (space). Each *tattva* has a particular sensible quality (*guna*), such as odour, taste, colour, touch, and sound.

something of their foreign history. This fictional showdown between the Shastri and the Professor and arbitrated by the air-pump marks a crucial juncture in the colonial career of experimental culture.

As *Leviathan and the Air-Pump (LAP)* revealed, such fictional conversations, as literary technologies of persuasion in natural philosophical discourse, played a significant role in the rise of the experimental paradigm in seventeenth-century England. In fact, Thomas Hobbes and Robert Boyle both authored such dialogues. Simon Schaffer and Steven Shapin identified Hobbes' *Dialogus physicus de natura aegis* (1661) as "the crucial text" for engaging seriously with his natural philosophy. Schaffer translated *Dialogus physicus*, which had never before been translated from Latin. This English translation appeared as an appendix to the book's 1985 and 1989 editions, and has since disappeared from subsequent editions. Boyle too staged a fictional conversation in *The Sceptical Chymist* (1661), where competing views on matter were debated and disputed. From *LAP's* meditation on these dialogues, historians of science have learned to analyse matters of fact, politics of science, and the entangled nature of natural, political, and social orders. From the book's multiple insights, we have also learned to attend closely to interlocutors and their staged speech-acts of making fact, truth, and the experimental life.

How then might we read Joshi's colonial dialogue alongside Hobbes' and Boyle's foundational literary technologies? What do we stand to gain from a dialogue between these Latin, English, and Hindi dialogues belonging to different "systems" of knowledge across the seventeenth and twentieth centuries? Let us take this task as one of translating historiographies in the global history of science. Such an eventful and connected history of experiment may help to explain how the global publics of science have become conscripted to the experimental paradigm.

Schaffer and Shapin analysed the literary structure of Hobbes' and Boyle's dialogues to demonstrate their respective theories of knowledge and their strategies of persuasion and disputation. *Dialogus physicus* proceeds in the Socratic mode as a conversation between two participants, A and B; A represents Hobbes and B his antagonist, who is a vacuist and an experimentalist. In *The Sceptical Chymist*, the conversation takes place between four characters: Eleutherius, Philoponus, Themistius, and Carneades (who serves as a mouthpiece for Boyle). Each of these characters represents different philosophical traditions and competing images of knowledge, such as Aristotelianism, alchemy, and mechanical philosophy. Thus viewed in the light of these other "traditional" interlocutors, Joshi's Shastri appears a little less out of place beside the air-pump.

In its literary structure, Joshi's "Five-Tattva" stands somewhere in between *Dialogus physicus* and *The Sceptical Chymist*. Of its three participants, only one is named – the student, Mukund, who is already a convert to the experimental paradigm. The other two, the Shastri and the Science Professor, are presented as archetypes and inhabitants of cultural roles, and as old and new figures of pedagogical authority. In the context of colonial-era institutional and intellectual transformations, Joshi used a neologism, *vigyanacharya*, to invoke the science professor who, even in the 1910s, was a new figure of authority in the north Indian milieu. The province of the professor, the laboratory or *prayogshala*,

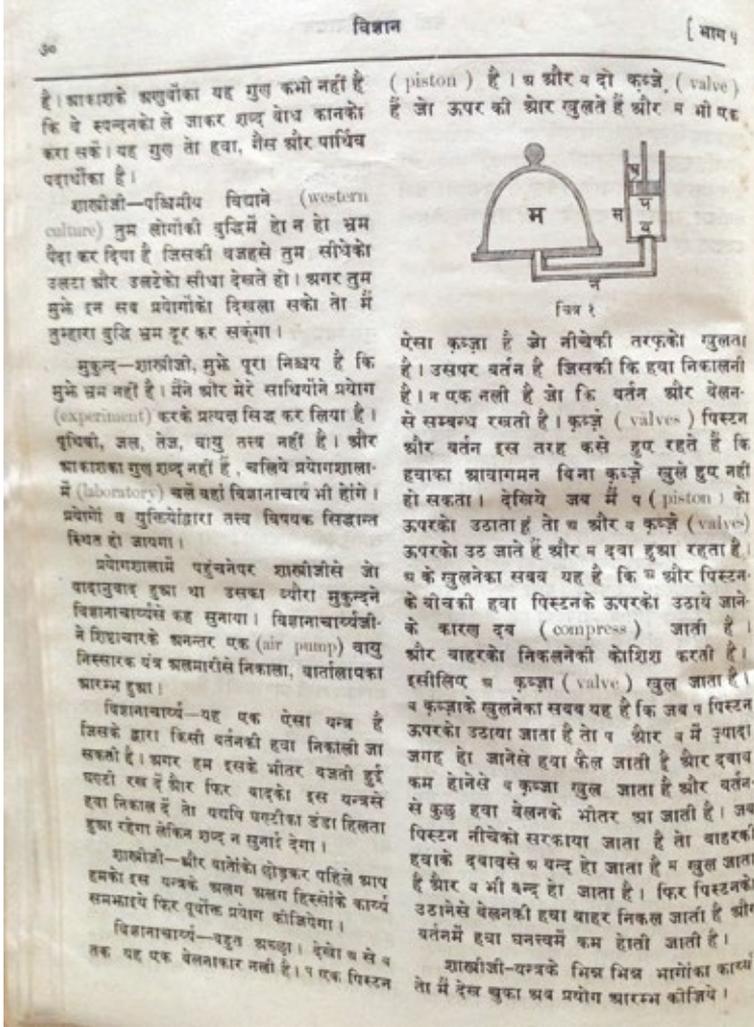


FIGURE 1. • The experimental apparatus illustrated in Prem Vallabh Joshi's fictional conversation "The Five-tattva" in the Hindi-language science monthly, *Vigyan* (1917).

was also a new scene in Hindi literary discourse at this time. The material technology of the air-pump in the seventeenth century often referred to as the pneumatical engine or the *machina Boyleana*, too required a new name in colonial north India: *vayunissarak yantra*; literally, an instrument to extract the air. For *Vigyan's* colonial vernacular readers, who were certain to have never seen an air-pump other than now on the printed page, Joshi produced a labelled diagram (Figure 1). Its iconography, linear and geometrical, was closer to Hobbes' than Boyle's.

The Shastri and the Science Professor represented distinct and competing images of knowledge – the traditional sciences encapsulated by *shastra*, and *vigyan*, a new category of knowledge in South Asia at the turn of the twentieth century. Rooted in the shastric conceptual universe, *vigyan* now appeared as the lexical and conceptual equivalent of “Science” (as in its English usage) in several South Asian vernacular languages, including Hindi. The growing status of this new category is indexed by the fact that the editors of the first monthly established to create new readers of science in Hindi had chosen to call their journal *Vigyan*.

Experiments – *prayoga* – appeared often in *Vigyan*. The dual connotation of experience and experiment embedded in the English usage does not neatly carry over into *prayoga*. In Sanskrit, *prayoga*’s primary meaning points to use and practice (as in language), application and employment (as in words and voice), and only by extension, to device and instrument. Broadly speaking, scholars have analysed *prayoga* as the practice of theory, *shastra*. In its Hindi usage in “Five-*tattva*” by 1917, when Mukund the student first speaks of *prayoga*, he means not the practice of *shastra* but the practice of *vigyan* – of science with a European experimental genealogy. As the professor elaborates, “these days, *vigyan* (Science) is considered foreign knowledge, because it is imparted on the basis of [its] European history and European works.”

What kind of truth then did the air-pump mediate across these vastly distant scenes?

As LAP shows, truth in *Dialogus physicus* emerges already fully formed in Hobbes’ philosophy. In *The Sceptical Chymist*, truth is dramatised as emerging from the four-way conversation. In Joshi’s dialogue, the Shastri’s beliefs are grounded in memorised shastric texts that are recalled and remembered by him. He deploys these learned truths linguistically, for instance by breaking down the meaning of *tattva* etymologically for Mukund. For the Professor and Mukund, who share the Shastri’s “culture” but not his beliefs, new matters of fact are established experimentally, for instance by the use of the air-pump. Over the course of “Five-*tattva*,” truth is dramatised as emerging from their three-way conversation, which always remains civil.

The structure and the linguistic rules of “Five-*tattva*” invite (and conscript) *Vigyan*’s readers to this discursive laboratory in two main ways. First, the Professor asks readers to think over an experiment he has just performed with the air-pump and a ringing bell to demonstrate that sound cannot travel in a vacuum. He invites these readers to contemplate the arguments made by him as well as the shastri, and to publish their own counter-arguments and disagreements in *Vigyan*. Thus, these new colonial virtual witnesses are enrolled in experiment’s global public. Second, the Professor invites the Shastri (and by extension *Vigyan*’s readers) to collaborate and co-author with him to produce “a new *vigyan*, based on the wisdom of eastern philosophers and aided by western scientific experiments.” The air-pump mediates precisely such a publishing programme in *Vigyan*. This vernacular science periodical became a key medium for extending the experimental paradigm in the colony.

# Remembering a transformative year in the MPhil program in 1984–85

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ANN BLAIR

Memorable reminders of what a different time it was. There were no telephones in the student rooms or residences and no email. In order to reach another student, e.g. to agree on a lunch date, one left a handwritten note suggesting a time and place in the appropriate pigeonhole at the bottom of the staircase. Or you could go up to their room and knock, encouraged by an indicator downstairs which could be set to “in” or “out” by sliding a little wooden plaque on a panel featuring the names of everyone in the staircase (of course it might be misleading if the person hadn’t switched it to the right setting when going out or coming in). In order to reach someone elsewhere, one used a public phone booth with a supply of coins. But long distance calls required a lot of coins and got cut off when you ran out. So a common tactic for those with parents far away (mine were in Geneva, Switzerland) was to use a few coins to call out and then get called back in that booth for a call that was limited only by the patience of the caller. Inevitably the lines to use the phone booths got very long as a result, especially on weekends. I tried to get there as early as possible on Sunday morning to beat the line.

But the video about HPS today shows that many things haven’t changed: the location on Free School Lane, the presence of the Whipple Museum with its great collection of historical scientific instruments, the tea room where students would hang out talking for hours, the students from all over the world who come to learn from one of the most distinguished centers of the field.<sup>1</sup> And I hope many discussions after a guest lecture or the like still end up at the Eagle down the street over beer or cider. Sadly I have no photographs from everyday life that year; taking pictures in those days was reserved for special occasions.

But I can see in my mind’s eye and hear in my mind’s ear snippets of many thought-provoking conversations with Simon. I was learning about the Strong Programme for the first time that year (no inkling of it had reached me in the History of Science Department at Harvard where I had been an undergraduate) and Simon pushed me to consider the social and political dynamics behind the decisions of natural philosophers like William Oughtred or Isaac Barrow (on which I wrote, respectively, a short paper and my MPhil thesis, under Simon’s supervision). That’s what’s *interesting* he emphasized.

<sup>1</sup><https://www.hps.cam.ac.uk/study>.

HISTORY AND PHILOSOPHY OF SCIENCE		Part 2	Lent 1985
<u>Paper 2</u>			
Seventeenth century physical science: natural philosophy and its context 1660-1700			
<u>Lecture 1</u>	<u>Experimental philosophy in the 1660s</u>	Main concerns of experimenters at the Restoration. Structure of lectures in natural philosophy at the universities. The establishment of the Royal Society. The Oxford group and physiology. The context of Boyle's pneumatics. Background to optics in London (Hooke) and Cambridge (Barrow).	
<u>Lecture 2</u>	<u>Newtonian optics 1664-1675</u>	Newton's reading in the 1660s. The importance of Cartesian mechanics and optics. Chronology of experiments on colours and the prism. The construction of the reflector. Philosophical interpretation. Debates at the Royal Society 1669-1675. Introduction of a matter theory in 1675. Survey of the optical theory.	
<u>Lecture 3</u>	<u>Matter theory in the 1670s</u>	Newton's use of alchemy in his early matter theories. The "Vegetation of metals" and the "Hypothesis on light and colour". Mechanical philosophy and doctrines of spirit. The significance of experimental pneumatics in Hooke, Mayow and Boyle.	
<u>Lecture 4</u>	<u>Cometography and mechanics 1665-1684</u>	Huygens and the English on the theory of colliding bodies; centrifugal forces; letters between Hooke and Newton on falling bodies in 1679; cometary theory and the debate with Flamsteed on the comets of 1680-1682; Halley's visit in 1684; the Lectures on motion.	
<u>Lecture 5</u>	<u>Newtonian astronomy 1684-1702</u>	Structure of argument of the <u>Principia</u> . The difficulties of vortex motion and the concept of action at a distance. Newton's knowledge and use of Kepler's Laws. Relation of astronomy and mechanics in Newton's system. Case of comets and the range of the inverse square law. The argument for inertial homogeneity and the void. Halley and Newton on comets and the lunar theory in the 1690s. Uses of the Newtonian system.	
<u>Lecture 6</u>	<u>Science and Puritanism</u>	Historiography on science and religion in 17th century England. Weber, Tawney and Merton theses. The support for natural philosophy in Puritan communities. The Civil War radicals and the London natural philosophers. Situation of natural philosophy at the Restoration.	
<u>Lecture 7</u>	<u>Natural Theology</u>	Science and latitudinarian theology. Recent political interpretations of Newtonian and Restoration natural philosophy. Boyle's natural theology. The sacred theories of the Earth (Burnet, Halley, Whiston, John Ray). Social organization of English natural philosophy.	
<u>Lecture 8</u>	<u>Newtonian cosmology</u>	Newton's cosmology in the Boyle Lectures. The letters to Bentley and arguments for a stable cosmos. The doctrine of active principles and the controversy with Leibniz, 1710-1716.	

FIGURE 1. • Simon Schaffer's Lectures on "Seventeenth-Century Physical Science," Lent 1985.

I have only a few papers from Simon's teaching, notably the schedule for his lectures on 17<sup>th</sup>-century physics in Lent 1985. I remember being called a "keen American" for attending lectures since the only requirements for MPhil students were to write four short papers and the thesis. But Simon's lectures were richly detailed – looking at it now I am impressed with the high level of material designed for the undergraduates who had opted for HPS in the last year of the Natural Science Tripos – and exciting to hear. He was also supremely generous to meet regularly with someone like me who was just passing through for a year. I have considered Simon an important mentor ever since.

The original from which my handout was copied looks like it was made from cutting and pasting a header to the body of the page – all of it typewritten and corrected with occasional whiteout tape (as for example at the end of the description of Lecture 1). I also made two manuscript notes, that lectures 7 and 8 were at 2pm instead of the usual 5pm. Simon's name appears at the top only as the thinnest line above "Lent 1985" – apparently absent but unquestionably present. I take it as symbolic of Simon's role in my life since then – not very visible but powerfully present throughout, notably as an inspiration to ponder what is *interesting* and why in whatever you study.

Warmest thanks for opening so many exciting new directions for the field with your generous teaching and your trail-blazing research and critique during these last 35+ years!

# Locating the Scientific Revolution

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GREGORY RADICK

Between mid-February and early March 1998, the Cambridge History Faculty hosted a four-lecture series on “The Scientific Revolution.” The occasion was the 50<sup>th</sup> anniversary of Herbert Butterfield’s lectures there addressing what he saw as – to quote from a hand-out for the new series – “a singular, momentous and irreversible change in western thinking during the early modern period.” The handout continued:

Since then, major revisions of Butterfield’s model have been proposed, including the claim that no such intellectual change on that scale is to be found in the Europe of that period. These four lectures survey a set of recently favoured definitions of the early modern European Scientific Revolution – a transformation of the order of scholarly disciplines; a dramatic reorientation of erudite interest towards novelty and curiosity; the institutionalisation of a new method of inquiry; and the mechanisation and disenchantment of the world. The lectures explore the characteristic social locations associated with these definitions, in order to examine the local character of changes in natural knowledge and its production during the early modern period.

Could that *be* more Simon Schaffer? I don’t just mean the emphasis on the local character of knowledge whose prestige depends on seeming to be independent of time and place. There’s also the bravura sweep and economy; the low but persistent hum of irony; and the cleverly reflexive premise of confronting the Scientific Revolution in the particular setting where the concept acquired that generalizing definite article.

When the lectures were announced, I was one of quite a few PhD students that Simon supervised in HPS in Cambridge, working however not on the early modern period but on the later nineteenth century. Still, this sounded unmissable. Here was a chance, a couple of years after the publication of Steven Shapin’s *The Scientific Revolution*, to hear how the other half of “Shapin & Schaffer” met the challenge of providing an up-to-date overview of that topic for a non-specialist audience. An historic, as well as historical and historiographical, event! I nevertheless managed to miss the first lecture, for reasons that I can’t now remember but were undoubtedly paltry. When I arrived for the second lecture, I found, to my astonishment, that the only people in the room – which I had

expected to be packed (as happened regularly when Simon lectured) – were a handful of History undergraduates, Simon, and me. So I was the only historian of science in the audience for reflections which, as far as I know, have never appeared in print.

I hope that, despite the necessarily abbreviated form, the reconstruction which follows gives a not-too-distorted glimpse. I've structured the whole around the lecture synopses from the handout, which also included extensive reading lists – typically for Simon, these omitted any mention of his own publications – and a pair of timelines for major events between the 1470s and the 1680s, one for Italy and France, the other for Northern Europe. As you read, you'll have to imagine an accompanying flow of illustrative images, as transparency gave way to transparency on the overhead projector. What your imagination can't supply, alas, is the rich detail that brought the local-character thesis to life so vividly: in the second lecture, for example, about how study of the collection which grew into the Ashmolean Museum led Bishop Wilkins to speculate about an Adamic tongue whose words would correspond to the essence of things; or how the anatomy theatre spread and thrived north of the Alps, developing into an amalgam of museum, library, club, theatre and church, in part because severe winter cold kept the corpses there from putrefying.

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*1 OBSERVATORIES AND COURTS: The Scientific Revolution as a change in academic disciplines: the example of astronomy. Interpretations of Copernicanism. Tycho's Uraniborg. Astronomers and court patronage – Kepler and Galileo. The telescope and princely patronage.*

Again, I wasn't there; but in Simon's review at the start of Lecture 2, he described the previous lecture as looking at benchmark events used to justify Butterfield's view of a singular and momentous irreversible change. The lecture concentrated on Copernicanism, and how the crucial epistemological shift, from a fictional to a realistic interpretation of what astronomers posited when predicting the heavenly motions, was part-and-parcel of a shift in the role and social place of the astronomer, from a badly paid university worker to a courtier whose business was the divining of the true paths of the planets (as per Robert Westman's classic article).

*2 CABINETS AND THEATRES: The Scientific Revolution as the cult of novelty. The rise of curiosity and the tradition of secrets. Museums and anatomy theatres. Examples from Bologna, Prague, Leyden and Oxford. Cartesianism interpreted as a science of marvels.*

The scholastics associated curiosity with the Fall, distrusted reports of anything not already known (especially when tied to the use of instruments), and privileged true justified syllogisms as what explained why things are as they are. Yet by the end of the seventeenth century, curiosity and novelty had become not just valued but institutionalised – as in the great museum collections of the era – with demonstration displaced by an open-ended model of empirical inquiry which travelled with its instruments. Behind this turn towards the unprecedented lay a number of developments, among them the emergence of the idea that this new knowledge was restoring what had become hidden, secret,

perhaps when the perfect language of Adam became corrupt and so ceased to match the true order of things. Like astronomy, anatomy was a science where epistemological change (the challenge to Galenic orthodoxy, e.g., about the flow of blood) went hand-in-hand with changes in social role and locale (those who actually examined the corpses acquired the right, in increasingly public and courtly contexts, to comment on the body). Descartes' career, from the philosophy-advancing secrets revealed to him in dreams, to his anatomical dissections, to his skill at using artifacts to generate natural marvels, was very much a part of this cultural geography.

*3 LABORATORIES AND GARDENS: The Scientific Revolution as a new method of inquiry. The new philosophy as regeneration: the example of the microscope. The social organisation of enquiry: academies, societies and experimental labour. Paradise and the reform of knowledge.*

In Paris, Oxford and elsewhere, laboratories were first associated with gardens, where high-powered medics pursued medical botany and medical chemistry. Those gardens in turn were associated with Eden, and so with the larger project of recovering knowledge lost at the Fall of Man, of regaining the knowledge of our father Adam. Even so, the rise of the laboratory looks surprising when we consider how much suspicion there was of singular, private experiences as a basis for natural philosophy. In the latter seventeenth century, experimentalists successfully dissolved that suspicion by stressing the gentlemanly status of those who designed and witnessed experimental trials, by insisting that the testimonials which mattered in these trials were those from things not from people (and the labour needed to assemble the things in the right way was assiduously rendered invisible), and by affiliating the knowledge acquired via artificial instruments such as the air pump and the microscope to what Adam had known via his prelapsarian senses. Difficulties in replicating the experimental claims of the likes of Boyle on air and Newton on light were resolved only with the spread of standardized commercial instruments built to behave as their presumptively true theories said good instruments should.

*4 MARKETS AND WORKSHOPS: The Scientific Revolution as the mechanization of the world-picture. On the rationality of demonology and the persistence of spirits. Mechanization and relations between the scholar, the merchant and the craftsman.*

Simon covered all of the above, brilliantly, with an especially instructive comparing of Menocchio the miller's Inquisition exam in 1584 and the opening of Galileo's *Two New Sciences* as conversations between the learned and the vulgar in Counter-Reformation Italy. But what has stayed with me, nearly a quarter of a century later, doesn't appear in his synopsis. Circled in my notes is the line: "the construction of limits to what is possible is the essence of the mechanisation of the world picture." As Simon emphasized, that is historiographic heresy, since most historians dwell on the increase of possibility. ("From the closed world to the infinite universe.") But in fact, he argued, the way that rational mechanics came to prominence depended on what is *not* possible, *not* to be discussed any longer, and so on. The attack on alchemy established the limits of what chemistry could achieve; the attack on perpetual motion machines established the limits of what

machines could do, given the laws to which they are subject. The 1773 Paris Academy prohibition on papers on the philosopher's stone and on perpetual motion machines is emblematic of how, in the new natural philosophy, quantification and disqualification went together.

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It was, of course, a thrill to attend these lectures. But the best part, if I'm honest, happened afterwards, when Simon and I walked back from the Sidgwick Site to Free School Lane, talking history and philosophy of science all the way.

# Up the Revolution: 1687, 1688 and All That

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ADRIAN WILSON

Simon Schaffer's career has been lived, as have all of our careers, in the shadow of the concept of scientific revolution – embracing both “the” Scientific Revolution of the seventeenth century, armed with capitalisation and singular in all senses of the word, and “scientific revolutions,” lower-case and plural, as the multiple structuring episodes which, according to Thomas Kuhn, run through all the histories of all the individual sciences. My inadequate little retirement gift to Simon is a small contribution to the critical reappraisal of that concept. Specifically, I shall interrogate a 1976 paper of I. Bernard Cohen's, which explored the use of the term “revolution” to designate permanent and progressive change, rather than its original meaning of cyclical return.<sup>1</sup>

Cohen made two points about that remarkable shift of meaning. First, contrary to what some historians of science had been suggesting, the *application* of “revolution”-in-the-progressive-sense to refer to the scientific developments of the sixteenth and seventeenth centuries was neither anachronistic nor inappropriate – for that usage, far from being recent, had originated in 1709 with Fontenelle's characterization of the calculus, was applied in 1747 by Clairaut to Newton's physics, and had gained wide currency well before 1800 to designate the very developments that would later be termed “the Scientific Revolution.”<sup>2</sup> Second, the *origin* of that sense of “revolution” lay in the realm of politics:

During the eighteenth century, the point of view emerged that scientific change is characterized by *an analog of the revolutions that alter the forms of society and the political affairs of the state*. Whereas earlier, science had contributed “revolution” to the discourse of social and political change [here Cohen alluded to the longstanding conception that affairs of state showed the cyclical pattern that characterized the motions of heavenly bodies], now *social and political thought gave back to science the concept of revolution in the newly established sense... as a series of secular discontinuities of such magnitude as to constitute definite breaks with the past*.<sup>3</sup>

<sup>1</sup> I. Bernard Cohen, “The Eighteenth-Century Origins of the Concept of Scientific Revolution,” *Journal of the History of Ideas* 37, no. 2 (April-June 1976): 257–88.

<sup>2</sup> Cohen, “Eighteenth-Century Origins,” 269–74. For the date 1709 see p. 268, n. 35.

<sup>3</sup> Cohen, “Eighteenth-Century Origins,” 258–9; my emphases.

Now these two claims were attended with a remarkable asymmetry: the first was documented throughout the article, but the second was simply assumed. Only once did the realm of “social and political thought” – the alleged origin of the new, progressive, directional sense of “revolution” – ever appear in the paper, and when it did, Cohen unwittingly drew attention to the asymmetry:

The fact that these earliest references to a revolution in science [Fontenelle, Clairaut] occur in relation to Newton is worthy of notice, since it was Newton’s achievement in pure mathematics coupled with his analysis of the system of the world on the basis of gravitational dynamics that actually set the seal on the “Scientific Revolution” and caused scientists and philosophers to recognize that a revolution had in fact taken place. In this sense, Newton’s *Principia* of 1687 would have played the same role in the recognition of the occurrence of a scientific revolution as the Glorious Revolution of 1688 *apparently* did for political revolution.<sup>4</sup>

I have italicised Cohen’s “apparently,” but mere typography cannot bring out that word’s devastating significance here. It is the tiny token of an enormous and catastrophic oversight, which arose from Cohen’s twentieth-century perspective by a process that can be reconstructed as follows. First, Cohen took it for granted that the usage of “revolution” in the sense of a progressive and irreversible discontinuity *belongs to* the political realm. Second, as a corollary, he evidently assumed that it must therefore have *originated* in that realm. Third, noticing that this entailed a question as to *when and how* it so originated, he ascribed it to the Glorious Revolution, as indeed he had to do, since that was the only political event designated as a “revolution” preceding the usage initiated by Fontenelle. And finally, recognizing that this was something which he had assumed but not proved, he acknowledged as much with the commendably candid word “apparently.” Yet this did not provoke him to ask the question that his assumption entailed, a question whose structure was identical to that of his own enquiry: how was the Glorious Revolution apprehended in the eighteenth century?

Unhappily for Cohen, but fortunately for us, that very question had already been addressed, in an essay by H.T. Dickinson which had appeared, remarkably enough, a few months earlier in this same year, 1976. And Dickinson’s findings utterly undermined Cohen’s assumption that the Glorious Revolution had initiated the progressive usage of “revolution.” Initially, Dickinson showed, “the Revolution” (as it was routinely called) was seen by Whigs and Tories alike as a return to a happy former state, that of the “ancient constitution.”<sup>5</sup> This way of depicting it persisted until the early 1730s, at which point Bolingbroke’s new “patriot” oppositional tactics provoked Robert Walpole’s pamphleteers to articulate for the first time the view that 1688 had created something new

<sup>4</sup> Cohen, “Eighteenth-Century Origins,” 269–70.

<sup>5</sup> H. T. Dickinson, “The Eighteenth-Century Debate on the ‘Glorious Revolution,’” *History* 61, no. 201 (February 1976): 28–45, at 29, 32, 33, 37.

and unprecedented. And while this became the standard view among the Whigs for the next generation, it had by no means displaced the older picture. On the contrary, apprehensions of “the Revolution” remained fluid and contested throughout the century; some saw it as “Glorious,” others did not; and the doctrine of the “ancient constitution” was revived, most notably but not only by Burke, in the wake of the French Revolution.<sup>6</sup> In sum, the progressive usage by no means originated with the Glorious Revolution, nor with perceptions thereof.

It seems that Cohen never saw Dickinson’s paper, for he repeated his Glorious-Revolution claim almost verbatim some nine years later (1985) in his book *Revolution in Science*.<sup>7</sup> Nor, so far as I am aware, has any subsequent historian of science ever referred to Dickinson’s findings. The implications of those findings, combined with those of Cohen himself, may be summed up as follows. When Lavoisier, writing in 1773, envisaged “une révolution en physique et en chimie,”<sup>8</sup> the word “révolution” was alluding not to 1688 but to 1687 – that is, to the developments of the previous century in astronomy and physics (what we call the Scientific Revolution), not in politics. *The concept of revolution as a progressive and irreversible change began with reference to natural philosophy*. It follows, therefore, that just as the “revolution” element of the concept “Scientific Revolution” is by no means anachronistic (which was Cohen’s first and well-researched point), so too that element is (contrary to Cohen’s second and unsubstantiated claim) by no means of exterior, political origin.

This, I suggest, clears away some of the thickets of misunderstanding that have sprung up around the dual associations of “revolution” – political and “scientific.”<sup>9</sup> Critiques of the “Scientific Revolution” concept on the grounds that it is a “metaphor” taken from political history are misplaced (because that was not its origin); so, too, are attempts to apply theories of political revolution as interpretative devices to illuminate the “Scientific” one (because that was not its nature). For the notion that seventeenth-century natural-philosophical changes were revolutionary-in-the-modern-sense by no means entails any analogy with political revolution. *All that the modern usage means is simply an irreversible, once-for-ever change*. In the history of knowledge that usage is occasionally deployed with reference to the future (as it was by Lavoisier), but it is typically a retrospective label; that does not make it wrong, but merely limits its utility. In particular, it tells us nothing about process or preconditions; it merely describes outcomes, or to be precise, perceived outcomes. In short, it’s neither as dangerous as some claim nor as useful as others – such as Cohen and Kuhn – would have it.

<sup>6</sup> Dickinson, “Eighteenth-Century Debate,” 39–44.

<sup>7</sup> I. Bernard Cohen, *Revolution in Science* (Cambridge: Belknap Press, 1985), 216, cf. also 53, 66, 69–73.

<sup>8</sup> Cohen, “Eighteenth-Century Origins,” 281.

<sup>9</sup> By way of analogy, consider the way the word “doctor” is used. My students commonly address me as “Doctor,” but they do not expect me to fix their ailments.

# How Simon Schaffer launched my career

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JAN GOLINKSI

Simon Schaffer launched my career. I suppose lots of people can say that, in a way. No doubt, there will be plenty of tributes in this collection to Simon's wise mentorship, his inspirational guidance of Ph.D. dissertations, his brilliant suggestions on drafts of papers, the lengthy and helpful bibliographies he apparently spins off the top of his head, and of course heady conversations over many pints of beer in *The Eagle*. But Simon did more than that for me; he created me and set me on my professional path.

Look at the Acknowledgments in the first edition – the hard-cover one – of *Leviathan and the Air-Pump*, and there I am: “Jan Golinski.” That generous tribute was the first time I appeared in print, but far from the last. In subsequent editions of the book, Simon scrupulously changed it, acknowledging a fellow called “Golinski” instead. But who is Golinski? Surely he didn't contribute anything to the famous book Simon wrote with Steven Shapin. Golinski disappeared into obscurity long ago. Rumor has it he lives in the woods of New Hampshire somewhere near the Canadian border. No-one has seen or heard from him for years.

My career, on the other hand, has flourished, and it's all thanks to Simon. Just search for “Golinski” on Google and you will find my name everywhere. There are hundreds of references to me in acknowledgments, reviews, footnotes, bibliographies, even in announcements for lectures and conferences. Sometimes, it's true, I have to share the glory with the aforementioned Golinski. Even within the same footnote or paragraph, an author will cite both of us, unsure where the credit really belongs. To take just one example: someone called David Wootton (I hope I've spelled that right), in a rather cantankerous book on the Scientific Revolution, takes me to task for a “muddle-headed view” about relativism, before shifting his target to Golinski in the very next paragraph. Talk about “muddle-headed!” I bet Golinski is grateful to me for taking the flak on that one.

And I'm grateful to Simon. I would never have become this famous without him. Every year, my tally of citations grows, with books, articles, and conference presentations ascribed to me. It all started with that note in *Leviathan and the Air-Pump*. I not only owe my professional profile to Simon, I can honestly say I would not exist without him.

# Re-literalization

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PETER GALISON

When I came into the history of science, it was a commonplace to dismiss the literal and material and to prize the metaphorical and abstract. Those were the heady days of anti-positivism, when philosophers and historians relished the idea of trashing observation as the propellant of science and celebrating ideas as the motor of the enterprise. Headwork over handwork: concepts made the world visible or invisible, theory first. It was a hierarchy that could call on an ancient tradition, pure ideas above the insubstantiality of the substantial.

This struggle over the primacy of abstraction and concreteness marked a generation of historians, one that shaped the discipline of history in the 1970s and 1980s. E. P. Thompson aimed to displace the abstract concept of culture from its claim to universal aesthetics, and instead to display the myriad meanings, values, institutions, and actions that constituted *particular* cultural formations. For Thompson there wasn't a culture-in-general, there were cultures-in-particular, an awareness of class and identity, in his case, that of the 18<sup>th</sup>- and 19<sup>th</sup>-century British working class. Culture, so argued a new generation of social historians, need not refer only to Mozart and Monet, it could also embrace games, songs, rhymes, as associations. Thompson obviated the idea that "working class culture" was in any way oxymoronic.

A more material history was emerging in France, too. Historians of the *Annales* School also paid attention to material relations: Fernand Braudel wanted to follow lines and difficulties of policing and communication. He studied how hills and mountains around the Mediterranean lands created greater obstacles to authoritarian domination than did grain and rice fields. He tracked how long it took to get letters from one site near the Mediterranean to another. From Marc Bloch, we learned how to read forgotten forms of life from long-past patterns of furrowed fields. This attention to work, process and materiality ran from medieval studies to more contemporary factory production, where social historians addressed coal faces, automobile assembly lines, secretarial pools. That materiality took an historically structural form in Michel Foucault's work, joining systems of utterances and actions together, always in the context of bodies, buildings, and the rules of discourse that enveloped them.

On opposite sides of the Atlantic, Simon Schaffer and I were absorbed by many of these issues. I spent most of my training at Harvard with time in Paris and a year at Cam-

bridge; he spent most of his in Cambridge with time in Paris and a year at Harvard. We both wanted desperately to get out from under the staleness of what was then much of intellectual history, with its vacuous thumbnail biographies, ideas in bits and pieces leaping from book to book. Both of us zeroed in on the laboratory as a portal to the history of science with a first-instance attention to material and discursive relations of places, people, and procedures.

When Steven Shapin and Simon Schaffer approached the vacuum/plenum debate in post-Restoration England (*Leviathan and the Air-Pump*), they turned to and contextualized an over-arching question: How should disputes be resolved? Should closure issue from the edict of an absolute ruler in politics and the authority of a manifest demonstration experiment, like the glass barometer explorations of Evangelista Torricelli? Or should a resolution come from a parliamentary deliberation in which fundamental (religious/metaphysical beliefs) were set aside? Boyle bracketed the foundational by setting aside Aristotelean or anti-Aristotelean metaphysics, and drawing attention to that which could be pursued and resolved with bell jars and air pumps, witnessed by the arbiters of the day: gentlemen. Here and in many probing essays, Simon pursued technical issues, using them to elicit broader claims about work, politics, and knowledge.

My focus in the early and mid-1980s was on the physics laboratory, not in the 17<sup>th</sup> century but the long 20<sup>th</sup>. Across the intervening centuries much had shifted. Beginning in the mid-19<sup>th</sup> century, a subculture of the discipline began to assert its identity: theoretical physics. Mathematicians had long since striven to formulate new ways of pursuing, say, Newtonian physics in its elaboration, conceptual clarification and calculational efficacy. But the idea of a theoretical physics with an ambition to offer new laws and challenge foundational ideas – that was new. As a result, the location of laboratory and theoretical physics work shifted. Experimental and theoretical lives in the discipline diverged: different patterns of training, locations, epistemic values.

My aim in *How Experiments End* was to see how laboratory work had its own forms of demonstration. What were the conditions under which experimenters could say, *ceteris paribus*, that an entity or effect was robust, not the result of artifacts of the environment or the apparatus? With that grounding, it became possible to look diachronically at how these demonstration standards shifted over the course of the twentieth century, from individuals to large-scale collaborations. In fact, though I've never commented much on it, I wrote *Image and Logic*, at one level, very much as a work-history of physics. It ran from the craft and apprenticed world of the early cloud chambers through the cottage industry of Cecil Powell's enlisted teams of microscope-adept women working in their coordinated homes to the factory-built world of the big bubble chambers. The book ends in the digitally distributed, digitally-controlled detectors that were coming into play in the mid-1990s.

There is a politics in much of the work Simon has pursued and in mine. It is visible, to be sure in Shapin and Schaffer's *Leviathan*, but also, strikingly so, in Schaffer's "Astronomers Mark Time." There, the history of workplace (and worker) control is explicit. The personal equation became a way of homogenizing, controlling and surveilling workers,

compensating for variability, making them replaceable. In my work too the embedding of science in a political world became more explicit. When Ronald Reagan accelerated the arms race, I began filming (in “Ultimate Weapon”) the participants in the first great moral-political reckoning scientists in the United States had with the nuclear weapons: the 1949–52 battle over whether to build or block the hydrogen bomb. Out of the nuclear race emerged a new and ubiquitous regime of secrecy. Prompted by its burgeoning size in the aftermath of 2001, Robb Moss and I began making “Secrecy” with the aim of rendering secrets less abstract and more procedural, specific, and consequential. “Containment” followed – we shot endless rows of black, isotope-laden bags of soil lining the roads of Fukushima; we filmed a 500-pound radioactive alligator sauntering inside the Savannah River nuclear weapons plant, and the myriad people who lived and worked amidst radioactive lands. And we filmed the architects, futurists, and semioticians designing a burial ground monument system for waste, which aimed to warn future generations for 10,000 years.

Stepping back, there is another level of politics in Schaffer’s work – and mine. Simon, aiming to show how a local system of thing-manipulating knowledge could extend its reach, began thinking about what he felicitously called “the multiplication of contexts,” the wholesale duplication and re-duplication of laboratory settings that could provide the conditions under which the effects and arguments of the air-pump could move. Confronting this multiplication was a way of thinking metonymically about knowledge that is imposed by colonial rule: the remaking of British colonial sites in the image of the colonizing power. Here was a remarkable exploration, grappling with the epistemology of de-localization in the penumbra of British colonialism. For my part, I became interested in what happens when cultures or subcultures of different power relationships engaged one another; how the inevitably halting, incomplete modes of exchange take place even absent a deep sharing of foundations. Actions, objects, inter-language and beliefs functioned partially: a grappling with the vicissitudes, bonds, and instabilities of American society.

For decades, I’ve thought on and off about the intelligibility of politics and epistemology through material practices, so has Simon Schaffer. But now I come to thinner ice: I am sure that I am endlessly fascinated (perhaps I’m too easily amused) by the sudden juxtaposition of specific, material relations and the big issues of scientific concepts from Newton and Maxwell to Einstein. (When Poincaré wrote about distant telegraphers coordinating the determination of longitude by exchanged signals, he might have in view, well, telegraphers exchanging signals to determine longitude.) Simon too finds amusement in this recovery of actual work in real place, I can think of dozens of conversations we have had over the years about ideas coming down to earth in actual settings. He would have to say if he too finds an evocative *aesthetic* in the abrupt closing of the gap between high and low, abstract and material. I think he does.

In 1905, Sigmund Freud published *Jokes and Their Relation to the Unconscious* – a joke, if ever there was one, of an aesthetic text. Freud says: We talk about mountains and lift a hand high, we speak of a short person and push a hand low. It is no doubt a form of com-

munication, true enough, but, Freud contends, it is true of thought itself, the rule, not the exception. Indeed, Freud considered that such “ideational mimetics” might be as applicable to other branches of aesthetics as they were to the comic. For Freud, abstraction at its root was always an extended version of the replacement of the smaller by the larger: “[W]hat is more interesting, more sublime and even more abstract are only special cases, with particular qualities, of what is larger.”

When . . . the degradation [*Herabsetzung*] of the sublime allow me to have an idea of it as though it were something commonplace, in whose presence I need not pull myself together but may, to use the military formula, “stand easy,” I am being spared the increased expenditure of the solemn restraint. . . . the difference in expenditure . . . can be discharged by laughter.

Examples of this comic, “degrading” fall from sublime-abstract to mundane-material include caricature (which fastens on a single overlooked trait) and parody/travesty/unmasking (which degrade by other means). Freud: If you brace yourself to catch what you expect will be a heavy ball, and suddenly, on catching what turns out to be a very light ball, you reveal by your movements just how superfluous that preparation was – and everyone watching this spectacle will see it as comic.

In concrete abstractions, we have the possibility of a generative historiography that helps us understand the history of scientific work and context; of an epistemology that deploys specificity and concreteness to illuminate with vividness; and of a materialized aesthetic with the pleasure of a startling humor. Over many years, I have hugely enjoyed reading, thinking and speaking with Simon through this triple refraction – and look forward to many more years re-literalizing the world of an embodied history of knowledge.

# On the Occasion of Professor Schaffer's Retirement

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JAMES DELBOURGO

The initial encounter with Professor Schaffer took place in 1996–7, and occasioned a frontal collision between the history of political ideas and the history of science. A master's student versed in transatlantic republicanism was enrolled in a seminar with Professor Quentin Skinner in which single chapters of Hobbes' *Leviathan* were scripturally parsed *par semaine*. Then, in the course of seeking advice for an essay about *The Education of Henry Adams*, the second law of thermodynamics and Adams' theory of the Virgin and the Dynamo, the student made his way to Free School Lane. There was chalk and a blackboard. Presently, an air pump appeared in the cigarette smoke. Subsequent readings, particularly "Natural Philosophy and Public Spectacle" and "Self Evidence," insisted that bodies and machines, electric fire and magnetic fluid, formed urgent theatres of conflict over both spirit and society. These were not ideas in context, but incarnate. Devotion to chapter and verse yielded to seductive images of ass-headed Mesmerists and demonstrations of model earthquakes. History was thick, not thin. The student couldn't quickly fathom the several interesting differences between Skinner and Schaffer, yet instinctively opted for the latter, and began to dream up stories of American Enlightenment – not worrying very much about whether America had an Enlightenment or had heard of Isaac Newton.

Without realizing it, the student was now enrolling in a school of intellectual and geographical eccentricity without resolution, one Schaffer has charted like Babel's own cartographer. It might be said that Schaffer's curious mapping allowed the student to find his way to America to study a European phenomenon (the Enlightenment), which study he then completed in Canada, prodigiously abetted by Professor David Armitage. Only later did the student realize that almost all histories of American Enlightenment are written by *Canadians*, as it were. To return the compliment to his mother country – if not to return – he later obtained Canadian funding to travel back to London to write a history of the founder of the British Museum. Professor Schaffer underwrote this venture by force of intellectual example, deep reserves of pubbish sympathy and the ink of his endorsement pen. It was again a work that could only have been completed outside the country whose history it sought to interpret. In all these respects, and not merely for the number of their meetings in cities that hug the forty-ninth parallel, Professor Schaffer's tutelage of the student has always been Canadian.

A pivotal moment came towards the end of the student's foray into American Enlightenment when Schaffer persuaded him to grapple with the fat and dangerous bodies of electric eels. The student was initially convinced he shouldn't handle such unpredictable and probably malevolent creatures. Could Enlightenment come from a fish? Rivers were not laboratories. He'd studied Franklin's Philadelphia as a little Paris on the Schuylkill, a model centre of experimentation, a European salon across the waves. But what had African slaves and Native Americans in common with Nollets or Humboldts when they felt shocks and sparks? A crude yet serviceable print-out of "Fish and Ships," however, showed that Cavendish's artificial ray did indeed model power for a modern world. Slowly and dimly, the student began to grasp that Enlightenment *could* come from a fish, and that a river *is* a laboratory.

Intellectual history was exploded; ideas evacuated; texts discarded; centres abandoned. Now there were rivers and hands, fields, networks, natural history. What *wasn't* in the network? *Who* wasn't? The world could no longer be carved at its joints because such joints were melting. Borges' map that is as large as the territory it charts could have been the poster for this new world, only, it couldn't have been hung on any wall. Go-betweens were everywhere, human and not, cunning and going, never staying or remaining. This xeno-club included seemingly everyone, though no-one was a member. The floaters the student wrote about – spies, traders, traffickers, traitors – still had no home, likely never would, yet they now won scholarships in a certain school of Canadian eccentricity.

The student himself, however, did *come home* to write about Hans Sloane, and found Professor Schaffer waiting for him in the Chop House. Natural history, the student assumed, produced neither earthquakes nor sparks, merely accumulations. It's not that there was nothing to see, there was too much. Natural philosophy has *moments*, yet natural history abolishes time. Collecting replaces the minute-hand of the clock with the blur of seriality: an endless procession of plants, animals and things. An excellent proposition then to spend fifteen years rifling the stuffed drawers of a botanist who lived to be ninety-three. Experiments had sinister power, but what of pressed flowers? Accession catalogues surely possessed no active principles. The Antillean provenance of Sloane's Chelsea herbarium was suggestive of colonial skulduggery. But what *use* were his 10,000 Vegetable Substances? Were they powerful evidence or powerless theatre? Did they represent a form of power or merely the power of form?

Professor Schaffer's history of "Asiatic Enlightenments" proposed an answer from anthropology. Collections incarnate cooperation and conflict, congealed. Sloane thus resembled the artificial man of the *Leviathan* rather more than suspected: his was the collection of an individual who didn't actually exist. Schaffer's reflections on Orientalism, meanwhile, prompted a disquieting new question: *what time is it there?* As Newtonians became Buddhists, opposing Catholics who turned out to be Hindus, the corkscrew of time and identity became strikingly exposed. The student soon found that everywhere the theme of space had been eclipsed by that of time; that space had always secretly implied time; and that thick history was thinning back out into an infinitesimal spiral, with

ancients and moderns floating in a loop of centuries and continents. Everything old was new again, but now required exponential eccentricity, dizzying even for Canadians.

It was at this approximate juncture that the student had lunch with both Professor Schaffer and Professor Shapin. The venue was again the Chop House. For the student, this was indeed a case of seeing double. Memories of the occasion glide to the pleasingly superficial: amused reviews of a Eurovision Song Contest; universal astonishment at Captain Kirk's performance on *Have I Got News For You?* The contrast between Schaffer's love of beer and Shapin's love of wine became increasingly evident as the lunch progressed. In retrospect, a charmed transposition was taking place, of which the student was typically unaware at the time, and of which he came to conceive only years later, in the course of writing a long history of the idea that the person who collects is sinister and warped. After reflecting on the intellectual and social sympathy between the two scholars with whom he ate sausages that early summer day, the student concluded that he had been grandly fortunate to have Professor Schaffer encourage his beer-drinking all this time, as well as introduce him to those who know about good wine. Whether the peculiar case delineated here possesses any enduring interest will, however, perhaps best be judged by reviewing its sequel from the vantage of an additional quarter-century, in 2047.

# The Accidental Maestro

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MICHAEL WINTROUB

There was a rumbling in the air.

No, not Simon's resonant voice holding forth on Boyle and air-pumps, Newton's prisms, the Board of Longitude, or Babbage's machines, but vacuum tubes pushed by electric guitars and too much gain. Distortion and fuzz, a squared signal, clipped, flattened and compressed leaving the clean tones of Charlie Christian for the muddy middle of down and dirty.

Rock 'n Roll.

Discovery, as Simon tells us, is a retrospective label, a technique for marking technical practices or effects which are prized by a given community. Such technical practices are not necessarily well thought out and rehearsed, the product of genius or a eureka moment of inspiration, they may be accidental, a mistake or the result of trial and error; they might also be considered less than desirable, not prized at all, but the result of bad taste or rebellion, something to be avoided, rather than replicated. This was most certainly the case for a guitar's distortion; generously, it was a mistake to be rectified; less generously, it was dangerous, hedonistic, primitive, and ugly.

But it sounded great.

Playing an Epiphone Emperor with a DeArmond FHC pickup wired to a Fender Pro and a steel guitar bridge pickup by Leo Fender wired out of phase to an Epiphone Electar amp, Lester Robert "Junior" Barnard got down and dirty with Bob Wills and his Texas Playboys on songs such as the "Fat Boy Rag" and the "Black Out Blues." Around the same time Willie Johnson on a Supro Ozark pushed the gain on his amp until the tubes clipped the signal into a screaming distortion that perfectly complemented harp, sax and Howlin' Wolf's growling vocals. When the big man moved to Chi-Town, Willie was replaced by Hubert Sumlin, who found that he could play through the higher-gain circuit mic channel on his Gibson EH-150, something you were not supposed to do, to push his guitar's sound into the gravel and drag it into the sky to keep up with Chester Burnett's howl. The list of those pushing the gain on their amps (in the immortal words of Nigel Tufnel) to 11, to create (socially) dangerous distortion includes Goree Carter, Joe Hill Louis, Guitar Slim, Pat Hare, and of course, Chuck Berry. Others found that a broken amp could do the trick. Paul Burlison of the Johnny Burnette Trio dropped his amp before a gig in Philadelphia, but he played the show despite the damage. Much to the dismay of the rest

of the band, his sound went from clean to dirty, and when the curtains closed, they lit into him. He pulled the back off the amp and found the tubes “just hangin’ in the sockets... acting like a rheostat, the electricity jumpin’ to the prongs.” Though his bandmates hated the sound the reviewers loved it, and when it came time to record “Train Kept A-Rollin,” Burlison tried to recreate the accident by deliberately loosening the tubes. A similar tale of accidental innovation is told about Willie Kizart’s distortion on “Rocket 88” by Ike Turner and his Kings of Rhythm. His amp fell out of the trunk when the band had a flat and they were digging around for the spare. At the studio, Sam Philips found both Kizart’s woofer and speaker cone broken, he used wadded up news and sack paper to hold them in, thus, inadvertently, creating the distortion that would, in years to come, define the sound of rock ‘n roll. Link Wray had a different kind of musical accident, using a vocal mic to boost the sound from his amp so that he could be heard above his brother’s loud drumming, he produced a distorted rumbling sound that made the audience, as he put it, “go ape.” Wray and his Ray Men rushed to the studio but had difficulty reproducing the sound, until Wray came up with the bright idea of punching holes in his tweeters with a pen, which produced a sound that, as Dave Marsh put it, “hits you straight through the central nervous system, glazes your eyes, and drops you in your tracks. Short. Nasty. Potentially lethal.”

In all these cases, replication was problematic; either the sound produced was entirely accidental, or its desirability was questioned by (many) musicians, tastemakers and audiences. But this was beginning to change, it just needed the right spark, and the right “black box.”

This happened in 1960 at the Quonset Hut recording studio in Nashville where Marty Robbin was recording “Don’t Worry.” The Rockabilly-country icon, guitarist Grady Martin was playing a Danelectro UB2 six-string bass on the song; he was plugged directly into a broken console. It sounded ... strange, disruptive, fuzzy, explosive. The engineer on the session, Jimmy Lockart, noted that the preamp in the console distorted; it turned out that Grady had blown the transformer in the preamp, but they let him continue to play through it instead of having it fixed. One of the other engineers, Glenn Snoddy, recounted in an interview with NAMM’s Oral History Program, how the company that made the console had farmed out its transformers, and whoever made them had “misjudged the windings somehow or other, and there were 250 volts going through the windings of the transformers, and one opened up at the time Grady was playing through it, and it caused this sound, a fuzz tone sound, later we called it ...” Captivated by the square wave distortion from the faulty channel, Martin and producer Don Law decided to feature it on the single despite Robbins’ objections. “Don’t Worry” turned out to be a hit; now Robbin’s had another problem – how to reproduce “that sound” when they played live?

The mistake, the error, the breakage became the site of a new sound phenomenon which challenged the ways music would be made, listened to, and appreciated. The success of “Don’t Worry” and its unusual bass line led to others seeking out the same effect, but the console had been repaired and was once again producing a “clean” unclipped sig-

nal. Snoddy decided to see if he could reverse engineer the effect produced by the broken channel. He worked with his colleague, radio engineer, Revis Hobbs to recreate the clipping. They experimented using various methods, before settling on a three germanium transistor circuit, powered by two 1.5-volt batteries. Snoddy and Hobbs housed this in a compact pedal box with a footswitch that would allow the guitar player to clip or not to clip, to fuzz or not to fuzz. After much fiddling, Snoddy and Hobbs took it to Gibson, and, in 1962, the world's first commercially available distortion pedal, the Maestro FZ-1 Fuzztone, was born.

But, few wanted it. It was a novelty item, marketed as a guitar-as-horn-section effect. It was not, as Simon says, prized by the community. No one realized the possibilities, that is, until one late night when Keith Richards literally dreamt-up the riff for "(I can't get no) Satisfaction," which would take the Stones to the height of mega stardom and make fuzz the defining characteristic of popular music. When they recorded what he thought was an early version of the song while on tour in California, Richards used Gibson's Maestro as a place holder for a horn section that he wanted to put on the finished track. He was horrified when he learned the band's manager had released what he considered a version in progress. Of course, the song was huge, not only for the Rolling Stones, but for the sonic evolution of the guitar as an avatar of freedom, rebellion, and creativity. The Maestro jumped off the shelves. Everyone had to have one, or one like it.

The history of distortion is a history that challenges conventions, it wasn't planned for and it wasn't by design, rather it was composed of mistakes, errors, accidents, trials and misappropriations, along with a bit of reverse engineering and a touch of late night inspiration.

Simon always says he's the Elvis Costello of the History of Science. I'd add, he's also something of a Jimi Hendrix, a rule-breaking virtuoso who plays left-handed on an upside-down right-handed Fender Strat to quite literally rock our academic world.

# Inside Leviathan (for Simon Schaffer)

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JOAD RAYMOND

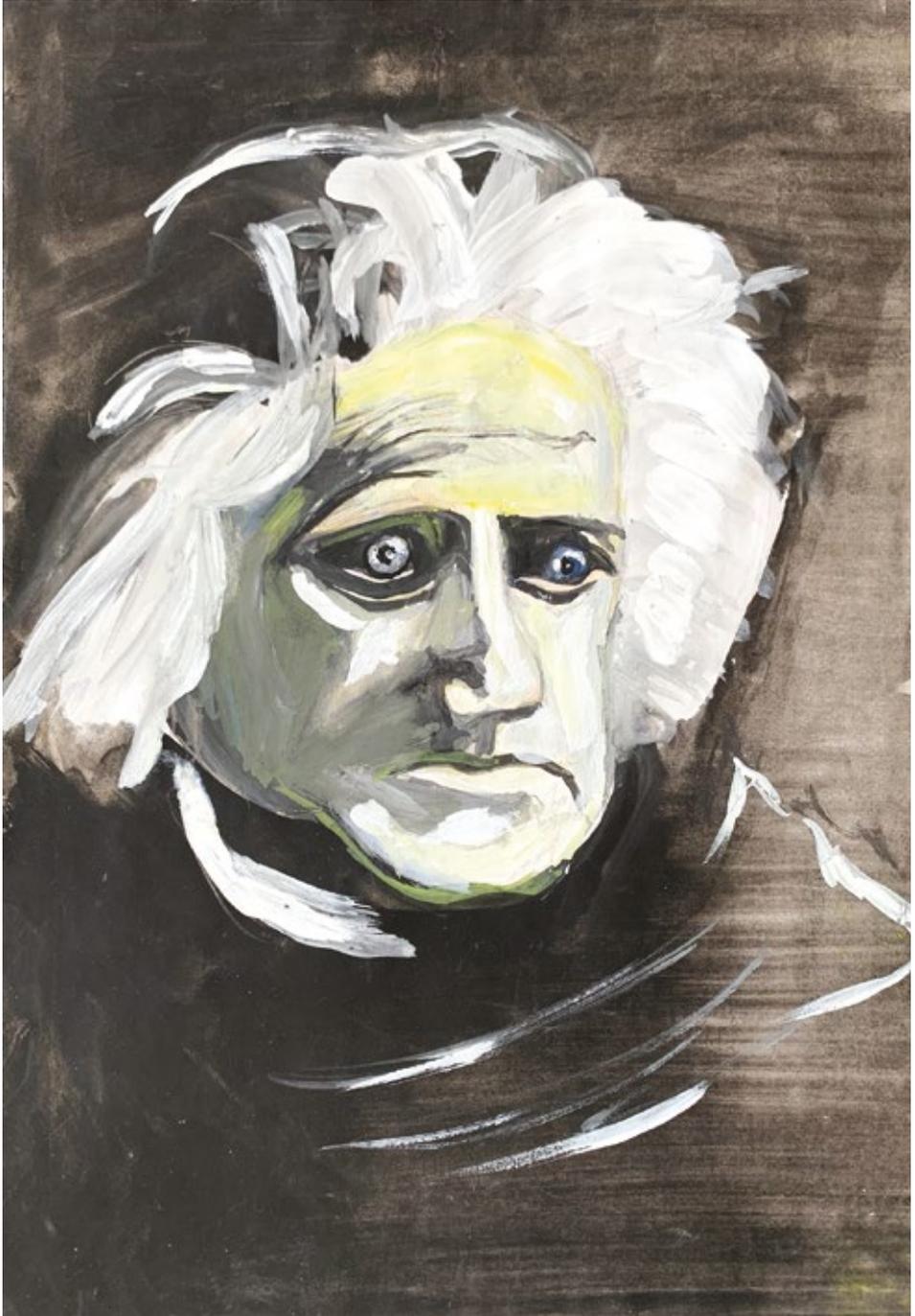


"Inside Leviathan (for Simon Schaffer),"  
by The Unattached, 10m 34s.

For Simon Schaffer, friend, talker and author of a million brilliant things, including *Leviathan and the Air-Pump* (1985). This piece began with a thought about the airlessness inside the artificial body of Hobbes' *Leviathan* (1651). It was improvised and recorded in one take with no edits using a single guitar and a rack of mostly Electro-Harmonix effects.



LIGHT FANTASTIC



William J. Ashworth, *Time to Reflect*.

# Instrumental practice and optical theory in Robert Hooke

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JIM BENNETT

In his own time and in ours, the reputation of Robert Hooke has owed much to his observations with optical instruments, the microscope in particular. He observed also with telescopes and was more engaged with the design and manufacture of telescopes than of microscopes. At the same time, he was an optical theorist and propounded notions about the nature of light that might have seemed astonishing, had anyone been paying attention. These two sides of his work in optics were linked. He used his observations with instruments to support his remarkable theorising. As he presented the story, the observations led logically to his natural philosophy of light, which without them would have seemed, literally, “fantastic.”

This is best illustrated by the lectures on light of c.1680, published by Richard Waller in Hooke’s *Posthumous Works*, where his speculative theorising around generation and transmission drew heuristic support respectively from his experiences with microscopes and telescopes. Microscopy spoke to the generation of the impulses that constituted light, while the telescope illustrated its remarkable propagation. We are familiar with modern-day cosmologists asserting the most extraordinary universal claims; Hooke does the same, at times with more grounding in rational argument.

Admittedly the ambitious theorist must begin somewhere, probably with an arbitrary assertion. Hooke said that light was a motion propagated through a “transparent” medium (i.e. “such a Body as it fit to propagate it”) and pressing on the eye.<sup>1</sup> It was entirely a mechanical vibration transmitted through this medium. Every point of a luminous surface of a shining body propagates light “in orbem” – even when the points themselves are invisibly small – and he supports that notion by reports of viewing a lucid body “by the Help of Microscopes.”<sup>2</sup>

Hooke thinks this propagation occurs in an instant of time, even over many millions of miles – *pace* Roemer – and even if the latter is right, the speed of light is very fast indeed. This great speed or even instantaneity of transmission does not absolve light from obeying the same mechanical laws as gross matter. Light is not a spirit but a body, subject

<sup>1</sup> Robert Hooke, *The Posthumous Works of Robert Hooke*, ed. Richard Waller (London, 1705), 76.

<sup>2</sup> Hooke, *Posthumous Works*, 77.

to the same mechanical laws as any corporeal body and its behaviour is similarly suited to geometrical treatment. The first consequence of this has a familiar ring:

And this appears first, for that its Power or Action is always proportionable to its Expansion; now this Expansion in a free Pellucid Medium, is in a Duplicate Proportion to the Distance it acts reciprocally taken.<sup>3</sup>

Its action, then, is directly analogous to gravitation, and Hooke's formulation here echoes the expression he used in presenting Newton with the problem of planetary motion at around the same time, in a letter of January 1680: "a Duplicate proportion to the Distances Reciprocally taken."

The remarkable implications of Hooke's account of the transmission of light would scarcely have been tenable without the support of "such as may really be discovered by longer and longer Telescopes:"

... it is evident, that Light extends it self to the utmost imaginable Parts; and by the help of Telescopes, we collect the Rays, and make them sensible to the Eye, which are emitted from some of the almost inconceivably remote Objects: And since we find, that still longer and better Telescopes do discover to us smaller and smaller fixt Stars, which in Probability are farther and farther removed from us, and that we cannot set Bounds to the Extent of it; it follows, I say, that the Extension of the Propagation of Light is indefinite, immense, and beyond our reach to conceive, yet nevertheless we see by clear Induction that so it must be, though we do not presently well conceive how.<sup>4</sup>

By combining his experience with the telescope and the microscope, Hooke has the confidence to move from the immensely large to the minutely small. He holds nothing back; the whole spectrum of size, he insists with the help of a dramatic illustration, shares the same mechanical character and behaviour.

Nor is it only the great Body of the Sun, or the vast Bodies of the fixed Stars, that are thus able to disperse their Light through the vast *Expansum* of the Universe: But the smallest Spark of a Lucid Body must do the very same thing [,] even the smallest Globule, struck from a Steel by a Flint, which is as small as the Point of a Pin. For that produces as real Light as the other; and all Light propagating *in Orbem*, that Point must do the same thing with every Point of the Superfices of the Sun.<sup>5</sup>

<sup>3</sup> Hooke, *Posthumous Works*, 79.

<sup>4</sup> Hooke, *Posthumous Works*, 77.

<sup>5</sup> Hooke, *Posthumous Works*, 77.

The microscope allows him to take this train of thought beyond what is visible to the naked eye.

Nor is this to be limited to a Point big enough to be sensible to the naked Eye; for by the Help of Microscopes viewing a Lucid and shining Body, as a burning Cole, or a red hot Iron, or the like; one is able to distinguish Parts that shine 1000 smaller than we can distinguish with the naked Eye, and yet these may be discover'd and are visible, and consequently must radiate *in Orbem*, as the bigger and more sensible Parts: So that hereby we are ascertained by our Sense, that the least sensible Point of [a] Body is able to affect the greatest *Expansum* of Nature.<sup>6</sup>

These are extraordinary conclusions, but Hooke coolly reassures his auditors, “So it appears both to our Sense and our Reason, and therefore we cannot doubt it, but set it down as an undoubted Principle.”<sup>7</sup>

Hooke develops the idea of this transmitted motion having a vibratory character. The transmitted effect is instantaneous, but the action continues for a time – for a moment – as a vibration in the medium:

Now though the Propagation be thus instantaneous, yet the Impression of this Motion on the Medium is Momentary, and though it be never so short a Motion, and never so quick, yet it must be temporary; for if the moving Luminous Body does move, or remove the Medium before it; it must remove it some space, and that Space cannot be passed without some time ...<sup>8</sup>

Experience with the microscope is cited in support of Hooke's account of the emission of light. The microscope could not reach the tiny areas it probes, were it not that a sensible amount of light is emitted by the smallest observable space, which the microscopist registers in spite of the inverse-square proportionality of its intensity with distance. Here the microscope is used not for revealing the micro-structure of bodies, but for detecting the smallness of the emitting mechanism of light itself.

Now we are sensibly informed by the Microscope, that the least visible Space (which is that which appears under an Angle of half a Minute of a Degree) may be actually distinguished into a thousand sensible Spaces: And could we yet further improve Microscopes, 'tis probable we might distinguish even a thousand more Spaces in every one of those we can now see with the help of those Microscopes we have al-

<sup>6</sup> Hooke, *Posthumous Works*, 77.

<sup>7</sup> Hooke, *Posthumous Works*, 77.

<sup>8</sup> Hooke, *Posthumous Works*, 130.

ready. Now possibly a less Space than the least of these may be enough for a Body to be dislocated in the Motion that is necessary to produce the Propagation of a Ray of Light.<sup>9</sup>

So the experience of working with the microscope, combined with Hooke's empirical determination of the resolving power of the naked eye, supports his conceptualisation of the action of his material and mechanical notion of light. A "space" must accommodate a dislocation for the propagation of a pressure through the transparent medium. The unaided eye can detect such a space of the size of half a minute. With the microscope a thousand spaces within this one contain sensible dislocation, that is, are "seen." We can readily imagine that with a better microscope, a thousand even smaller spaces will be seen, each originating the transmitted motion that is light.

Hooke goes further by combining this reasoning with his experience of examining the eyes of insects with the microscope. When our eyes have reached the limit of their acuity, we can consider the implications of eyes possessed by other species:

... we may argue yet farther from the Curiosity and Make of their Sight; for we plainly enough see, that the smaller the Eye is, the smaller is the Picture of the visible Object that is made at the bottom of it upon the *Chorooides* or *Tunica Retina* ... how small will be the Picture of the Object that is painted at the bottom of one of those Eyes which by a Microscope we discover in the Cluster of the Eyes of Flies, and other small Insects?<sup>10</sup>

The existence of eyes attuned to such tiny "spaces" is further evidence of the smallness of light-generating dislocation. Hooke's instruments not only reveal the invisibly small and the invisibly distant: they justify his nomination of light as "the most operative and most considerable Ingredient of the Universe."<sup>11</sup>

<sup>9</sup> Hooke, *Posthumous Works*, 134–35.

<sup>10</sup> Hooke, *Posthumous Works*, 135.

<sup>11</sup> Hooke, *Posthumous Works*, 90.

# Ibn al-Haytham and Hevelius’ *Selenographia*

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NADER EL-BIZRI

The engraving here is the frontispiece of the *Selenographia sive Lunae descriptio* of the Polish astronomer Johannes Hevelius (1611–1687 CE), which is a treatise on the moon and the description of its topography that was printed in 1647 CE in Gdańsk (*Autoris sumtibus, typis Hünefeldianis*) during the era of the commonwealth of the Kingdom of Poland and the Grand Duchy of Lithuania, and contained Hevelius’ observations from the observatory at his home, as helped in this endeavour by his wife Elisabetha Catherina Koomann-Hevelius (1647–1693 CE).

The *Selenographia* frontispiece depicts two foundational figures of this scientific discipline. To the right side, Galileo Galilei (1564–1642 CE) stands on the pedestal of “*sensu*” (“with sense”) while carrying a telescope, in recognition of his contributions to selenography by way of visual observation as aided by an optical instrument. On the left-side we see an artist’s impression of the eleventh-century Arab polymath (optician, astronomer, geometer, architect) al-Hasan Ibn al-Haytham (known in Latin as “Alhazen,” or “Alhasen;” born in Abbasid/Buyid Basra ca. 965 CE/AH 354, and died in Fatimid Cairo ca. 1040 CE /AH 430). Ibn al-Haytham (“Alhasen”) stands therein on the pedestal of “*ratione*” (“with reason”) while holding a compass and a geometrical diagram in acknowledgement of his contributions to the mathematical underpinnings of selenography. Hevelius presents herein his own empirical method as aided by scientific instruments and guided by mathematical reasoning. He paid homage in this not only to a contemporaneous illustrious figure from the European culture and its Christian milieu, such as Galileo, but he also displayed his indebtedness to Ibn al-Haytham as one of the pre-moderns, while crossing as such the historical, cultural, ethnic, and religious divides in recognizing the scientific legacy of an eleventh-century Muslim Arab polymath in Europe. The printing of the *Selenographia* took place in an era of conflict between the Polish–Lithuanian commonwealth and the Ottoman Empire that was also at war with Venice during the end of the reign of Sultan Ibrahim (1615–1648 CE). This publication unfolded at a turn in Hevelius’ own career, not only as a scholar and a beer-brewing guild merchant, but in how he was readying himself to a political life that resulted in his election later as councillor and mayor of Gdansk in 1651 CE. The wider intellectual interests in the Arabic sciences during this epoch were already being institutionalized in Europe, and not simply in expression of their adaptive assimilation in the High Middle Ages and



FIGURE 1. • Frontispiece to Johannes Hevelius, *Selenographia sive Lunae descriptio* (Gdańsk: Autoris sumptibus, typis Hünefeldianis, 1647).

the Italian Renaissance, but more visibly in the context of establishing early-modern Arabic chairs at universities; such as the Sir Thomas Adams's chair in Cambridge in 1632 CE and the Laudian chair at Oxford in 1636 CE.

Hevelius praises "Alhasen" in the "Prolegomena" of the *Selenographia* as being one of the most experienced and highly discerning amongst the mathematicians and opticians, with an emphasis on his legacy in studying the refraction of physical light in dioptrics. Like many of his European contemporaries and predecessors in scholarship, Hevelius had access to the legacy in dioptrics of Ibn al-Haytham through the printing of the Latin translation of the latter's *Kitāb al-manāzīr* (*Book of Optics*) in Basel in 1572 CE (*Per Episcopios*). This edition carried the title: *Opticae thesaurus, Alhazeni Arabis libri septem*, and it was established under the editorship of the German mathematician Friedrich Risner (1533–1580 CE), as backed at the Collège Royale de France by Petrus Ramus (1515–1572 CE), with a dedication in its *Praefatio* to the patronage it received from Caterina de' Medici (1519–1589 CE) during the Gallic sovereignty of her son Charles Maximilien IX (1550–1574 CE). The printing of this opus happened at a time of strife in the year of the *Massacre de la Saint-Barthélemy* against the Huguenots under Charles' reign, and a few months after the naval battle with the Ottomans in Lepanto of allied European fleets under the suzerainty of the *Stato Pontificio* of Pope Pius V (1504–1572 CE).

Publishing treatises in the classical Arabic language rather than in Latin translation became instituted from 1584 CE through the Oriental *Typographia Medicea* under the directorship of Giovanni Battista Raimondi (1540–1614 CE) and the patronage of the Grand Duke of Tuscany Ferdinando I de' Medici (1549–1609 CE). This corresponded with founding the *Pontificio Collegio Maroniti* in Rome in 1584 CE, and the role of Cardinal Antonio Carafa (1538–1591 CE) as chief librarian of the *Bibliotheca Apostolica Vaticana* in acquiring Arabic manuscripts and making translations from Latin into Arabic with contributions from the exiled Syriac orthodox Levantine patriarch of Antioch, Ignatius Ni'mat'Allāh (1515–1587 CE). The purposes of such endeavours were motivated by the longstanding interest in the transmission of Arabic *cum* Islamicate learning to Europe, as well as producing proselytizing Catholic scriptural sources in Arabic to be used by missionaries in their interactions with Levantine-Arab Ottoman subjects.

The Arabic treatise of the seven divisions of Ibn al-Haytham's *Kitāb al-manāzīr* (*Book of Optics*) was composed in Cairo, and most likely in the period when he gradually resurfaced from his confinement and his feigning of madness, which came after the death of his patron the Fatimid Caliph-Imam al-Ḥākim bi-Amr Allāh (985–1021 CE). Ibn al-Haytham deconstructed the Aristotelian theory of vision, and deployed the geometrical modelling of the Euclidean-Ptolemaic emission doctrine into a novel intromission theory that rested on his isomorphic composition of mathematics with physics in the context of experimental controlled testing and verification. The Arabic manuscripts of his *Kitāb al-manāzīr* reached Andalusia, Sicily, Byzantium, Persia, and it was eventually translated into Latin in the twelfth-century in Toledo in the Kingdom of Castile within the circle of Gerard of Cremona (1114–1187 CE), with manuscript versions of it being subsequently disseminated under the titles: *Perspectiva*, *De aspectibus*, and *Opticae*. The

Latinate wider interest in studying Arabic sources gained an earlier momentum after the *reconquista* of Toledo (Ṭulayṭula under Arab-Muslim Andalusian rule) in 1085 CE by the King of León and Castile, Alfonso VI (1041–1109 CE). The Latin transmission of Ibn al-Haytham's *Optics* impacted the *Opus maius* of Roger Bacon (1219–1292 CE) under the patronage of Pope Clement IV (1190–1268 CE) in a scholastic milieu that was also impacted by Avicennism and Averroism. The *Optics* influenced also the Polish Franciscan scholar Vitello (Erazmus Witelo; 1230–1280 CE) and the *Perspectiva Communis* of Archbishop John Peckham (1230–1292 CE), while impacting as well the meteorological investigations of the German Dominican friar Theodoric of Freiberg (1250–1311 CE), and the *Questiones super perspectiva communi* of the Italian natural philosopher Biagio Pelacani da Parma (1350–1416 CE). This *perspectiva* legacy inspired the Renaissance pictorial and architectural arts, such as the *Della Pittura* of the Florentine architect Leon Battista Alberti (1404–1472 CE) and the *Commentario terzo* of the architect Lorenzo Ghiberti (1378–1455 CE). Its impact reached later the Belgian architect François d'Aguilón at the Jesuit mathematical school in Antwerp (1567–1617 CE) and his *Opticorum libri sex*, which was illustrated by the vignettes of the Baroque Flemish painter Sir Peter Paul Rubens in depicting experiments and anatomical studies that resonated with Books I–III of Ibn al-Haytham's *Optics*. This lineage was furthermore influential in developing the rudiments of projective geometry by the French architect Girard Desargues (1591–1661 CE).

Hevelius recognized the merits of Ibn al-Haytham's dioptrics, especially in terms of its applications in astronomy, meteorology, and selenography, which rested on the investigations in Book VII of the *Optics* of the refraction of physical light via the geometrical modelling of sections of the cone, the cylinder, and the sphere as convex and concave lenses. This was also supported by experimental installations that assisted in the examination of the propagation of physical light as it passed through diaphanous media that were not isotropic. Ibn al-Haytham focused also on catoptrics in Books IV–VI of his *Optics* by studying the mechanics of the reflection of physical light while using conical, cylindrical, and spherical sections as mirrors. His consideration of the moon in the *Optics* was complemented by separate epistles on moonlight, lunar eclipses, and the trace on the face of the moon, along with his treatises of *Doubts* concerning Ptolemy's *Almagest* and *Hypotheses*. The explication of the moon illusion figured in Propositions 19–21 of Chapter 7 of Book VII of his *Optics*, wherein he investigated the visual misinterpretations that arise due to the refraction of physical light, and the consideration in this regard of the minimal secondary optical impact of thick vapours on the appearance of celestial bodies. He ultimately argued that the moon illusion results from a psychological phenomenon of the speculative discernment of its apparent size when it is compared with the visible clues of foreground earthly objects at the horizon, as opposed to how such visual references are absent when looking at the middle of the sky. While Ibn al-Haytham's interest in the moon was linked to the inner technicalities of his studies in optics, astronomy, and selenography, this was *grosso modo* embedded within the wider Muslim endeavour to establish precise lunar calendars and accurate demarcations of the Hajj to Mecca and fasting in Ramadan.

# Translating Schaffer

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JUAN PIMENTEL

It was thanks to the support of Simon Schaffer, already an eminence in the history of science at the time, that I was invited as a Visiting Scholar to the Department of the History and Philosophy of Science (HPS) of the University of Cambridge between 1994 and 1996. I had just completed my doctoral thesis in the Universidad Complutense of Madrid. Since then I have constantly maintained contact with him, especially when it came to asking him by e-mail about some doubt or for bibliographical recommendations on any topic. Simon always replies, always has something interesting or enlightening to say, and always takes the time for his ex-students (one of whom I count myself, at least informally).

Those years in Cambridge were extraordinary. The educational team constituted by the HPS and the Eagle (the pub par excellence) was a privileged academic space where I had the good fortune to learn a lot and to meet Dan Brown, Michael Wintroub, H el ene Mialet, Xavi Roqu e, Henry Atmore, Serafina Cuomo, Silvia de Renzi, Brian Dolan, Otto Sibum, William Ashworth, Richard Staley, Michael Bravo and many other marvellous people. I also got to know John Crawford while playing pool. Years later he renovated the new home of Simon, Anita and Eva. In a job like ours, it is impossible to separate the professional from the personal, because the professional pervades everything and the personal lies behind the pages we read and write. This may not be a very British point of view, but it is true.

Simon called me some time later to take part in a project that ended with the publication of the book *The Brokered World: Go-Betweens and Global Intelligence, 1770–1829* (Sagamore Beach: Science History Publications, 2009). It was an enriching experience to share an intellectual project with historians like James Delbourgo, Kapil Raj, Neil Safier and Lissa Roberts. They asked me to write about a go-between in the Iberian world – a simple enough task given the length of the list of interpreters, go-betweens, prisoners, Creoles, Muslims, Jews and matchmakers who populate the history of the Iberian world. My chapter was about the fossil remains of an extinct quadruped, the Megatherium, and the Creole gentleman who founded the Royal Cabinet of Natural History in Madrid in 1776, Franco D avila. This meant focusing on a region of the world that is usually under-represented by North European scholars. The Cambridge years had already taught me how little they knew about the Iberian world. For the English, the South of Europe is

generally limited to Italy. Last year the University of London closed down the Institute of Latin American Studies. Maybe Brexit has exacerbated this lack of interest.

All the same, Simon always showed me his curiosity about a cultural context that was foreign to him and about which, as a good intellectual, he wanted to learn. Two anecdotes from those years illustrate this. The first was when Simon visited Mexico for the first time. I think it was in 1995 and that he had been invited by a friend we have in common, Carlos López Beltrán. Before the flight I made a small dossier of themes, persons and a bibliography on the history of Latin American science. Once he had arrived, Simon sent me a postcard with a newspaper clipping signed by sub-commander Marcos (a Zapatist leader) on light and Newton's crucial experiment. It was a very intelligent article on a theme very close to Simon, the vicissitudes of scientific instruments and evidence. How he managed to translate or decipher that article written in a beautiful and convoluted Spanish has always been a mystery to me, although I suspect that Carlos had to help him.

The second anecdote goes back to a course he was teaching. Besides attending the seminars, now and then I used to join his classes. Listening to Schaffer was and still is a source of inspiration and genuine entertainment. As we all know, he is as good an actor as a teacher. It so happens that on that day he was talking about tacit knowledge. To illustrate, he handed out to his students "Instructions for Climbing a Staircase," a short text I knew well by the Argentinean writer Julio Cortázar. The number of movements that we carry out unawares when it comes to climbing a single step explained tacit knowledge more graphically than Polanyi and the whole sociology of science.

But apart from bringing the Iberian world minimally to Simon Schaffer, what I am most proud of is the opposite: to have translated Schaffer into Spanish, which I did during the years of preparing *Trabajos de cristal. Ensayos sobre historia de la Ciencia, 1650–1900* (Madrid: Marcial Pons, 2011). At first I thought of *Leviathan and the Air-Pump*, but another friend and an Argentinean publisher had beaten me to it. The classic by Shapin and Schaffer had been translated into Spanish by Alfonso Buch and published by the University of Quilmes in 2005. That was when I decided on a translation of some of his articles and contributions to volumes. I discussed it with Simon, we selected a representative range, and I chose one of the best Spanish translators, Miguel Martínez Lage, who won the national translation award with his edition of James Boswell's classic *Life of Samuel Johnson* (Barcelona: El Acantilado, 2007). Regrettably, Miguel died before completing the translation of *Trabajos de cristal*, so I took on the task of finishing the job. My knowledge of English was not as good as his, but I was more familiar with the themes and jargon of the history of science.

The articles collected in *Trabajos de cristal* range from some prodigious transfusions of animal blood in Restoration England to the physical ideas and commercial interests behind the market in soap dispensers in the Victorian era. It also includes such fascinating episodes as the strange social life of astronomical instruments in China and the Pacific during the Enlightenment, the secret of the robot chess player, or the contingencies of the crucial experiment of Newtonian optics. The evocative title "Glass Works" provided us with the title of the volume, *Trabajos de cristal*. We wanted to cover the transparency

and visualisation of facts, but at the same time its contingent character, the fragility on which the edifice of knowledge is constructed. In those nine chapters Schaffer closely analyses the artisanal and the mundane in scientific operations, inquires about their multiple meanings, and traces the exchanges with other cultural forms. His inquisitive gaze scrutinises what goes on both inside and outside the laboratory, always ready to problematise the trivial, simplify the complex, not take anything for granted, and especially not what seems evident.

Translating him was no sinecure. His plays on words, jokes, implicit references to the innumerable works he has read, are not easy to translate. Still, it was a very rewarding task, because translating someone means getting inside their head, savouring in slow motion each phrase, exploring their arguments and “literary technologies.” To state that Simon Schaffer is a unique historian is to state the obvious, but I think it correct to add that he has always been a generous teacher, ready to share his knowledge and contagious energy.

Seen in a positive light, to translate some of his articles was the best option, because perhaps the best of his work is short. Schaffer writes short stories, not novels, far from redundant

prolixity and interminable beating about the bush. It was Cortázar who said that while the

novel progressively heaped its effects on the reader, the short story is “incisive, caustic, giving no quarter right from the opening sentences.” Perhaps the Argentinean writer had someone like Simon in mind when he added that the good short story writer behaves like a very skillful boxer. The first blows might appear rather ineffective, but they were already wearing down “the most solid resistances of the opponent.” Since time is not on his side, having recourse to this type of boxer/writer consists of “working in depth, vertically, either upward or downward from the literary space.” If the novel wins on points, the short story does it with a knock-out. Simon was always like that, you never make it to the third round.

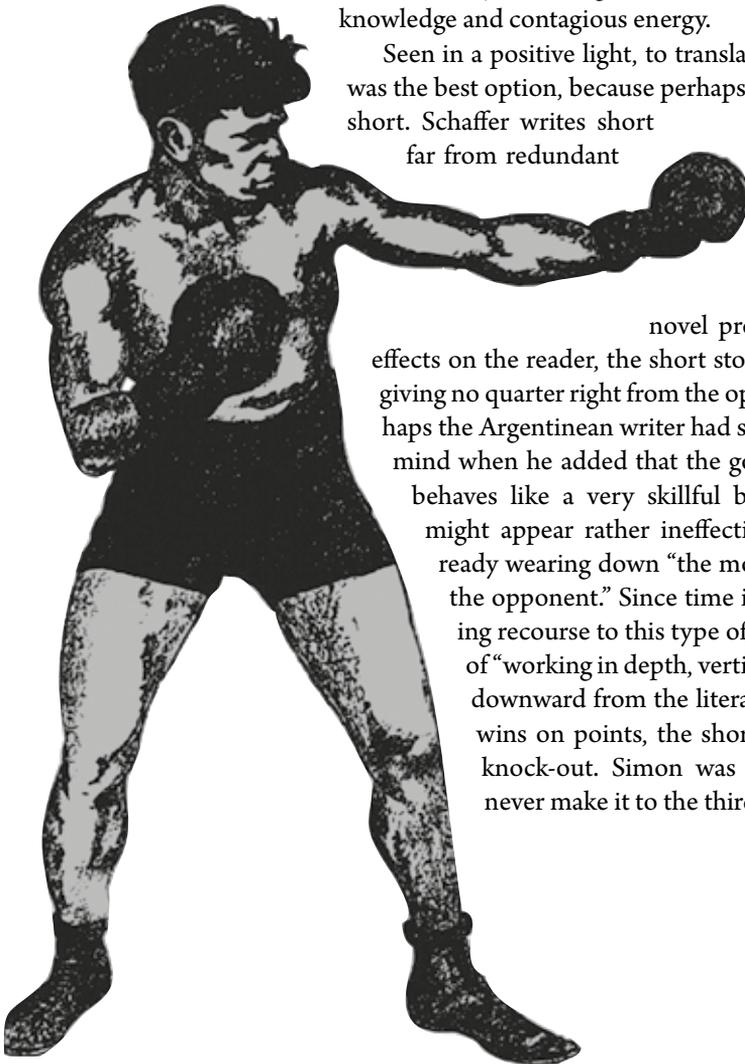


FIGURE 1. • Simon, the very skillful boxer.

# A poem for Simon Schaffer from Star Waka by Robert Sullivan (Auckland/Aotearoa 1999)

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## MAIA (JESSOP) NUKU

### WAKA 16

Beloved  
sent to Hawaiki  
to become a star  
who guides  
dreamers to reality

to become a star  
portrait on the cloak  
of a night on whose  
shoulders rest  
dreams

of a restless people  
who dream white  
waves of currency  
waka rides  
and falls

black and blue  
with only stars  
to point away since  
sun and moon  
are tagged for domination

yet stars are  
ancestors  
they are stars  
our ancestors ...  
and we will be stars

like kauri  
totara  
kahikatea  
rimu  
awa

tapped for fire  
sapped for gum  
used for battle  
construction materials  
veins into dams

where the power  
of the land powers  
a mechanical culture  
strange ships in the sky  
air filled with radiation

we are vacuumed into this  
culture of menace to the land  
we are told we would do this  
too, if we had the technology  
and our people do it

to the land for people  
by people and this land  
joins the congress of scars  
on the planet a culture  
of urban decay and renewal

a culture of dead capitals  
sucking the life out of new cities  
a culture that knows  
no boundaries has only  
prophecies called strategies

and stars look down on this  
and eyes of divinities  
look down on stars  
and eyes  
of the powerless look up

but only at night  
when machines  
lighten blackness  
when many stars  
are lost in the lightning

except in the papakainga  
from tops of pa  
from middle of ocean  
from these places stars  
meant to be seen can be

[end]

Thanks for your energy, wit and all the fantastic 18<sup>th</sup>-century collaborations in Cambridge thinking about the rich synergies between Polynesian art and scientific instruments.

I hope the poem can remind you of the amazing canopy of stars glimpsed from all your trips to the Pacific with Anita and Eva, including but not limited to a Pacific Arts Association (PAA) conference in Rarotonga, 2010 where our paths all coincided.

Ka pai

# The Inquisitive Giant

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JON AGAR

When I arrived, in 1991, to start a PhD at the University of Kent at Canterbury, I knew a lot of mathematics but very little history of science. Perhaps even then I had come under Simon's influence. During my final year as a student at Cambridge, I had studiously absorbed the gravitational tensors of black holes and the nonlinear fluid dynamics of the Part III tripos, but what I had most enjoyed was the boozy, brilliant informal university, and especially the college bar arguments with the HPS students. I was on the side, then, of science as the rational, disinterested, single-method, ahistorical, objective view from nowhere. And I was quite upset that it was the losing side.

My proposal was to study the challenge of the steady state cosmology to the big bang, and since one of the few HPS books I had read at this point was Kuhn's *Structure*, I thought of these as rival paradigms. But the project petered out fairly soon. What I needed was an archive, and, thanks to a tip off from Sally Horrocks, I heard that Bernard Lovell was passing thousands of Jodrell Bank files to the John Rylands Library at Manchester. In short order I was helping catalogue the piles of primary sources, and I had a new topic – radio astronomy – if not yet a project or an argument.

If you turn from the narrow rigours and abstractions of mathematics to history of science then you find yourself in the vast fields of the humanities, spiced by the social studies of knowledge. I don't think I have ever read faster or further so quickly or with such excitement. I knew I had a topic that mixed science, politics and culture, and I knew I had access to as rich an archive of a modern scientific organization that I could have hoped for. Lovell had kept nearly every document. If I wanted the film of radio echoes from newly discovered daytime meteor showers from 1948, it was there. If I wanted to know what was eaten in the canteen on Mayday 1954, it was there too. And the centrepiece of Jodrell Bank, the construction and operation of the first, large, steerable radio telescope, was documented in detail, in all its troubles and achievements. But what I did not have was a way to think about my topic.

I can't remember who the go-between was. (Was it Ben Marsden? Or Graeme Gooday? Or Crosbie Smith?) But sometime in 1992 I was at my desk – six of us, in a room the size of a branch-line waiting room – and I had in front of me a poorly photocopied samizdat-like draft of "The Leviathan of Parsonstown: literary technology and scientific representation." I no longer possess it, but I do still have seven pages of neatly-



FIGURE 1. • “Rosse telescope,” image 56 in the storyboard for *The Inquisitive Giant*, ink drawing, 1955. Jodrell Bank Archive at John Rylands Library, University of Manchester. JBA CS7/39/4.

written (for me) notes. This was Simon’s paper on the instabilities of meanings of nebulae and telescopes from William Herschel to Lord Rosse, circulating in the wild, and subsequently published in the edited collection *Inscribing Science* in 1998.<sup>1</sup> Re-reading my notes now, I am struck not only by its variants of core Schaffer argumentation, but also by how much it must have influenced my own analysis. Simon told us how literary and visual technologies helped fashion authoritative bearers of telescopic knowledge, while the social process of making facts was elided; that telescopes were assemblages of systems, each of which could be fragile or controversial; that authority might be contested (such as between Rosse and his onsite adjutant Robinson); that interpretations of the heavens could serve terrestrial purposes; that visitors might be encouraged (but kept at a distance and controlled); and that a big telescope, like the Leviathan, could not only have contested meanings but also that they could only be understood when they were placed within political and cultural currents of the day.

Reading the draft “Leviathan of Parsonstown” gave me ways to think and questions to ask. Jodrell Bank, as a place, as a socio-technical organization, as a site of making knowledge and making authoritative astronomers, began to make sense. I tracked the tussles

<sup>1</sup> Simon Schaffer, “The Leviathan of Parsonstown: Literary Technology and Scientific Reputation,” in *Inscribing Science: Scientific Texts and the Materiality of Communication*, ed. Tim Lenoir (Stanford: Stanford University Press, 1998), 182–222.

between lead astronomer and consulting engineer – who would gain credit, who would be identified with a telescope of unprecedented scale and form? I noticed the control and filtering of visitors. I noticed that representative practices (in radio astronomy, pen charts of radio signal strength) were key, contested, and linked in turn to social questions of who was in, who was out, who could speak authoritatively, and who could not. The context might have changed from the Victorian period to the Cold War, from Ireland to Cheshire, but it was still helpful to ask if the Jodrell Bank 240-foot radio telescope – now, wonderfully, the “Lovell Telescope” – was another Leviathan of sorts. The thesis now had an argument, and I think Simon agreed – he was the external examiner for it in 1994.

In 1952, with the heavy construction of the one-thousand-ton steel instrument underway, Lovell suggested that a visual technology should be deployed. Specifically, a film would document the construction, engage (and manage) public interest, and, stirringly presented, would help justify (and stabilize) an already immensely expensive scientific project. The Department of Scientific and Industrial Research thought the telescope had “great potential as a much-needed symbol of national prestige,” would help gain engineering contracts overseas, and altogether be a “great public spectacle.” The Foreign Office found the £10,000 needed. Shell’s Film Unit – then at the top of its game of science documentaries – turned down the project, stating that the telescope had no connection with petroleum projects. Tarrred by no brush, the government’s own Central Office of Information took it on. The COI in turn contracted Anvil Films of Beaconsfield.

The negotiations over this visual technology – the careful scrutiny of script, the narrative formation of the storyboard, and the messages selected for presentation – show us that these textual and visual practices were just as fraught and vital in 1950s Britain as for 1840s Ireland. It was intensely nationalistic. The “film should leave the audience feeling,” said Anvil Films, “that Britain has shown courage, great imagination, and well justified faith in her own scientists and engineers in devoting at this time so much material, labour, and skill to the furtherance of scientific research.” It made sure the astronomer, and not the consulting engineer, had most credit, while making their relationship appear close and harmonious: the telescope was to be “a tribute to the mind and spirit of Man himself,” “man in two complementary types ... the scientist, the seeker, the dreamer of dreams, the thirster after knowledge ... and his essential partner, the practical engineer.” (Even as the film was being released, in 1957, audit committees were sniffing around the budgetary overruns that suggested a more troubled division of responsibilities.) And it televised virtual witnessing: a meeting of the Royal Astronomical Society was restaged – albeit in a different city and in a more impressive room –, applauding their assent to this new direction of astronomy.

The Leviathan of Parsonstown appears in *The Inquisitive Giant*, as the film was named.<sup>2</sup> It has its place in a sequence of images that Anvil Films thought would tell of humanity’s “perennial fascination with the heavens.” The sequence did more besides. Starting with

<sup>2</sup> *The Inquisitive Giant* (1957, Anvil Films for COI, directed Marcus Dods, script by James Cameron, music composed by Peter Racine Fricker).

the sun rising over Stonehenge, the viewer sees in rapid succession Hipparchus standing by the Sphinx in Egypt, a page of the *Almagest*, Copernicus, Tycho Brahe, Hans Lipperhey's workshop (glassworks!), and then a sequence of telescopes through Galileo, Newton, Herschel, Lord Rosse's *Leviathan*, over the Atlantic to Mount Wilson and Mount Palomar, until, from the embers of war, radio astronomy and Jodrell Bank were forged. It's a sequence that connects the *Leviathan* of Parsonstown to Jodrell Bank. But it is also a sequence that served to frame the Jodrell Bank telescope as the "great national spectacle," nationalistically returning astronomy to Britain after American leadership. It also effectively erases astronomy from other parts of the world, save the "ancient beginnings" signaled by Hipparchus and Ptolemy.

The ink wash drawing of the *Leviathan* of Parsonstown from the storyboard for *The Inquisitive Giant* (1957, Anvil Films for COI, directed Marcus Dods, script by James Cameron, music composed by Peter Racine Fricker) can be seen in Figure 1. As a small, symbolic restorative I have inked an extra, missing storyboard image, the great observatory at Benares, seen in Figure 2, inspired by Simon's paper in *The Brokered World*. It can be inserted into the sequence wherever it would be most disruptive.



FIGURE 2. • Jai Singh's observatory at Benares, ink drawing in the 1950s style of the storyboard for *The Inquisitive Giant*, by the author.

# “Blurred and indistinct:” Robert Paul and the challenges of early film exhibition

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RICHARD DUNN

This piece takes inspiration from two ideas in Simon Schaffer’s work to consider the realities of film exhibition in its nascent period: that we learn much when things go wrong; and that we should attend to where exactly technologies are used.<sup>1</sup> Focusing on the brief run of Robert W. Paul’s Theatrograph at a Whitechapel music hall in 1896, the following explores the precarious nature of the projected moving image in its earliest incarnations, in particular its sensitivity to the spaces in which it was viewed.

The commercial exhibition of “animated photography” in London began in earnest in 1896. After a demonstration at Marlborough Hall on 20 February and the next day at the Polytechnic, Regent’s Park, shows with the Lumière Cinématographe began at the Empire Theatre of Varieties, Leicester Square on 9 March. Also on 20 February, London electrical instrument maker Robert W. Paul demonstrated his Theatrograph at Finsbury Technical College, then at the Royal Institution eight days later.<sup>2</sup> The later performance led to an invitation to exhibit in the Palmarium, an entertainment annex within Olympia, Earl’s Court.<sup>3</sup> By the end of April, the Theatrograph had appeared in at least five more London venues: the Egyptian Hall, Piccadilly; the Alhambra Theatre of Varieties, Leicester Square (where it was renamed the Animatograph); the Canterbury Theatre of Varieties, Westminster Bridge Road; the Paragon Theatre of Varieties, Mile End Road; and Wonderland, Whitechapel. While most of these initiated long runs, that at Wonderland lasted just three weeks, an apparent failure that this piece explores.<sup>4</sup>

Built on the site of a former theatre next to St Mary’s Station (on the District and Metropolitan Railways), Wonderland was proposed as “a museum and popular exhibi-

<sup>1</sup> Simon Schaffer, “Easily Cracked: Scientific Instruments in States of Disrepair,” *Isis* 102 (2011): 706–17; Simon Schaffer, “Transport Phenomena: Space and Visibility in Victorian Physics,” *Early Popular Visual Culture* 10, no. 1 (2012): 74.

<sup>2</sup> John Barnes, *The Beginnings of the Cinema in England 1894–1901. Volume 1: 1894–1896* (Exeter: University of Exeter Press, 1998), 42–3; Deac Rossell, “A Chronology of Cinema, 1889–1896,” *Film History*, 7 (1995), 142–4; Schaffer, “Transport Phenomena,” 72–4.

<sup>3</sup> Robert W. Paul, “Kinematographic Experiences,” *Journal of the Society of Motion Picture Engineers* 27 (1936): 501; R. Brown, “England’s First Cinema,” *The British Journal of Photography* 124 (1977): 520; Christie, *Robert Paul*, 53–4.

<sup>4</sup> Barnes, *The Beginnings of the Cinema*, 46–7; Christie, *Robert Paul*, 50–61.

tion, conducted as nearly as possible on the lines of a polytechnic and bazaar.”<sup>5</sup> After formal consultation with the London County Council and adaptations, the approved plan was for a venue with a large stage, seating for 200 and an open area or promenade. Promotional copy began appearing in the London press by the end of March 1896 ahead of its opening on Easter Monday, 6 April. Bringing together “the advantages of an agreeable lounge and an interesting promenade, where light refreshment may be obtained and smoking indulged in,” Wonderland was said to have one of London’s widest stages, with three proscenium openings, the central one offering variety and sketch entertainments, with those on either side for “exhibitions of illusions and cosmoramic views.” Behind the seating was “practically one vast promenade” for attractions, including “freaks,” natural curiosities and stalls showing manufactures and industries.<sup>6</sup> Audiences were promised attractions that would “surpass anything ever attempted in England,” prominent among them Paul’s Theatrograph, “the Greatest Wonder of the Age ... Life Size Living Pictures that do Everything but Talk.”<sup>7</sup>

What Wonderland offered was fairly typical, a fixed programme with film one among many acts. At

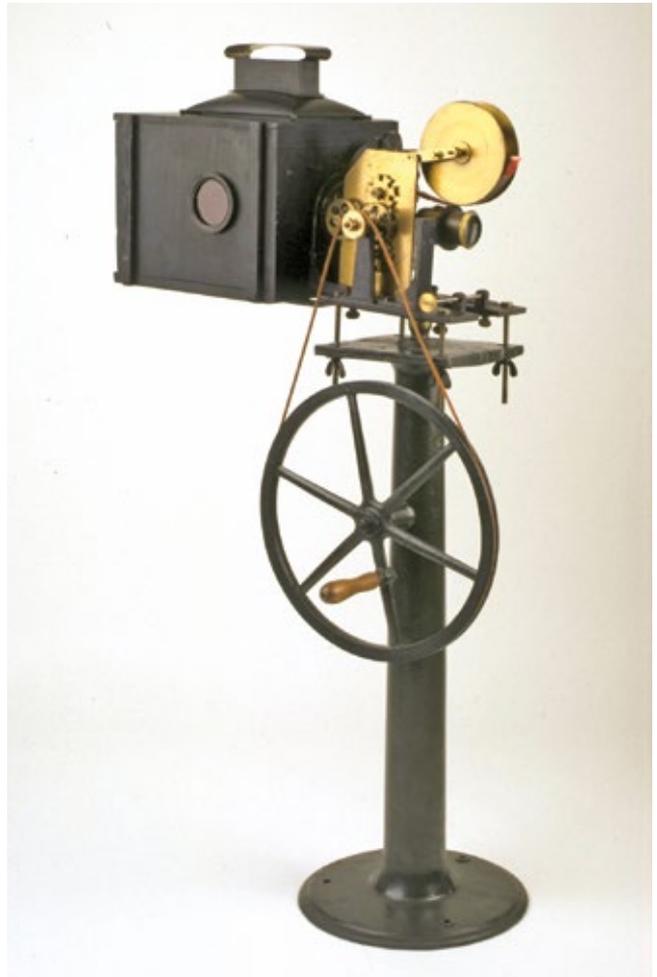


FIGURE 1. • Robert Paul’s Theatrograph projector no. 2 mark 1, patented in March 1896 (Science Museum Group Collection 1913-549).

<sup>5</sup> London County Council, “Theatres and Music Halls Committee – Presented Papers: West Norwood Public Hall: Whitechapel Baths, Windsor Castle Music Hall (Woolwich); Wonderland; Wyndham’s Theatre,” 1889–1910, London Metropolitan Archives LCC/MIN/10924.

<sup>6</sup> “A New Enterprise in the East-End,” *The Illustrated Police News*, 28 March 1896: 2.

<sup>7</sup> Wonderland playbill, week beginning 6 April 1896, Wellcome Collection EPH+34:46 (see Fig. 3); see also “Public Amusements,” *Lloyd’s Weekly Newspaper*, 29 March 1896: 10.

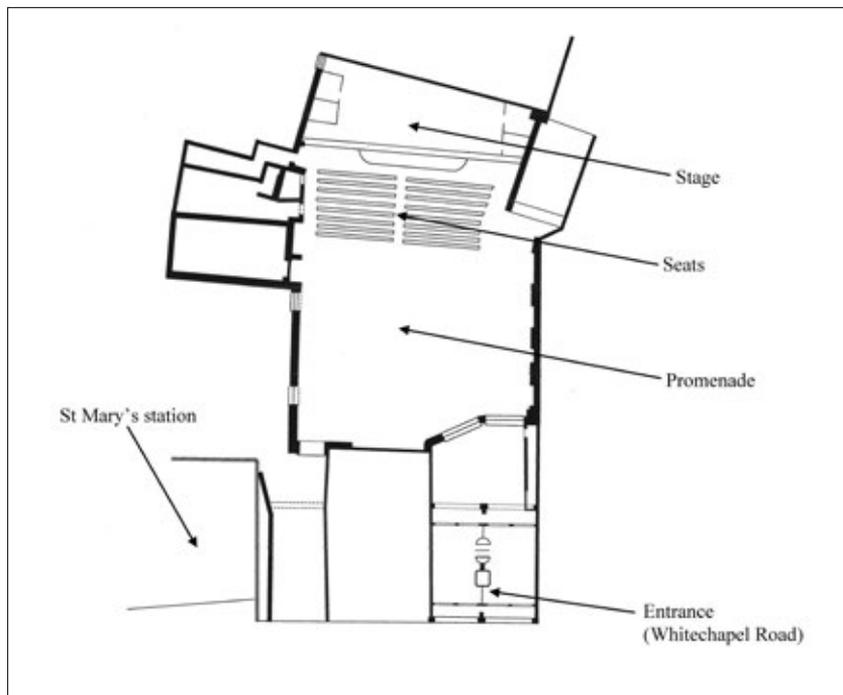


FIGURE 2. • Plan of Wonderland music hall (drawn from the approved architect's plan, January 1896, London Metropolitan Archives GLC/AR/BR/19/0574).

the Paragon in Mile End, a seated venue with a stage, animated photography appeared in a programme of sketches, comic songs, acrobats, a tumbler and an impersonator.<sup>8</sup> At Maskelyne and Cooke's "Home of Mystery" at the Egyptian Hall, Piccadilly, Nevil Maskelyne himself narrated the Theatrograph's development and films of real life and performances by celebrated artistes.<sup>9</sup> By contrast, "Animated Pictures" were lower down the order at Olympia, grouped with "Rontgen 'X' rays," "Hamlet in a Hurry" and crystal gardens.<sup>10</sup> Shown initially in an "indoor promenade" near the main entrance, by mid-April the Theatrograph had a dedicated projection theatre with one hundred seats.<sup>11</sup>

With theatre and promenade under one roof, Wonderland combined elements of both Paragon and Olympia. Audiences seated near the stage enjoyed musical acts, comedy, dance, ventriloquism or a short play. In the promenade, a "lecturer" guided them through

<sup>8</sup> Matthew Lloyd, "The Paragon Theatre, 93–95 Mile End Road, London," in *Arthur Lloyd.co.uk* <<http://www.arthurlloyd.co.uk/ParagonTheatre.htm>> [accessed 9 January 2022].

<sup>9</sup> "The London Music Halls," *The Era*, 18 April 1896: 16; "Exhibitions, Entertainments, Etc.," *The Standard*, 6 April 1896: 1.

<sup>10</sup> "Olympia" (advertisement), *Daily Mail*, 13 May 1896: 4.

<sup>11</sup> "Easter Amusements," *The Standard*, 7 April 1896: 1; "Easter Entertainments," *Morning Post*, 7 April 1896: 2; "County Council and Amusements," *The Era*, 16 May 1896: 16; Brown, "England's First Cinema."

displays of “freaks” and demonstrations of trades such as glass-blowing.<sup>12</sup> Given the Theatrograph’s technical needs and prominent billing, it was presumably set up on the stage to show the usual range Paul offered: real-life scenes, variety acts and comic pieces.<sup>13</sup> Nevertheless, audiences could smoke, partake of refreshments and move around the space as they wished and as different elements caught their attention.

The run lasted just the three weeks of the initial booking for reasons that became clear at Clerkenwell County Court on 14 July 1896, when Paul sued Wonderland’s proprietors for £22 10s, three weeks’ rental for electrical accumulators (with the music hall responsible for supplying current). At the same time, Jonas Woolf, Wonderland’s manager, issued a counter-claim for £15, claiming losses due to the Theatrograph’s “complete failure.” Woolf contended that because Paul had only used batteries and a limelight apparatus Wonderland supplied, the pictures appeared “blurred and indistinct,” adding that the audience “used to hiss the performance, and many people had demanded and received back their money.” The failure of its star attraction saw takings fall in one week from £128 to £73, he claimed, and in the next to £58. Paul’s barrister, Mr Gill, argued that the show did not in fact rely on the Theatrograph alone, forcing Woolf to belittle the prominently advertised “Bear Lady” and “Fire Queens” as “padding.” Making fun of grandiloquent publicity for those acts, Gill suggested that he was, “not surprised that these monstrous exaggerations damaged your business. It was not the theatrograph.” The presiding judge concurred, dismissing Woolf’s counter-claim: Wonderland should have supplied a proper light and were responsible for the failings.<sup>14</sup>

The case is revealing in two ways. Firstly, the Theatrograph and other projection systems were novelties and sold as such, to the music halls and to the public.<sup>15</sup> They commanded high prices at first: £20 a week at Wonderland (though weekly rates soon fell to £4 to £5).<sup>16</sup> With rates so high, proprietors had to market animated pho-

<sup>12</sup> “Music Hall Artistes Wanted,” *The Era*, 25 April 1896: 24; “‘Wonderland’ at Whitechapel,” *The Era*, 16 May 1896: 16.

<sup>13</sup> Barnes, *The Beginnings of the Cinema*, 229–61.

<sup>14</sup> “The ‘Theatrograph’ in Court,” *Islington Gazette*, 15 July 1896: 3; “The ‘Theatrograph’ in Court,” *The Era*, 18 July 1896: 7.

<sup>15</sup> Luke McKernan, “The Familiarity of the New: The Emergence of a Motion Picture Industry in Late Nineteenth-Century London,” *Nineteenth Century Theatre and Film* 33, no. 2 (2006): 34.

<sup>16</sup> Michael Chanan, *The Dream That Kicks: The Prehistory and Early Years of Cinema in Britain* (London: Routledge, 1996), 127–8.



FIGURE 3. • Wonderland  
playbill, week beginning  
6 April 1896  
(Wellcome Collection  
EPH+34:46).

tography hard, sometimes emphasising the great cost, as Wonderland did for the Theatrograph. Even so, other performers shared top billing. Secondly, living photography's early technical flaws were evident. At Paul's first Alhambra performance, "the apparatus did not work with the smoothness and regularity that might be expected after a night or two." At the Canterbury, "one of the pictures was so blurred and indistinct that the audience did not hesitate to express their disapprobation," just as Woolf claimed at Wonderland.<sup>17</sup> One early operator noted "faults due to imperfect apparatus causing flicker and movement of the screen." Even towards the end of 1896, the *Kentish Independent* commented on "painful wobbling" and "patches and flashes which dazzle the eye and bewilder the brain," while in Torquay the images were dark and "somewhat hazy."<sup>18</sup>

Paul later admitted that his first Theatrograph model was poorer "in steadiness and clearness" than the Lumière projector.<sup>19</sup> As the Wonderland case showed, illumination was a significant challenge, exacerbated by the density of film stock, which further dimmed the images.<sup>20</sup> An interview with Paul noted that,

Darkness is essential to the effective exhibition of the pictures; and a difficulty arises in this respect at a variety theatre where smoking is in progress, and where there is a frequent ignition of matches. One learns for the first time the illuminatory power of a single wax vesta, when it is suddenly ignited in the darkened Alhambra during the progress of Mr Paul's exhibition.<sup>21</sup>

Such problems must have been evident at Wonderland and even in the dedicated theatre at Olympia, which at least eliminated the other distractions arising from the open layout of the Whitechapel venue. Audience behaviour had to be controlled, with theatre programmes requesting they not strike matches during performances.<sup>22</sup> Paul also recognised the need to control his technicians:

Though we did our best to train lanternists and limelight operators to use the machine properly, their results were sometimes indifferent. Therefore, I attended in the evenings at many of the London music halls, the times of showing being carefully arranged in advance. This helped to maintain the reputation of the projector.<sup>23</sup>

<sup>17</sup> Barnes, *The Beginnings of the Cinema*, 46–7.

<sup>18</sup> Rachael Low with Roger Manvell, *The History of British Film. Volume I. The History of the British Film 1896–1906* (London and New York: Routledge, 1997), 114; Amy Louise Bethel, "Suburbia, Seaside and Sensation: Showing Films in London and the South-East, 1896–1897," (unpublished PhD diss., University of York, 2015), 80–1; Rosalind Claire Leveridge, "'Limelights and Shadows': Popular and Visual Culture in South West England, 1880–1914" (unpublished PhD diss., University of Exeter, 2001), 156–7.

<sup>19</sup> Paul, "Kinematographic Experiences," 501; Christie, *Robert Paul*, 57 and 298 n. 63.

<sup>20</sup> Barnes, *The Beginnings of the Cinema*, 122.

<sup>21</sup> "A Chat with Mr. R. W. Paul," *The Era*, 25 April 1896: 17.

<sup>22</sup> Barnes, *The Beginnings of the Cinema*, 123.

<sup>23</sup> Paul, "Kinematographic Experiences," 502.

By early autumn 1896, such close and personal attention underpinned advertisement claims that “no other apparatus (except Lumière’s Cinematographe) has stood the test of appearing at a London Hall.”<sup>24</sup>

Losing the court case did not deter Jonas Woolf from showing animated photography at Wonderland: Birt Acres’ Kineopticon began playing there in September 1896.<sup>25</sup> Other music halls and theatres took to film quickly and Robert Paul forged a successful career, becoming a pioneering figure in the British film industry.<sup>26</sup> Yet film did not simply work; it had to be made to work. Before the development of the more controlled environment of the cinema theatre, animated photography fought for space and attention in venues like Wonderland within a programme and physical setting that challenged the viewing experience. What happened in Whitechapel showed that it could be difficult to impress audiences, even with innovative technologies. Paul came to understand the fragility of the new medium in these spaces and the strategies needed to adapt his equipment and its operators to the environment or to adapt the environment itself, both the audience and the physical space. As Toulmin suggests, the music hall was a difficult and constraining context. New models for exhibition – for the development of the cinema – were better found elsewhere.<sup>27</sup>

<sup>24</sup> “Animated Photography” (advertisement), *The Era*, 12 September 1896: 29.

<sup>25</sup> “Wonderland, Whitechapel,” *The Era*, 26 September 1896: 18.

<sup>26</sup> Christie, *Robert Paul*.

<sup>27</sup> Vanessa Toulmin, “Cuckoo in the Nest: Edwardian Itinerant Exhibition Practices and the Transition to Cinema in the United Kingdom from 1901 to 1906,” *The Moving Image* 10 (2010): 52–79.

# Waves Matter

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ISSAM KOURBAJ

The first time I learnt about Simon Schaffer was through **n01se**, a series of exhibitions that he co-curated with artist Adam Lowe at Kettle's Yard, the Whipple Museum of the History of Science and the Cambridge University Museum of Archaeology and Anthropology, Cambridge, in early 2000. It was a very brave exhibition to plan in 1999, in anticipation of the destructive "Millennium Bug" and, in hindsight, I wonder if curators were disappointed when no computer malfunction nor major glitch in the global online system transpired.

The **n01se** exhibition catalogue is a handsome, spiral-bound publication containing essays, artworks and illustrations of historic and recent science experiments, introduced by Michael Harrison (1947–2013), the director of Kettle's Yard from 1992 to 2011, who established a great tradition for exploring art and science, transforming the gallery into a dynamic and illuminating space for contemporary art. Michael's introduction ended with: "**n01se** is a celebration of that excess, the disorder which allows order to emerge."

Simon's introduction also echoed this sentiment:

**n01se**, of course, has many stories to tell, not just one carefully selected pathway. Instead of presenting one safe set of signs from the messy complexity of arts, sciences and everyday life, all homogenised and nicely packaged for cook/chill consumption, **n01se** probes many different ways of seeing and being in the world. Chances are your own sense of order is already someone else's **n01se**.

Unfortunately, it was more than five years until I had the chance to meet Simon in 2006, thanks to Professor Peter Lipton (1954–2007), then head of the Department of History and Philosophy of Science (HPS), who visited my studio at Christ's College. I was working on a project called *The Eyecone*, a camera obscura in the form of a spire at the top of Great St Mary's to celebrate the 800th anniversary of Cambridge University: a proposal based on unrealised plans by Matthew Parker, the 16th-century Archbishop of Canterbury and Vice-Chancellor of Cambridge, and revived by the artist and architect Edward Blore circa 1820. Peter was taken by the number optical experiments that I was conducting in order to understand the workings of light and the way it behaves, and he suggested that his students should visit my studio to see my models, and make their own, to rein-



FIGURE. 1. • Issam Kourbaj, *King's College Chapel, Cambridge*, a digital image of an optical image made by a portable camera obscura.

force their theoretical knowledge of light and optics. He also suggested I should urgently meet Simon Schaffer.

A few days later, Simon visited my studio to inspect my collection of camerae obscurae installed in my studio, facing King St and Malcolm St, where one could see the coming and going of everyday life, transformed by a simple means into an extraordinary performance of light, inverted image and unfamiliar motion. We spent hours talking and playing with optics in my studio as well as in the dark attic of the Visual Arts Centre at Christ's College, where I first encountered the inverted image of life outside that triggered my fascination with the camera obscura. Delightful to meet but also embodying the ethos behind **n01se**, Simon was like a human camera obscura, transforming the ordinary to extraordinary with only a few, well-chosen words.

I started attending Simon's lectures at the HPS and I found his encyclopaedic knowledge very inspiring, and his sense of humour a joy to listen to. After one of these lectures, we went for a drink and I asked him where I should look if I were to make something related to light in its many forms and meanings, but specifically connected to Cambridge. His answer was already formed, as if written in an invisible notebook, suggesting that I look at the following (as paraphrased from my own notes):



FIGURE 2. • Issam Kourbaj, *Darwin's Room, Christ's College, Cambridge*, a digital image of an optical image made by a constructed camera obscura.

- **Isaac Newton's prism experiments.** The production of a coloured spectrum by a prism dispersing solar light rays: the crucial experiment in which a monochromatic ray is shown to maintain its colour even after a second refraction.
- **The orrery.** The Whipple Museum holds an example of the George Adams grand orrery, as featured in the 1766 painting *A Philosopher Giving that Lecture on the Orrery, in which a Lamp is put in place of the Sun* by Joseph Wright of Derby (1734–1797).
- **Roger Long's planetarium.** Long (1680–1770) was master of Pembroke College from 1733 onwards, and became the first Lowndean Professor of Astronomy and Geometry in 1750. In the 1740s, Long constructed a huge planetarium in the gardens of Pembroke, inside which an audience of thirty people could view a model of the heavens, and which was extant until 1871.
- **Thomas Young's wave machines.** A medic and Egyptologist of Emmanuel College, Young (1773–1829) designed a series of devices to show that light was a kind of wave, several of which compared light, sound and water waves. The installation would also involve remarkable patterns of standing waves produced by drawing a violin bow across the edge of a glass plate onto which fine lycopodium powder was sprinkled, known as “Chladni Figures.”



FIGURE 3. • Issam Kourbaj, *Fellow's Parlour, Christ's College, Cambridge*, a digital image of an optical image made by a constructed camera obscura.

- **Charles Babbage's Ballet.** In 1846, Babbage (1791–1871), inventor of the first mechanical brain, proposed a “mechanical light ballet” about the origin of the rainbow. This ballet used new lighting technology, including oxyhydrogen lamps, and was planned for Her Majesty's Theatre. The libretto and engineering scheme survive in his autobiography and manuscripts.
- **J. J. Thomson's cathode rays.** In 1896, Thomson (1856–1940), the Cavendish Professor of Physics, launched a series of famous experiments to investigate the behaviour of cathode rays, brightly coloured electron streams in evacuated glass “discharge tubes” between electrically charged plates. Thomson used the newly discovered Roentgen rays (X-rays) to ionise the space and make the particles bend in electrical and magnetic fields.
- **C. T. R. Wilson's cloud chamber.** In 1895–96, Wilson (1869–1959) designed a machine for making clouds artificially. Spark photographs taken with this chamber in Cambridge revealed the first particle tracks for subatomic particles.
- **Eddington and Einstein.** Arthur Eddington (1882–1944), director of the Cambridge Observatory from 1914 onwards, led the decisive 1919 expedition to the South Atlantic to detect the bending of starlight during a solar eclipse to prove the theory of general relativity. These photos made Einstein famous.



FIGURE 4. • Issam Kourbaj, *The Dancer Room, Kettle's Yard, Cambridge*, a digital image of an optical image made by a portable camera obscura.

Simon also suggested that I research the following related themes (and relevant departments): photoluminescence and fluorescence (Chemistry Department and photochemistry); Charles Darwin and the phototropism of plants (Botany Department and Botanic Gardens); optical computing and solid-state physics (Cavendish Laboratory); radio astronomy, quasars and background radiation (Mullard Observatory).

I am often astonished by Simon's knowledge at any given time and the fluency of his articulation. Following many similar conversations with him in the first year of our acquaintance, I decided to apply for the Arts and Humanities Research Council Fellowship in the creative and performing arts. My proposal was called *Light works: The visible and the invisible presence of light. Interdisciplinary research on light and its use in architecture, biophysics and astronomy through history*. Simon was crucial among the Cambridge academics who were happy to contribute to my research at that time. Sadly, the application was not a success and the feedback was that my experience was limited to Cambridge; however, it was through this application that I was able to make connections with very significant people in Cambridge!

Anyway, Simon and I continued to meet in my studio, and he directed me towards his *Light Fantastic* series, which I found richly informative and inspiring, and I decided to carry on playing with light and optics and see where it might take me. I then worked on numerous projects inspired by what I had learned through my friendship with Simon, including:

- *Cambridge Palimpsest* (2009). As part of the 800th anniversary of the University of Cambridge, I was commissioned to make a limited-edition artwork in the form of a jigsaw puzzle called composed of historic “layers” of the city of Cambridge. I worked with artist and cartographer Jon Harris on this project in collaboration with the Cambridge Archaeology Unit and I also met Christopher Evans who knew Simon, and we three forged a nice friendship and met regularly at the Eagle pub before the COVID pandemic: a tradition I look forward to reviving soon.
- *Light Matter: Celebrating 800 Years of Science Through Art* (2009). Held in the historic venue Senate House for the University of Cambridge’s 800th anniversary, this project included contemporary dance, live music, and stunning visual effects in a celebration of Isaac Newton and his epoch-making quest to understand the nature of light.
- *Upside down / inside out* at Kettle’s Yard (2009), an exhibition of camerae obscurae for visitors to view inverted images of Kettle’s Yard House in real time.
- *Let Newton Be* (2009), a touring play for the Menagerie Theatre, which toured the U.K. and U.S.A. in 2011.
- *Intimate Distances* at Christ’s College (2010). In darkened private spaces (such as Darwin’s College Room, the Muniment Room and student rooms), I set up a pin-hole camera so that the outside landscape was partially invited in and projected on the inner walls. The result was a juxtaposition of these inner and outer landscapes; a dialogue between public and private spaces; a conversation between light and shade.
- *Excavating the Present* (2013). I worked with etching on discarded hospital X-Ray plates and produced photograms from them.
- *Into boundless space I leap* (2016), curated by Guy Haywood, at Kettle’s Yard. For this exhibition, I recorded activity in the Maxwell Centre’s laboratories and working spaces, ranging from historic instruments to the development of new superconducting materials by contemporary scientists.
- *122 Moons and counting* (2021), a project relating to astronomical notation, shown alongside a historic farmers’ almanac.
- For various recent projects relating to Braille and braille machines, as well as Arthur Eddington’s handwriting, I knew where to go for an answer.

When I came to live in Cambridge in 1990, I was alone and I did not speak a word of English, but I have since met a great collection of people who have made this place welcoming: Simon is one of the most important of these people. Throughout the years since we met, regardless of the projects I have worked on, I know that Simon is there and always happy to be consulted, which has enriched my work more than I could have imagined.

# Serial Knowledge

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NICK HOPWOOD

Simon Schaffer welcomed me to HPS even before I arrived – should I switch from developmental biology? “Do it!” he said – and as a colleague he has provided an extraordinary education. More important than the many substantive lessons of Simon’s teaching and teaching with Simon, of reading his work and his generously reading mine, he has exemplified a cooperative and experimental way of working which challenges the individualism rife in the humanities and the tight mission-orientation of the usual team projects. This style of knowledge-making combines broad curiosity and sharp analysis with discussion to try out and improve ideas, before focusing pragmatically on the most interesting arguments that can be made with the necessary rigour. My most intense engagement in such an enterprise came after one of the best moves I ever made in HPS: persuading Simon and Jim Secord to spend ten weekday, term-time evenings of 2003–4 in Simon’s living room speculating about “serial knowledge.” The problem, how the serial organization of the sciences might have related to the serially organized worlds they have produced, demanded collaboration. I also wanted to channel my conversations with two of the best historians of science into more abstract intellectual issues than grade boundaries, supervision arrangements, or admissions policy.

We started on 3 November by re-reading Arthur O. Lovejoy’s *The Great Chain of Being* (Harvard, 1936), a perhaps surprising choice, since if there was one approach that we were not going to take it was the history of ideas this book represents. Sure enough, when news eventually leaked out, a colleague asked in disgust: “Why on earth are you reading that?” But that was the essential starting point and Simon ended up writing an article about Lovejoy’s series and the predicament of the modernist intellectual. The following week, since it was clear that the periodical press would be a major topic, Jim had us talk about serial murder as news in response to chapters from *Jack the Ripper and the London Press* by Perry Curtis (Yale, 2001). This provoked reflection on how institutional events and murder-like sensations have intersected in the reporting of science.

Fuelled by more red wine and biscuits, a busy Lent Term began with Mary Bouquet’s suggestive if wild article on family trees and an excellent unpublished text by Nathan Schlanger, “Axes of Perfection: Stone Implements and the Predicament of Progress in Nineteenth-Century Prehistoric Archaeology.” With gaps one of the key properties and problems of series, we continued with “missing links” through Gillian Beer, a BBC *Horizon* documentary on Devonian tetrapods that Simon had taped, and some of James W.

Cook's *The Arts of Deception: Playing with Fraud in the Age of Barnum* (Harvard, 2001) – a perfect segue from Lovejoy's remark that, had Aristotle "been permitted to return ... in the eighteen-forties, he would have made haste to visit Barnum's Museum." A session on "picturing motion, motion pictures" paired Marta Braun's *Picturing Time*, the standard work on Étienne-Jules Marey, with Mario Biagioli on the discovery of sunspots.

Then Anke te Heesen, who with Mechthild Fend had just organized a workshop on "Muster" (Patterns) in Berlin, joined us to talk about Claude Monet's series through readings she selected by Grace Seiberling, Gottfried Boehm, John Coplans, John Klein, and Paul Hayes Tucker. Art history offered early and rich analyses of series as strategies for marketing and display. And then for something completely different – or was it? (series were everywhere) – we dipped into the corporeal semiotics of Brian Rotman's *Taking God Out of Mathematics and Putting the Body Back In* (Stanford, 1993) before finishing the term closer to home (for me, at least) with "organic analysis": selections from Jean-Baptiste Lamarck and Étienne Geoffroy Saint-Hilaire plus Toby Appel's article, "Henri de Blainville and the Animal Series." Iwan Morus dropped by.

May was devoted to primary sources, with Karl Ernst von Baer and Ernst Haeckel on embryonic development, and then an eclectic selection of entries which Simon photocopied from British (mainly Scottish) encyclopaedias and dictionaries, many of them then conveniently housed in glass-fronted cabinets in HPS Seminar Room 2:

OED, "Series"

*Encyclopaedia Britannica* (1771), "Astronomy," Ch. XVIII: "Of the Division of Time"; "Natural History"; "Nature"; "Succession"

*Encyclopaedia Britannica* (1797), "Descent"

Rees, *Cyclopaedia* (1819), "Order(s)"; "Succession"

Brewster, *Edinburgh Encyclopaedia* (1830), "Mineralogy," Ch. IV: "On the Formation of Rocks, and on Formations"

*Penny Cyclopaedia* (1837), "Cycle"

*Penny Cyclopaedia* (1840), "Ornithorhynchus"

These prompted talk of mathematical series and more generally of limits to change.

Knowing that we should write something but not having time, we took another eight months to draft three short position papers. I still like the others'. Jim expressed reasonable reservations about "series" as a peg for a big-picture account and scouted out the benefits of "look[ing] more thoroughly at the experience of seriality and somewhat less at images and texts in which seriality is manifest." Simon's "Seriality in a Second Scientific Revolution" still reads rather wonderfully as an attempt to connect the generic journalization of natural knowledge, its disciplinary institutionalization, and the metaphysics of William Whewell, James Clerk Maxwell, and others.

I look back fondly on this first, exploratory phase of the project and the huge privilege of learning so much from Simon and Jim, Jim more cautious and sceptical, Simon always willing to try for a riff without becoming too committed to it, both drawing on broad read-

ing and the powerful insights that animate their approaches to history. I had begun with rather abstract questions, and this was an education in drawing eclectically on a diverse body of work, but then making productive a theme that continually threatened to descend into mere analogizing or float back off into history of ideas. Deciding to concentrate on the long nineteenth century gave us some chance of recovering, as we later put it, “connections ... especially between serial modes of organization, production and communication and the serial contents of nature.” There was still much to do, but we now knew the sort of work we wanted to encourage and could start spending money and sharing the fun.

We went public with three most enjoyable workshops, one in 2007 revisiting Lovejoy’s *Great Chain* after 70 years (Bill Bynum having taken stock at 40), and two on “Seriality and Scientific Objects” in the ages of revolutions (2008) and of capital and empire (2009), from which we edited a special double issue of *History of Science* that appeared in 2010 with articles by Volker Hess and Andrew Mendelsohn, John Tresch, Nathan Schlanger, Chitra Ramalingam, Alex Csiszar, Axel Hüntelmann, Marianne Sommer, and Simon himself. Drafted by Simon, our introduction identified “practices that pose a set of pervasive and prominent questions about continuity versus discontinuity, the play of difference through standardized objects, and the sequential display versus the array that could be seen at a glance.” We highlighted “seriality,” or the “important extra meanings and powers ... involved in the disposition of elements in series,” and asked how these were “developed and used to produce knowledge.” We gave various specific answers to “the more general question: what kinds of interactions were there between novel models of serial development and new spaces of representation, on printed pages and in museums and observatories, and what barriers to interaction were set up or had to be overcome?”

Series surely invite further study. As I finish a history of human embryos, I am continually reminded of series’ strange powers. How recognition of Louise Brown as the first so-called test-tube baby depended on placing her both at the end of a long series of rejected claims and at the start of a far longer line of replications and variations. How series have been made either to elide ignorance, such as by substituting the germs of other animals for human stages as yet unknown, or conversely to highlight gaps that cry out to be filled, notably the new “black box” in human development around and just after implantation. How the first and last items frame a series, but stressing continuity may turn it into a cycle. The mammalian geneticist Anne McLaren downplayed the conventional starting point, fertilization, by depicting “the cyclical nature of development” in arguing for human embryo research as a member of the Warnock Committee.

As these few examples indicate, by the twentieth century, where I now spend most of my time, there were probably too many series of too many kinds in too many places to pursue our original question – connecting the serial organization, production, and communication of the sciences with the serial contents of nature – with much hope of general conclusions. By the same token there is enormous scope for perspicuous work on seriality, and I look forward in particular to investigating further the intersections of series and cycles. But from my interactions with Simon, during that project and others, I treasure less the specifics and more the model of collaborative exploration that is still an inspiration today.

# Can Science Save the World?

## A Peek at the Representation of Science and Technology in Manga and Anime

ROBERT LISS

I was first introduced to Simon Schaffer by our mutual friend Lissa Roberts in conjunction with a book project they were working on. Simon wanted to include a study of go-betweens in Tokugawa Japan in *The Brokered World* and Lissa thought I might be the man for the job. She and I had met previously, thanks to a shared interest in the historical figure Hiraga Gennai (1728–1780). Especially well known in Japan for “inventing” his *elekiter* (static electric generator), he also worked as a mining adviser, authored popular works of fiction and *honzogaku* (~natural history), and manufactured unique and collection-worthy ceramicware. While interested in his biography, Lissa and I were also fascinated by his appearance in numerous manga and anime series. Usually cast as an inventor – sometimes bumbling, but always genius, Hiraga Gennai even appears as a villain in the series “Read or Die.” In fact, it is as an artificial human – an *I-Jin* – created from his DNA that he appears in the series, using his *elekiter* to bring down airplanes, cut New York City’s electricity supply, and destroy the White House in Washington D.C. Hiraga Gennai the *I-Jin* is finally stopped by the main character of “Read or Die,” a secret agent and librarian at the British Library with double O status (license to kill), who uses her special power over paper to fashion a sword that can do battle against the *elekiter*.

As Lissa and I began investigating, we quickly learned that Hiraga Gennai is not the only instance of



FIGURE 1. • Hiraga Gennai’s *elekiter* (replica on display at National Museum of Nature and Science, Tokyo).

(the history of) science and technology crossing paths with manga and anime. Given, for example, the prevalence of robots and use of time travel as a narrative vehicle in many series, as well as the broad shadow cast on Japanese culture as a whole by the mushroom clouds that ended World War Two, this was hardly surprising. But some of the particulars of this mix are worth sharing, which accounts for this brief essay.

Manga traces its roots back (at least) to the Edo period, most famously associated with the artist Hokusai – though his “manga” brought individual sketches together rather than presenting an ongoing story. While some historians have charted manga’s continuous development since then, it seems clear that the events of World War Two, the American military’s post-war presence, and the role of techno-scientific innovation in Japanese industrial development have all left indelible marks on the genre. The same can be said for anime, its animated counterpart. As is true more broadly of the history of science and technology in Japan and beyond, an essential tension inhabits the core of the role assigned to science and technology in manga and anime since at least the 1950s. Whether focused on the harnessing of nature’s powers, human ingenuity, or a hybrid of the two, story lines frequently reveal their intertwined promise of progress and threat of destruction. Observers with a more philosophical bent might also be drawn to see these genres as interrogating the moral character of science and technology themselves; indeed, as questioning whether they should be understood simply as neutral vehicles for the morally laden actions of their human users or if they can be said to possess their own moral agency.

Strikingly, manga and anime’s ambiguous stance regarding the nature and historical role of science and technology is underscored by their nonlinear conception of temporality. The premise of the popular series “Jin,” for example, rests on its main character’s traveling back in time. Jin Minakata, a late twentieth-century brain surgeon, awakens from having been knocked unconscious by a patient and finds himself back in 1862, close to the end of the Tokugawa regime. Medical threats ranging from cholera to syphilis not only challenge Jin’s ingenuity – how to treat dangerous medical conditions without access to all the advanced accoutrements of modern-day medicine? They also prompt moral and ethical concerns regarding the consequences of fashioning instruments and introducing treatments “before their time.” How will patients, not yet accustomed to the medicalization of their bodies, react to what they experience as invasive and morally questionable procedures? How to assess the value of saving lives at the moment in relation to the risk of changing the course of history? And how to act in the face of powerful members of the medical establishment regarding Jin’s heroic efforts as a threat to their interests?

Turning to another example, “Fullmetal Alchemist” adopts a cyberpunk aesthetic and storyline, which marry the old and the new in a stylized way, to portray life in the fictional country of Amestris at the beginning of the twentieth century. Rather than celebrate the age as the shiny dawn of modern speed and industry, the series’ war-torn world is dark, inhabited by loss and danger. Appropriately, alchemy is the dominant science in Amestris, the use of which is governed by the “Law of Equivalent Exchange:” anyone attempting to engage in transmutation must be willing to give up something of equivalent value. We can appreciate this law and key vehicle for the series’ plot line as both an ironic

tribute to Lavoisier and marvelous fictional counterpart to Shapin and Schaffer's dictum that "solutions to the problem of knowledge are solutions to the problem of social order." Especially important, however, is how this conjured regime of equivalent exchange challenges the standard equation between scientific practice and social progress. This point becomes even more powerfully poignant when we recognize the regime's consequences for the series' main characters. The alchemist brothers Edward and Alphonse Elric want nothing more than to bring their mother back from the dead. In their (cruelly unsuccessful) quest to achieve that by harnessing the act of transmutation, Edward gives up an arm and a leg, while Alphonse sacrifices his entire physical body; his brother manages to retrieve his soul and bind it inseparably to a suit of armor. The series thereby not only casts a shadow on faith in progress and the hope that it can be assured through the exercise of science and technology. It undermines the material bedrock on which the certainties of everyday life rest as it foregrounds the indelible link between change and loss.

The issues raised so far in this essay appear equally in manga series that are set in the future. "Dr. Stone," for example, propels its readers and viewers to the year 5738, but with a twist. The world it presents has been in hibernation since a mysterious flash of light left almost all forms of life petrified in 2019. Human history must thus be recognized as discontinuous, punctuated by distinct epochs. At the dawn of a new age, the central characters reflect on the past as they devise conflicting paths toward the future, each through their own interpretive lens. For the hero, scientific prodigy Senku Ishigami, the common good can best be achieved by the recovery and application of scientific knowledge; his mission is to establish a "kingdom of science." His nemesis, the martial arts expert Tsukasa Shishiō, has a more negative view of the social role played by science in the past. For him, true civilization demands that scientific research and application, including case-specific questions of whether to pursue them, be subordinated to a social order based on power and strength.

Manga and the anime that flow from it provide one of Japan's most popular forms of cultural expression. As such, it's fascinating to observe how the genres have portrayed some of the most pressing matters of both Japan's history and concerns for the future. And while (modern) science has traditionally been identified with the West, it might be said that the most startling instances of science as simultaneous motor of progress and peril have occurred in Japan. Small wonder, then, that manga and anime storylines grapple with some of the most fundamental themes addressed by historians of science. Surely the most astute of such historians is Simon Schaffer, who has never been afraid to face the ambiguities of science in action and examine its socially embroiled essence. If I were to author a new manga series, I would make Simon its hero.



FIGURE 2. • Simon Schaffer, manga hero.

# Simon Schaffer

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PAUL SEN



On a glorious summer day at the very beginning of the 21<sup>st</sup> century, I travelled to Cambridge to interview Professor Simon Schaffer for a Channel 4 TV series I was producing called “Six Experiments that Changed the World.” With me was the show’s presenter, the unforgettably eccentric actor, comedian and occasional ventriloquist, Ken Campbell. We had come to ask Simon about Newton’s prism and Galileo’s ramp.

I was anxious. An encounter between Cambridge academic and off-the-wall comic had the potential to be awkward. But there was no reason to fret. Sitting in the grounds of Darwin College, illuminated by dappled sunlight, Simon and Ken hit it off famously. Both shared an understanding of the absurd nature of ... well ... everything. And like all great historians and great comics, they cared about uncovering the truth.

Simon mesmerised Ken and me with tales from the lives of Newton and Galileo and insights into the societies in which they lived. The experience transformed my career as a

television producer. For as the interview unfolded, it became obvious to me that the history of science is the most important branch of history. The activities of the people who do science – be it with abstract mathematics or steam boilers – have far longer lasting consequences than those of politicians and generals. So why do we obsess over the latter and largely ignore the former?

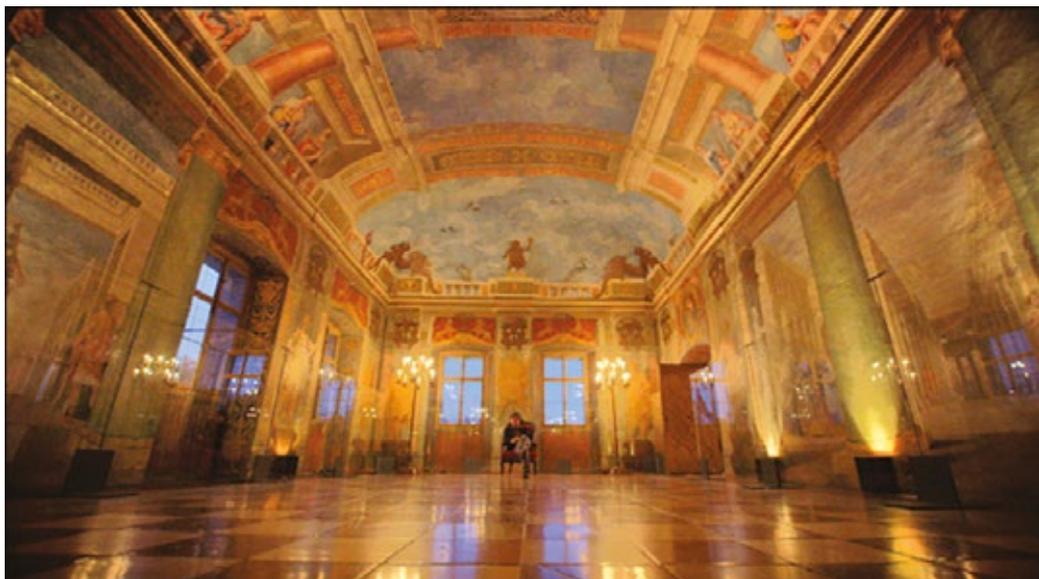
The second lesson I learned was that science is a profoundly human activity. This may be obvious to most readers of this article, but it is not to the wider public. It is certainly not the view held by senior television executives who regard science as an arcane practice carried out by peculiar characters acting in splendid isolation. (Ironically, that's a reasonably accurate description of senior television executives.) I understood for the first time that scientists are not that different from the rest of us, and they do what they do in response to what's going on in the world around them. In short, I saw that science is a collective endeavour and all of us form a part of it.

For a hack like me, it became clear that the history of science is a treasure trove of stories. And, even better, of stories I like to tell. There are two kinds of journalism or factual programme making – the first is uncovering the evil that men do, the second is celebrating the good. In other words, you can either make films about Hitler or about Einstein. And I much prefer making films about Einstein. And what I learned that day from Simon is that history is full of Einsteins whose stories should be told.

To my own astonishment, I have managed to make a living, by and large, by telling these stories. And most joyful of all, many of the films I've produced featured Simon – either as presenter or as a central contributor. Soon after the Ken Campbell show, I produced "Light Fantastic" – a 4-part series in which Simon led us on a dazzling ride through humanity's relationship with light – a show which helped cement the reputation of BBC 4 as a channel.

We narrowly avoided disaster during that production. A helicopter, carrying pilot, cameraman and sound recordist, was filming Simon who stood atop an ancient burial mound in eastern Ireland. Suddenly, the craft dropped like a stone out of the sky. Fortunately, no one on board suffered long term injuries – the soft peaty soil absorbed most of the energy of impact, sparing all on board. An inquiry found that the cause was the unexpected failure of the tail rotor. Simon and I spent much of that afternoon in an interrogation room in an Irish police station, answering the questions of the accident investigator. It was conducted in a very polite and civilised manner, but that day had not gone as anticipated!

Over the next two decades, many of the films I'm proudest of as a producer – "Science and Islam," "Everything and Nothing" and "Britain's Greatest Codebreaker" featured sparkling contributions from Simon. He presented two others – "Mechanical Marvels, Clockwork Dreams" and "Mechanical Monsters." The core of these films, the heart of why they work so well, is down to Simon's wisdom, wit and sheer presence. One example is a monologue Simon delivered in a vast chamber in the Palace of Versailles. Simon sat at the far end of the gigantic room. But despite being a tiny figure in a very wide shot, he fills the space, imperiously.

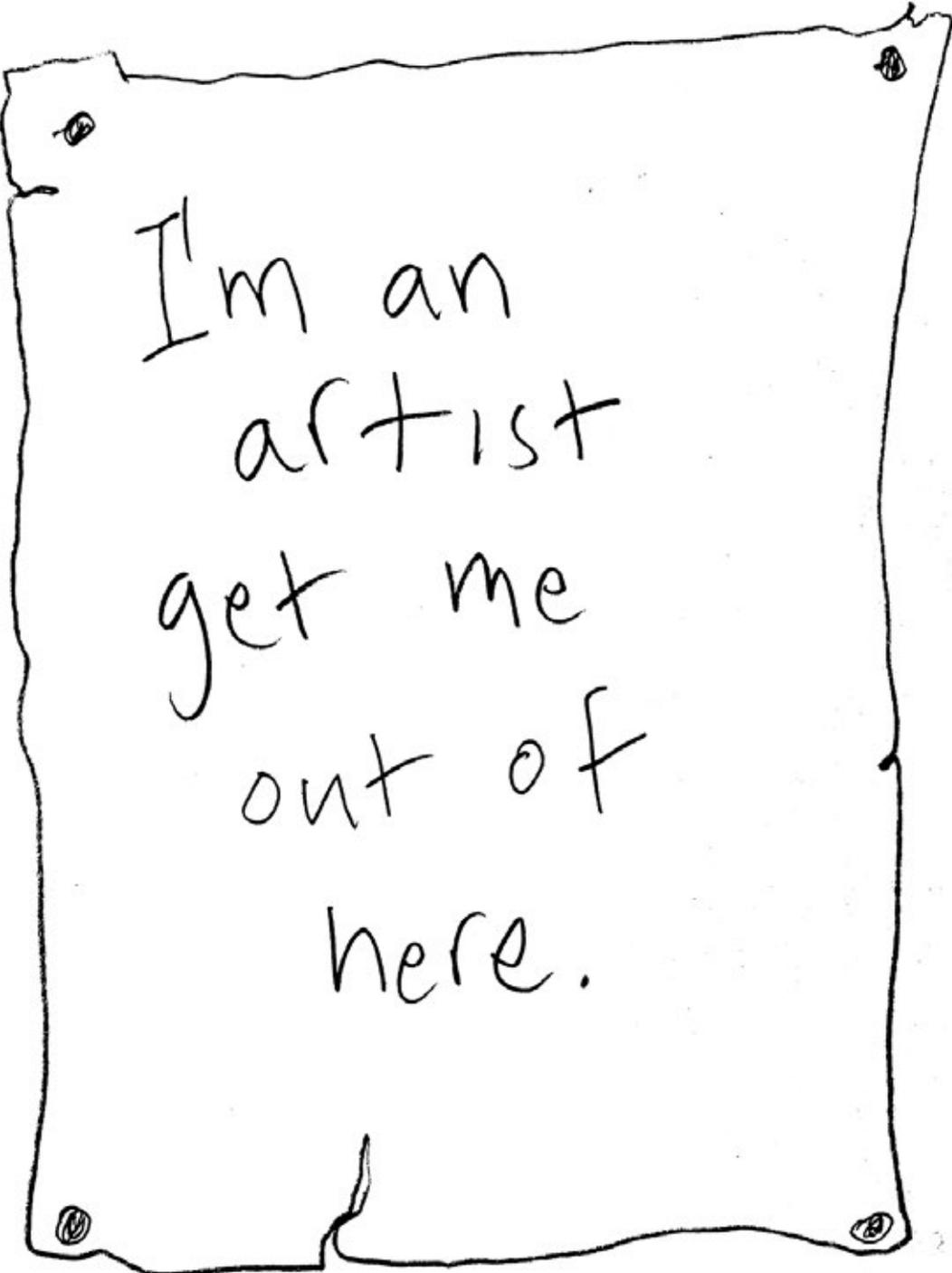


“Mechanical Marvels” and Mechanical Monsters” were both made while Simon was fighting illnesses, which took an enormous physical and mental toll. But he never let that show or even slow him down. His energy during filming was astonishing given what he was battling inside. No one who sees these films would ever know what he was going through while we were making them.

And finally, I want to thank Simon for his limitless generosity. Time and time again when I’ve needed advice, he’s offered it unstintingly. In 2006, I began work on a BBC 4 series about quantum physics called “Atom.” One of the first things I did was travel to Cambridge with the production team to ask Simon to tell us what he considered to be the key aspects of that story. We spent a memorable afternoon furiously scribbling down everything Simon said, and the resulting films were a milestone in my career and in that of the director Tim Usborne and presenter Jim Al-Khalili. More recently, while writing my book, “Einstein’s Fridge,” on the history of thermodynamics, I regularly sent drafts of chapters to Simon and his comments and corrections were invaluable.

I’d like to end with a plea. This publication marks Simon’s retirement from academia. I hope that doesn’t mean he’s also retiring from television in all its modern forms. We need his wisdom and knowledge to make sense of the world!

# DISCOVERIES AND DISPUTES



I'm an  
artist  
get me  
out of  
here.

S. Gamble, Ph.D.

# A Proofing Nose

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HÉLÈNE MIALET

I wanted to find an object, “a Thing,” a conundrum that would pick Simon’s insatiable curiosity; something that could compete with ... let’s see ... how to measure a soap bubble, blood transfusion between sheep and human, Newton poking his eyes with a needle to see a ray of light, the mechanical Turk, Babbage ... and of course, the story of our modernity whose birth was suspended on the flight of a feather in an air pump! But how could I? I had to find something strange and familiar, a hybrid, a nugget of gold, a diamond illuminating past, future and present, something light and soft, theatrical and loud, historical and ethnographical, philosophical and political, scary and funny, my gosh, but is it Simon that I’m describing? No I reassure you, the object or subject I picked is called a Proof Dog.

I discovered the existence of the Proof Dog when I was doing my fieldwork in California. This hybrid object/subject has all the characteristics that could pique Simon’s interest: it is a furry and loving animal, but it is also an instrument of extreme precision; it is capable of detecting low blood sugar dropping in the case of a hypoglycemic episode faster than any machine on the planet, it is used to “proof out” the material upon which other dogs are trained and it is also a standard against which diabetics alert dogs are compared when they are fully trained. Love, precision, fast machines, standard, calibration, what more could we ask for?

The Proof Dog originated in the mind of a man who travels regularly between the dry lands of California, not far away from Silicon Valley, the belly of the beast, and one of the oldest physical science laboratories in America called NIST (the National Institute of Standards and Technology) in Washington. Mark Ruefenach is the name of the man; Armstrong is the name of his dog, both are now in the *Guinness Book of World Records*. Mark not only trained the first dog able to recognize low blood sugar, but he is also trying to develop standards applicable not only to all diabetic dogs, but also to all medical alert dogs. Mark has Type 1 Diabetes and he is the founder of D4D, a non-profit organization that trains Diabetics Alert Dogs. He also works in the Office of Weights and Measures (OWM) at NIST in the United States. Moreover, his family is at the origin of Heusser Nerweigh, a highly respected precision weighing and metrology company, now part of Rice Lake Weighing Systems, a global leader in measurement. There seems to be a link between Heusser’s and D4D. If there is one, what is it?

Diabetics Alert Dogs are known to be able to detect low blood sugar faster than any machine on the planet, but, so far, nobody knows what they really smell. Thus, how can one train a dog to recognize a smell that only he or she can recognize? In the case of police dogs who are trained to detect drugs, trainers know the composition of the drugs they use. In the case of low blood sugar, how can one know the chemical composition of its mysterious scent? And if one could, how could one recreate it in such way that one could “control” what the dogs are trained on? This is exactly what Mark tried to do – discover the chemical composition of the “hot scent.” To do so, he joined forces with Roche, a pharmaceutical company that was ready to help him replicate what the dogs were identifying in order to develop a sensor that might utilize a non-invasive form of measurement – a replica of a dog’s nose. Roche was looking at around 8 parts per million of low blood sugar scent components collected on a sample taken on a human being having low blood sugar. The chromatograph, however, can barely compete with the nose of a dog who “has hundreds of millions more olfactory receptors in his nose than a human does.”<sup>1</sup> Yet, Roche was able to identify “three” chemicals that were present in samples with low blood sugar and that were not present in samples with normal blood sugar; they tried to create a “faux scent” based on the combination of these three chemicals, but they never succeeded to have the dogs respond to the composition they put together ... Unable to replicate the scent, that is, to create a “pseudo scent,” that they could use as “a reference standard material” to train the dogs, D4D had no choice, but to train the dogs on the samples people might give them called the “dead scent:” or the “historic” scent.

But, how can we know that “the historic scent” upon which the dogs are going to be trained, works? How can we know “exactly” what the dogs are trained on? How can we make sure that that the “dead scent” is “valid” or “viable?” If Mark, with the help of Roche, was not able to discover and reproduce the “real” chemical composition of the “hot scent,” he had to come up with a way to create “a standard reference material” upon which the dogs could be trained. Here are the criteria he chose 1) The person who has type 1 diabetes has to be “symptomatic,” that is, she or he has “to feel low.” 2) the sensation of low blood sugar has to be calibrated against a number produced by a glucometer, the machine that measures blood sugar; 3) the number has to be below 70 milligrams per deciliter – the medical standard, and 4) 70 “milligrams” can be “traceable back” to a known standard: “the grand K” protected in Sevres in Paris against which all the kilograms on the planet are calibrated. But, if “the scent on the piece of gauze” (the unknown), is *proofed out* against “a number” (the known standard), how do we know (and/or how can we trust) that the client provided the right number or that the number was not off? Well, this is where the 5<sup>th</sup> criteria emerges: The number will have to be proofed out, not by another machine (e.g., Continuous Glucose Monitor versus Glucometer), but by a fully trained and highly accurate “proof dog.” As Mark said: “We do know that the sample is at 70 if this is what the glucometer told us, so we don’t ask the dog to tell us

<sup>1</sup> *The New Yorker*, 23 February 2013.

what number it is, we are only asking the dog, is it a viable sample for the other dogs to train on who don't know the sample so well?"<sup>2</sup> The proof dog becomes the standard (e.g. the equivalent of the Kilogram in Paris) against which the scent is proofed. And, there isn't just one proof dog, there are 2 proof dogs whose results will be compared against each other. Indeed, proof dogs always work in pairs. They are, one might say, calibrated against each other; sometimes a third one will appear if a doubt emerges.

A proof dog is "highly trained, highly skilled, highly accurate, highly precise, highly reliable" dog, no time here to go into the details of the training where Heusser and D4D meet again. However, a fully highly trained dog on the path of becoming a proof dog will be tested against other proof dogs. And the first proof dog, that is, "the standard" against which these other proof dogs were measured, was Armstrong, not the first man to put a foot on the Moon, but the first dog ever trained to recognize low blood sugar. Armstrong is the equivalent of the Grand K in Paris against which all the diabetics alert dogs trained by this facility are calibrated. And how was Armstrong trained? He was trained on the body of his inventor who experimented on himself as Newton did in his time, not with a bodkin, but a syringe that he planted directly in his vein to make his blood sugar fall as low as 20mg/dc, a level close to a coma. Indeed, when Mark started to train Armstrong, he would not use random low blood sugars. He would use his own body as a mini-laboratory. He would self-experiment and try to control his "low" numbers (and produced standard reference material!) to control which numbers the dog could recognize and eventually be trained on.

And how was the proof dog initially proofed out? It is out of their collaboration with Roche that D4D developed the collection and training protocols that enabled them "to proof" their proof dog. Indeed, the 3 chemicals confirmed that if the dog was making a distinction between low blood sugar scent and normal human scent in the training facility, it was because there was a difference there to be found in the first place. This time the 3 chemicals were the equivalent of the Kilogram locked with 3 keys in Paris.

As for D4D, it has just been renamed the National Institute of Canine Service and Training.

This is my story for you Simon. A gift, or a counter-gift, for all I learned from you, though as you like to remind me always "I know far far more than you ever will know on this subject ..." To be continued.

<sup>2</sup> Mark Ruefenach, Lab Visit, 1 March 2019.

# Speaking of Tongues

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LORRAINE DASTON

*N.B. Best read while consuming one's favorite food and drink.*

*De gustibus non est disputandum*; “there is no discussion of taste” – taste being a sense so notoriously evanescent, subjective, and inarticulate that words falter in attempts to describe one’s own sensations and fail utterly in trying to reach a consensus about the tastes of a collective. Well, try telling that to Nehemiah Grew (1641–1712), late seventeenth-century physician, botanist, and Fellow of the Royal Society of London. In *The Anatomy of Plants* (1682), he sums up with a Ramus-style table of the genera and species of the tastes of plants a lengthy discussion of the kinds of tastes (not just sweet and bitter but also “rough” and “acid,” sixteen in all), their degrees (on a scale of one to five: root of Sorrel is bitter in the first degree, gentian in the fifth); their “augment and decline” (how long it takes for the taste to reach its peak intensity from the moment of first perception and then to fade away – about six minutes for “the *Pungency of Jalap*”), whether they stay in one place on the tongue or move to other parts of the mouth and throat, and whether constant or “tremulous” (which comes and goes in pulses on the tongue).

For early modern botanists like Grew, there was lots to discuss about taste; as a “matter of sense and demonstration” it was capable of both stable consensus and proof. And although Grew went furthest in his attempts to specify the dimensions of taste by kind, degree, location, and duration, he was by no means alone in his conviction that taste was an essential epistemic tool for identifying and classifying plants, as well as for discovering their medicinal and culinary properties. The tongue was a sensitive scientific instrument, as useful to the botanist as the microscope with which seed structures and leaf fibers were assiduously examined by the Royal Society of London and the Paris Académie Royale des Sciences in the late seventeenth century. The most widely circulated botanical works of the sixteenth and seventeenth centuries, such as those of Pietro Andrea Matthioli (1501–1577) and the brothers Johann (1541–1613) and Caspar Bauhin (1560–1624), also relied on taste to differentiate plant species, especially those that looked very similar. For example, the *Ranunculus dulcis* could only be distinguished from the almost identical *Ranunculus minor* by its sweet taste, which did “not burn on the tongue” like other varieties of the same plant. The best and medicinally most potent varieties of cardamom seed (prescribed to relieve sciatica and coughing) came from Armenia and the Bosphorus and could be distinguished from other, inferior varieties by their “acid and piquant taste, a bit bitter, [and] its smell which gives one a headache.” Taste was at least as reliable as

sight for the identification of plants and considerably more reliable in discovering their medicinal virtues.

Why were these botanists so confident in their abilities not only to distinguish but also describe tastes? Why did they believe that such precision was not only possible but teachable? And why are we moderns so skeptical about both propositions?

Since the mid-nineteenth century, the calibration of observations has been understood as a problem of the variability of individual observers: it is their personal equations and irreducibly private sensory experiences that must somehow be made commensurable by standardized instruments, protocols, and statistical techniques. For early moderns, in contrast, the variability of the phenomena loomed larger than that of observers, and the problem of how to amalgamate multiple observations was almost as great for one and the same observer as for several. Early modern observers also tried to standardize instruments and procedures, but they were untroubled by the epistemological quandary of how to make private experience public. Early modern philosophers worried about whether colors like the red of cherries or tastes like the bitterness of wormwood corresponded to real properties of the world, not whether you see the same color red or taste the same bitterness that I do. Individual differences in perception were instead regarded as matters of talent and skill, susceptible to training like other apprenticeships of the senses, from master chef to sommelier.

Apprenticeships of the senses are famously mute. As the author of a 1698 French cookbook addressed to “*mâîtres d’hôtels, sommeliers, confiseurs*” reassured these and other *officiers de la bouche*, there was no need to worry about the disclosure of trade secrets in print: “in order to become perfectly adept or to be able to understand [these] things more easily, it is necessary to work for some time under masters. That’s how practice teaches at a glance several preparations that can’t be well explained.” Such elbow-to-elbow apprenticeships rarely leave paper trails. But manuscript instructions and corrections to the collaborators in one of the most ambitious collective scientific projects of the seventeenth century have miraculously survived, and they show how the sensation of taste could be made into an epistemic tool, capable of yielding shared, stable knowledge.

In January 1667, less than a month after the Parisian Académie Royale des Sciences had held its first official meeting, the architect and physician Claude Perrault (1613–1688) proposed ambitious projects in comparative anatomy and botany. Both projects were to be undertaken by the entire *compagnie* (as the early Academy referred to itself, a term redolent of guilds and other corporate bodies), both aimed to set new standards for accuracy and completeness in their disciplines, and both were to be opulently illustrated with copperplate engravings. At the Academy’s quarters in the Bibliothèque du Roi in the rue Vivienne, a team of anatomists, assisted by several artists, dissected a camel, a bear, a chameleon, a pelican, an ostrich, and other such animals as came their way, usually via a death at the royal menagerie. Across town at the Jardin du Roi, botanists and artists under the direction of physician and academician Denis Dodart (1634–1707) meticulously described live plants cultivated in the garden or herbarium specimens collected from far and wide.

The natural history of plants project has left behind stacks of detailed instructions, in the form of queries and replies on each plant species that was to be described and drawn. These loose sheets reveal how the senses of the botanists and artists were schooled to see, taste, and describe in unison. Take this typical example of queries relating to wormwood. The questions direct the attention of the observer by demanding closer investigation (“I. The seeds? Under the microscope.”), requesting further details (“II. The flower is composed of how many florets? [reply in a different hand] around 50 or 60.”), or directing the observer to focus more sharply on color, texture, and taste (“IV. Is the root really bitter? [reply in a different hand] The bitterness is not extreme, but it is piquant.”).

The copious and exacting instructions, paired with the laconic and sometimes dissenting replies, bear witness to a struggle between ways of seeing, touching, smelling, and tasting. Were the roots of the *Aconitum salutarium* fringed or furry (as Camerarius had figured them)? What did the *Aconitum flore Delphinii* smell like? Did the roots of *Fraxinella officinis* taste insipid or bitter? Sight was not the only sense the botanists who oversaw the *Histoire des plantes* attempted to train and standardize. Taste and smell of root and leaf were as often subjects of Dodart’s queries as the exact color of the flower. The tongue, like the eye, could be taught to discern nuances. A long postscript to the queries for *Anonyma foliis Ribesii* gave detailed instructions on how to go about tasting plants:

It is necessary to chew in a leisurely way, and to distinguish that which appears [to be the taste] at first from that which appears at the end, for there are tastes and smells that only appear at the end, and which are of great consequence, for example extreme acidities, of which some take hold in the throat and others register only on the tip of the tongue etc. There are also unpleasant [tastes] that appear only at the end. There are agreeable tastes like that of raw peas that leave a quite bad taste in the mouth. It is necessary to note all this; and especially not to taste anything while one has some lingering impression in the mouth of the taste of something that one had tasted before.

Neither queries nor replies betray any doubts that tastes could be as precisely specified as color; vision was not yet botany’s premiere sense. Disagreements as to whether leaves tasted bitter or acidic took exactly the same form as those over whether petals were brownish crimson or scarlet – and in all cases, the infallible rule was to repeat the observation yet again. Dodart’s attempts to calibrate the eyes, noses, and tongues of his assistants drew on the corporeal methods of the artisan: the earliest regulations of the Paris Académie provided for *élèves*, or “pupils,” who would learn the craft of botany or chemistry as an apprentice learned that of confectionary or miniature painting. They all learned to speak of tongues.

# Walking, climbing, floating

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STAFFAN MÜLLER-WILLE

He was not looking forward to what lay ahead. On the way here, he had come down *from a cold and frozen fell into a warm and seething valley*.<sup>1</sup> Walking downhill to *Törrfjorden* had been a joy, the legs moving all by themselves, so that, even after coming to a halt, *he felt himself still walking*. Now, too, *the heat was very strong*, but scaling the mountain it was *perpetual winter* that was lying ahead, *hard wind and rain*. He marvelled again at his two guides, *one of them approaching 70 and the other 50*, who were now way ahead of him, *fleet of foot* as usual, *even though each of them had his load to carry*. He knew he'd be lost without them, so he needed to catch up.

Undulating uphill, step by heavy step, while trying to keep his breath in tune, he looked inwards and back. He had come a long way from Uppsala, on horseback, to begin with, by boat, and finally, afoot. Annoyingly, he had written much less than he had hoped for, a few notes and observations here and there. He would have to find some time later on to transfer these into a proper journal. The journey had been smooth to begin with, and he had made sure to use every opportunity to climb a mountain. He remembered *Nolbykullen* in *Medelpad*, which, *in times of war with the Russians, the inhabitants used as a look-out point*. His first venture into Lappmarken, turning inland up the Ume river for Lycksele, and as he had fancied, Sorsele, had ended in disaster, though. In the bogs north of Lycksele, *all the elements had been against them, for it was raining and it was windy*. *At every step the water reached their knees, even higher where one could not step on tussocks*. Who knows whether they would have made it back without the help of that curious woman who looked like *she had come right from Styx*.

No opportunity for observations under these circumstances, but certainly an adventure he would be able to make a lot of one day. He was lucky, moreover, that Pastor Ole

<sup>1</sup> Sections in italics here and in what follows are from Carl Linnaeus's Lapland journal (1732), in a translation modified by the author from Carl Linnaeus, *The Lapland Journey*, trans. Peter Graves (Edinburgh: Lockhart Press, 1995). The following articles provided helpful context: Theodore S. Feldman, "Applied Mathematics and the Quantification of experimental Physics: The Example of Barometric Hypsometry," *Historical Studies in the Physical Sciences* 15, no. 2 (1985): 127–95; Gerhard Wiesenfeldt, "Das Collegium experimentale sive curiosum und die Anfänge experimenteller Naturlehre in Deutschland," in *Johann Christoph Sturm (1635 – 1703)*, ed. Hans Gaab, Pierre Leich and Günther Löffladt, *Acta Historica Astronomiae* (Frankfurt am Main: Deutsch, 2004), 184–202.

Gran in Lycksele had been so welcoming; *a quiet, handsome man, who had promoted his journey up and down with great care, and had even given him a Lapp boat en miniature, which cost 2 carolins*. Schoolmaster Fiellström, *a modest and polite man*, had readily shared a long list of Sami plant names (he was working on a dictionary). Petrus Alstadius in Kvikkjokk had been equally forthcoming, *a sincere man of old faith, in his fifties*. He had to make sure to tap into his knowledge on his way back again, also that of his wife, Christina Groth, who was fluent in Sami and whom Rudbeck had recommended for her knowledge of medicinal plants and women's issues.

Lots to write up about the Lapps, then, their food, drink, medicines, their marriages, their tools and industry, and reindeer husbandry. But recollecting these conversations brought back, with a pang, the unpleasant encounter he had had with Chaplain Jonas Högling in Jokkmokk, *truly a scumbag, a brutal and unlearned man*. He, and the local schoolmaster Malming, were not at all impressed with his letter of recommendation from the *Royal Society of Letters and Sciences*. Despite the fact that this letter asked everyone to assist Mr. Linnaeus, *for the love of the common good*, these two fellows accommodated him in an entirely base manner with mockery. They even had the audacity to question why the *Royal Society* should have called on a mere student to do this job, *as if the Society had thought it impossible to find a competent man in the north to undertake it*.

Whether they were really serious about this, he doubted, but they had managed to drag him into a discussion *about clouds in Lappmarken, how they sweep the mountains, take away stones, trees and creatures, which they transport away*. When he objected that this was likely more due to strong weather, and that clouds otherwise do not lift anything, they smirked saying that he had never seen a cloud since he had never been on the mountains. "Yes, I have," he had shouted in response, *"since if there is fog I walk in clouds, and if the fog falls straight down, it rains below me."* Again, a sardonic smile in response to such beadwork, as they called it. *Clouds were solid*, they pointed out with reference to the bible, repudiating his discourse of watery spheres suspended in the air. They sneered at natural philosophers who want to understand all with their reason, like Sturmius about how to fly with hollowed globes.

This episode was embarrassing, even more so since they had a point. When he argued with that *stubborn, vulgar priest and pedagogue* in Jokkmokk, he had indeed not been in the Laplandic fells yet, so what did he know about the clouds up there? Mentioning Sturm was particularly painful. He did recall browsing through Sturm's *Compendium experimentale* when studying in Lund and coming across a plate showing a flying boat carried by four copper spheres which had been emptied of all air. How such a contrivance could float was beyond his comprehension, and he was unable to defend the idea. But it was still an ingenious design. He also remembered now how he had copied, with eager enthusiasm, Wagenseil's *hydraspide*, an apparatus consisting of a floating belt and a set of paddles to be fixed to the feet, with which sailors could be saved from distress at sea. He had himself nearly drowned as a child, so coming across this when excerpting the *Acta eruditorum* in Uppsala library had been very exciting.

He regretted now that the *Royal Society* had declined to equip him with a *barometer*. He could tell the world now that the clouds in the mountains were not solid, and that

one could walk inside them. But who, except those two idiots in Jokkmokk, would have doubted that? With a barometer he might – like Scheuchzer in his *Itinera Helveticae* – have measured the weight of air while walking up the mountains. People believed that the air is thinner in high places. Were it not for the barometer showing him that *pressio aëris* was less up there, he'd doubt that and say that this was simply because they had been walking uphill and become breathless because of the blood pressing on the lungs. But then, Sturm had explained it all well in his *Compendium* with little drawings that showed a column of air with broken lines weighing on the mercury. But then, again, this seemed to run counter to reason. Surely, air was not just sitting there, it was in constant motion. Scheuchzer as well, he now remembered, pointed out that barometric readings depended on the weather. Here was a neat piece of reasoning with which to succeed on his return: *One knows that the Fells are higher than all the other hills in the world because no river runs over them; the western rivers run into the western sea and the eastern rivers run into the eastern sea. If we*

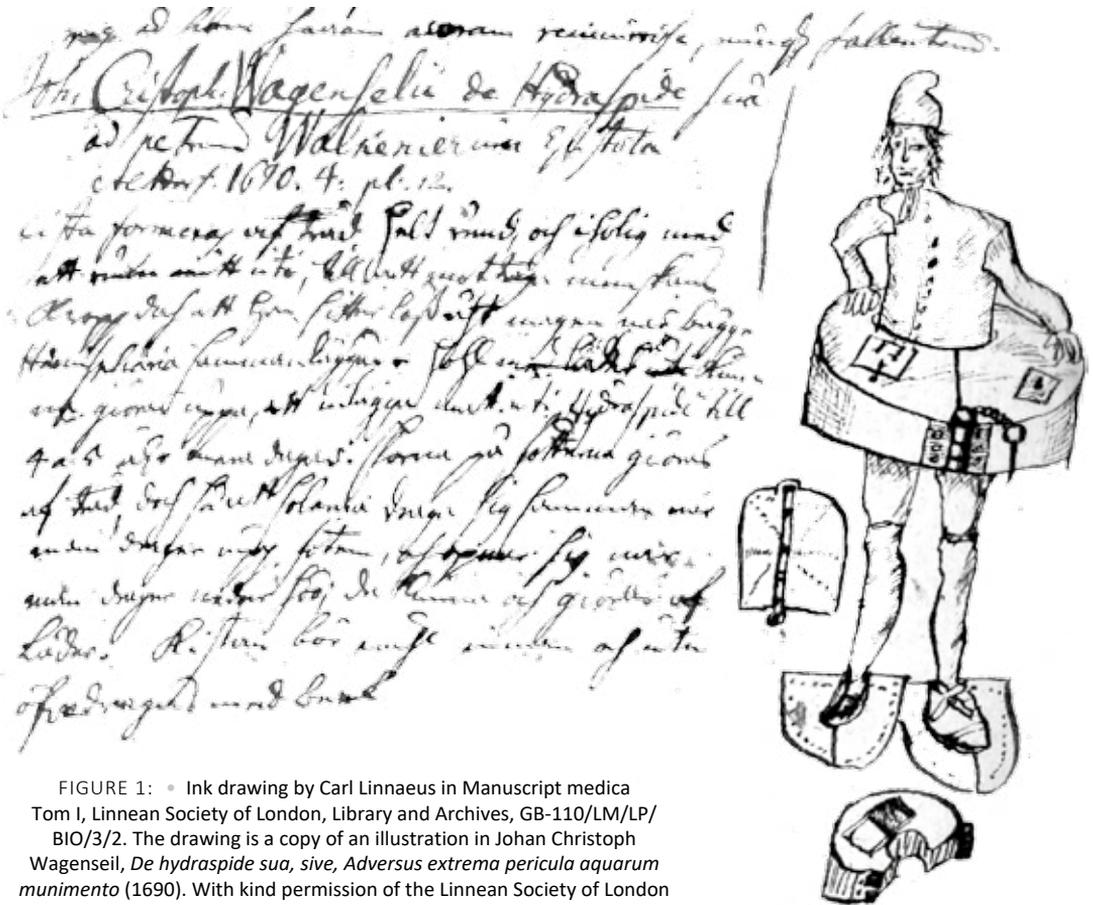


FIGURE 1: • Ink drawing by Carl Linnaeus in Manuscript medica Tom I, Linnean Society of London, Library and Archives, GB-110/LM/LP/BIO/3/2. The drawing is a copy of an illustration in Johan Christoph Wagenseil, *De hydraspide sua, sive, Adversus extrema pericula aquarum munimento* (1690). With kind permission of the Linnean Society of London ([www.linnean.org](http://www.linnean.org)).

*then consider all the waterfalls and rapids that lie between the mountains and the sea, we must conclude that the mountains have a considerable height both on the seaward and on the landward side. Now, when the air is pushed from the land onto the sea and has to pass over this very considerable height, it follows that it must be compressed. If it is compressed, and eventually packed, it must become thicker. Hence it often freezes here, even in the height of summer.*

He did after all have a knack for reasoning, it was not in vain that he had thoroughly studied *Sviceri Erotematicum physicæ Aristotelico-Cartesianæ compendium* at Växjö gymnasium. He only needed to write it all up at some point. Scheuchzer, he had heard, had studied in Altdorf in Franconia, where Sturm and Wagenseil had been teaching. He should go there, rather than to Holland, the future seemed to lie there ... He stumbled over a tussock, and, looking up, realized that his two guides had vanished in the clouds that had been building up overhead for a while now. He needed to catch up.

# First Encounter

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IWAN RHYS MORUS

I would like to tell the story of how I first met Simon, since it says a great deal about him as a friend, a teacher, and a scholar.

I took 1B History & Philosophy of Science during my second year at Cambridge in 1983–84. The subject opened my eyes in all sorts of ways. For the first time since I had arrived at the university I was being taught by people who actually appeared to be interested in the stuff they were teaching – pretty much all the lecturers on the various natural sciences options I had taken during the first year had been dreadful. It quickly became clear that any remaining plans I had to do Physics in my final year would need rethinking. I was going to do Part 2 HPS. At that stage, though, my interest was very much in P rather than H. I had even started thinking about the dissertation I would (and eventually did) write on the use of models in physics.

Then, at some stage in the Lent term, we were told that there would be some additional history of science lectures arranged for us at the beginning of the Easter term. They would be given by someone called Simon Schaffer. Looking back, I think he must just have been appointed and have agreed to do some lectures before officially starting his lectureship the following academic year. The lectures were on nineteenth-century physics, and the first one was on Laplacian physics. Simon's lecture was a revelation – not just the sheer enthusiasm, but the opening up of what was to me a whole new way of thinking about the history of science.

However, I had been doggedly working my way through Edmund Whittaker's *History of the Theories of Aether and Electricity*, and what Simon said in the lecture didn't quite match what I remembered from Whittaker. So obviously, I stuck my hand up at the end of the lecture and asked a question. Mercifully, I don't remember what the question actually was, but Simon answered it patiently and courteously, and I went on my way. The following week, however, as I was leaving at the end of the lecture, Simon stopped me, and handed over a photocopied article – it was Eugene Frankel's paper "Corpuscular Optics and the Wave Theory of Light: The Science and Politics of a Revolution in Physics." I still have the photocopy. Simon explained that it might help answer my question, and we walked down Pembroke Street together taking about the history of science until I crossed the road to join the queue for informal hall at Emmanuel.

And that was it – my conversion to history had started. I've seen many, many similar encounters between Simon and students and colleagues over the years, and they're all the same – Simon invariably goes out of his way to help. Thinking about this as I write – Simon probably was quite literally going out of his way that day: the *Eagle* was the other direction!

# Schaffer's Questions

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HASOK CHANG

Simon Schaffer's paper on "Priestley's Questions" is not his best-known work.<sup>1</sup> Perhaps eclipsed by the ground-shaking publication of *Leviathan and the Air-Pump* just a year later, this paper has only been known to aficionados. Yet it is a microcosm that embodies the key themes of his later and more famous works: a move away from totalizing simplifications; the replacement of intellectualist explanations, with investigations of sociality and material practices; and not least of all, the sheer erudition dripping from every passage.

"Priestley's Questions: An Historiographic Survey," published by the young Schaffer, not yet 30 years old, was neither based on his PhD dissertation (which was on Newton's cosmology) nor derived from material going into *Leviathan*. Yet its densely packed 30-odd pages contain a wealth of sophisticated material and analysis worthy of an entire book.<sup>2</sup> How, and *when*, did he manage to do all the work going into this hidden gem?

For this paper he chose a subject of complexity and subtlety worthy of his intellectual prowess. The historiography of Joseph Priestley, and the related historiography of the Chemical Revolution, have been multi-layered, both fractured and fractious. In real time already, there were concerted attempts by some key actors at self-fashioning and propaganda; many of their contemporaries jumped in with their own histories-up-to-just-now; and then generations of historians and scientists projected their own intellectual, institutional and national agendas on to Priestley.

Schaffer laments the state of the historiography that he found, tied up in a paradox: "a search for some unifying principle is matched against a set of imposed divisions between Priestley's various avocations." He wants to lead us out of the rut: "I shall explore the sources in Priestley's texts which have legitimated such historiography, and I shall indicate some routes which historians might follow in order to break out of a rather restricted model of Priestley's questions."<sup>3</sup>

The paper attempts and achieves a variety of aims. There is, of course, a detailed survey of the secondary literature, and some choice bits of Priestley's works and ideas are

<sup>1</sup> Simon Schaffer, "Priestley's Questions: An Historiographic Survey," *History of Science* 22 (1984): 151–83.

<sup>2</sup> Such a book was later realised in John G. McEvoy, *The Historiography of the Chemical Revolution: Patterns of Interpretation in the History of Science* (London: Pickering & Chatto, 2010).

<sup>3</sup> Schaffer, "Priestley's Questions," 152.

introduced and explained. Schaffer disputes and corrects some implausible or misguided interpretations by other historians. More broadly, he suggests a wholesale re-orientation, as he says while commenting on John McEvoy: “It seems necessary to move on from this conceptual claim to an investigation of the social relations and practical techniques of work,” “to a story which picks out the problems of experimental replication and public polemic.”<sup>4</sup> At some moments he also breaks off from the survey into his own take on Priestley.

He also points to promising future work – I can easily picture a dozen major research projects picking up on the suggestive threads let loose in this paper. For example, one could really look into Priestley as an enforcer of instrumental regimentation or examine the community of atmosphere-focused practitioners of eudiometry and pneumatic medicine (and perhaps their connections with Thomas Beddoes’s later work).<sup>5</sup> One could dig into how “Priestley connected assent to political and religious authority with assent to matters of fact,” or, “in principle it might be possible to connect the vicissitudes of the Dissenters’ work in politics with details of Priestley’s methodological and metaphysical utterances.”<sup>6</sup> Where are the talented PhD students interested in these areas?

I have had a complicated personal relationship with this paper, consisting mostly of regret. A few people urged me to study it when I was starting to write my own revisionist history of the Chemical Revolution.<sup>7</sup> I picked up the article eagerly, having always admired Simon’s work and benefited personally from his kind mentoring ever since the summer of 1992, which I spent happily as an unofficial visiting student in Cambridge. But I could not see my way through this paper. I felt trapped and lost in its multi-layered erudition, with a feeling of trying to walk through a molasses-filled maze. I finished my work on that project without being able to benefit substantially from Simon’s paper, and did the honest thing of not even citing it, having been unable to use it. All this was just as I was making the move to Cambridge to become his colleague.

More than a decade later, on the occasion of contributing to the present volume, I picked up my old photocopy of “Priestley’s Questions” again. This time I was able to handle it better, and able to savour all the twists and turns – how reassuring to think that I must have made some progress as a historian in the intervening years! Looking back on the paper now, one core message is this (buried two-thirds of the way into the paper, contrary to how we encourage students these days to shout about the main point in the introduction): “Certainly it seems important to reject an account of Priestley’s *chemistry*, however loosely defined, which adopts a teleology directed exclusively to his benighted failure to see the light shining out of Paris.”<sup>8</sup> When I first tried to read the paper I shared the desire to reject the common story, but I was preoccupied with arguing against it head-

<sup>4</sup> Schaffer, “Priestley’s Questions,” 166 and 163.

<sup>5</sup> Schaffer, “Priestley’s Questions,” 164 and 174.

<sup>6</sup> Schaffer, “Priestley’s Questions,” 174 and 173.

<sup>7</sup> This work was published later as Chapter 1 of *Is Water H<sub>2</sub>O?* (Dordrecht: Springer, 2012).

<sup>8</sup> Schaffer, “Priestley’s Questions,” 170.

on, showing that the light shining from Paris was no brighter than Priestley's own. So the whole re-framing of the historiography suggested in Schaffer's paper did not find enough resonance in me. I feel it more clearly now: "Priestley's failure to become a convert to French chemistry still occupies pride of place amongst the range of questions asked by historians." "If, however, we identify some of Priestley's publications on airs with the interests of those physicians and natural philosophers concerned with the atmosphere, then the French contests no longer seem so significant nor so definitive."<sup>9</sup> More generally, "we need a historiography which explores the relation between specific communities, audiences, and collaborators, and the work which Priestley published."<sup>10</sup>

Some questions still remain in my mind, ranging from the trivial to the methodological. Is "allegiance" a technical concept?<sup>11</sup> Why is it "scarcely coincidental" that the historiography of Priestley has suffered from the same sort of divisiveness as the divisiveness of allegiance seen in the history itself?<sup>12</sup> Why exactly was it that Lavoisier couldn't make the nitrous air test work, while he could learn much more complicated things?<sup>13</sup> And did Henry Cavendish and Alessandro Volta really "change the meaning of the instrument [eudiometer] when they introduced it as a decisive factor in the electrical sparking of inflammable air" – rather than creating some other instrument based on the same kit?<sup>14</sup> Schaffer mentions an "extremely valuable study" by M. Canovan, in which she shows "how Priestley's method in the history of religion links his political campaign with a form of subversive empiricism in natural philosophy."<sup>15</sup> Who was Canovan? And how does Priestley's argument discussed by her, that a religious belief caused by historical or social factors cannot be true, constitute an "asymmetry thesis"? And we read that "it is necessary to adopt an interpretative attitude to such philosophical texts" – as opposed to what kind of attitude?<sup>16</sup>

I have never asked him all these questions and more, perhaps always embarrassed to admit that I had not read this paper properly. Schaffer's paper starts with an epigraph from John Adams, who wrote to Thomas Jefferson in 1813: "I shall never send you all the questions that I would have put to Priestley, because they are innumerable." My feeling exactly, changing "Priestley" to "Schaffer"! In a self-indulgent moment I imagine a future historian of our discipline who suspects that much of my thinking derived from what I learned from the great Simon Schaffer. I imagine her discovering something in the depths of the archives, a tiny matter of fact that is nonetheless exciting to her because it is a smoking gun confirming her hunch. The discovery is a map of the layout of the HPS Department in the 2010s: Schaffer in Room 16, Chang in Room 14. They were in the

<sup>9</sup> Schaffer, "Priestley's Questions," 162 and 169.

<sup>10</sup> Schaffer, "Priestley's Questions," 157.

<sup>11</sup> Schaffer, "Priestley's Questions," 170.

<sup>12</sup> Schaffer, "Priestley's Questions," 175.

<sup>13</sup> Schaffer, "Priestley's Questions," 168.

<sup>14</sup> Schaffer, "Priestley's Questions," 169.

<sup>15</sup> Schaffer, "Priestley's Questions," 173.

<sup>16</sup> Schaffer, "Priestley's Questions," 171.

same corridor, *just two doors down* from each other! She infers that they must have talked all the time about subjects of common interest, including Priestley. No need even for the proverbial water-cooler moments. She also finds testimony from people who were in the same milieu that Schaffer always kept his office door open and generously welcomed anyone passing by to come in and pick his brains about any scholarly topic. It would be inexplicable to this future historian that I would have never asked Simon my questions about Priestley's questions. It is inexplicable to me. At least, it is still not too late.

# Action at a distance

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LAUREN KASSELL

Pinned to the shelf above my desk in HPS was a series of scraps of paper. Many of them included things that Simon had said. When I packed up my office to move to Florence after 20 years on Free School Lane, I typed them into a document called “What Simon Says.” It reads:

*Historians write about themselves when they write about people in the past.*

*Some historians make strange things seem familiar, others make familiar things seem strange.*

*Beware of people who expect you to study what they think a historian of science/medicine studies.*

*Action at a distance.*

Simon did not say any of these things. He speaks in full, long, rich sentences, not aphorisms. What these phrases capture is my sense that in our fleeting conversations in his office or my office, in seminars and meetings, walking up Free School Lane, in the pub, or over lunch, I was trying to hold onto his way of seeing the world. Those long sentences are full of stuff. He knows stuff. He remembers stuff. But how he knows it is what interested me. That was what I wrote down and retained. These are tropes and tools that I have carried in my head as I have learned to be a historian of science and medicine.

For me, dear Simon, there is one conversation that I return to from time to time. Remember William Maxwell? In my memory, we were in the corridor between our offices, probably sometime between July and September 2006, or maybe several years later. You were writing a paper on Richard Mead and astrological medicine for a conference on “Astrology and the Body” that Hilary Carey, Rob Ralley and I were running, and you said something like “The draft is fine, but William Maxwell is annoyingly elusive.” An image of an Augustan gentleman of the sort that Simon studies and I do not began to appear in my mind. Then a shady misfit from a century earlier replaced him. I ventured, “Maxwell? William Maxwell, the William Maxwell? I know him.” I had spent much of the previous two years trying to understand who William Maxwell was.

William Maxwell was an obscure man, perhaps from Scotland, who seems to have been an associate of Robert Fludd's and probably wrote a treatise on magnetical medicine in the 1630s. It was reprinted several times, variously attributed, in later decades. Fludd's writings are theoretical, Maxwell's treatise is practical. It explains how to make a microcosmical magnet that harnesses astral powers and acts as a universal medicine. That is what I argued, as part of a larger consideration of bodies and spirits, the living and the dead, and doctors and patients in a 2007 essay.<sup>1</sup> It would be a stretch to argue that Maxwell was to Fludd as Hooke was to Boyle.

Or, in Simon's account of debates about the magnetical therapies of Franz Anton Mesmer in the 1780s, William Maxwell was an intellectual ancestor of the controversial therapist. Critics of Mesmer, such as Michel-Augustin Thouret, the fashionable Parisian physician, and William Godwin, the eminent English philosophical radical, crafted a history of medical astrology in which Maxwell's work was "the most complete and copious treatise upon the subject," itself an attempt "to support its declining credit by calling on the assistance of that theory of the universal spirit that he derived from the earliest philosophers;" and a presentation of "the exact counterpart of the system of M. Mesmer."<sup>2</sup> Mesmer denied having read Maxwell, and was accused of failing to read Richard Mead's *Discourse concerning the influence of the Sun and Moon on animal bodies*, which was first published, in Latin, in 1704, and circulated widely thereafter. Mesmer had in fact plagiarized Mead's work in his 1766 thesis, though his critics had not read this earlier work.

For twentieth-century historians, the esteemed physician Richard Mead, not the obscure William Maxwell, matters. As Simon shows, Mesmer's reading of Mead has been understood as a sign of enlightened modernity, while Mead's use of astrology has been considered as evidence of the survival of an antiquated astral medicine into the eighteenth century. Was Mead's celestial environmentalism a form of advanced enlightenment physics or banal and out-dated astrological medicine? The answer lies in the links, pursued across the centuries, between cosmos and air, instruments and bodies. Ultimately, as Mesmer's critics argued, Fludd – and the elusive Maxwell – understood how bodies and spirits worked better than Mesmer. The physics of imagination rendered the physics of magnetism unnecessary. Inquiry into the material powers of celestial fluids acting remotely on the body became a historical, social, and moral examination of the remote propagation of beliefs about the capacities of the human body. In Simon's way of thinking, differences, bodily and otherwise, are inscribed within history, and history is action at a distance.

It is possible to study astrology and air, medicine and physics, from opposite ends of a corridor and sometimes to meet in the middle. If it weren't for Simon, I would have forgotten all that I once knew about Maxwell. I miss that corridor.

<sup>1</sup> Lauren Kassell, "Magic, Alchemy and the Medical Economy in Early Modern England: The Case of Robert Fludd's Magnetical Medicine," in *Medicine and the Market in England and its Colonies, c. 1450–1850*, ed. Mark S. R. Jenner and Patrick Wallis (Basingstoke: Palgrave Macmillan, 2007): 88–107.

<sup>2</sup> Godwin, 1785, 7; Azouvi, 1985, 147; cited in Simon Schaffer, "The Astrological Roots of Mesmerism," *Studies in History and Philosophy of Biological and Biomedical Sciences* 41 (2010): 163.

# Simon and the Stars

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PATRICK CURRY

Simon was the External Examiner for my PhD thesis for History and Philosophy of Science at University College in late 1987. The title was *The Decline of Astrology in Early Modern England 1642–1800*; my supervisor was P. M. Rattansi.

Simon was critically supportive of my attempt to (in a nutshell) marry the philosophical emphasis of HPS on epistemology with a Thompsonian social history from below. The thesis eventually took the form of *Prophecy and Power: Astrology in Early Modern England* (Polity / Princeton University Press, 1989), which is about to be reprinted by the Sophia Centre Press with a foreword by H. Darrel Rutkin.

Simon also contributed a sterling paper on “Newton’s Comets and the Transformation of Astrology” to a seminal collection of papers I edited entitled *Astrology, Science and Society* (Boydell, 1987). That project helped stimulate a significant revival in the study of the history of astrology – previously Whiggishly scorned – at the Warburg Institute and elsewhere.

So I have reason to think my efforts in this tiny but fascinating corner of social, cultural and intellectual history have been reasonably successful, and I’m not at all sure it would have been possible without Simon’s help. But of his intelligence, kindness, and industry there can be no doubt whatsoever. Thank you, Simon!

# “A New Set of Glasses:” *The Grumbler’s* Diogenesian Observations of the London Solar Eclipse of 1715

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STEPHEN DAVID SNOBELEN

## “The Great Eclipse” in London Town

On 22 April 1715, shortly after eight o’clock in the morning, the sun began to darken over the great city of London. Around half-past nine, according to modern reconstructions, a total eclipse of the sun enshrouded the metropolis in an eerie twilight for four minutes and fourteen seconds. But it came as no surprise – least of all to the enterprising astronomers and showmen of that metropolis. The newspapers covered the eclipse, while the commercially available astronomical broadsheets had predicted the event with unprecedented precision. *The Weekly Packet* provided “*An Account of the Eclipse, that will happen on the 22d of the next Month*” in its 19–26 March 1715 number. It began:

THE great Eclipse, which will happen to the Sun on the 22d of *April* next, is like to be so very surprizing, that we can’t omit giving our Readers a short Account of what the Astronomers expect on the Day, about nine in the Morning, that they may not be frighten’d at the wonderful Work of Nature, *viz.* That the Sun will be obscur’d, and the Stars appear over the greatest Part of *England*.<sup>1</sup>

Here we see an early example of an attempt to calm public superstition and anxiety about a spectacular astronomical phenomenon using accurate forecasts from science. The same paper provided a dramatic account of the eclipse after the event:

The Sun shone with great Brightness ’till somewhat past Eight in the Morning, when its Light gradually decreas’d till a Quarter after Nine; after which, the Darkness ensu’d, that lasted near three Minutes; in which Time the Stars were seen, and what Light remain’d, was as Moon-shine.<sup>2</sup>

Astronomer Edmond Halley viewed the eclipse from the roof of the Royal Society in Crane Court, accompanied by other members of the Society, along with the Earl of

<sup>1</sup> *The Weekly Packet*, 19–26 March 1715, No. 142.

<sup>2</sup> *The Weekly Packet*, 16–23 April 1715, No. 146.

Abingdon and Chief Justice Parker, whom he thanked for their assistance, and two Royal Academicians from Paris. Halley’s description of the beginning of the eclipse to the point of totality offers a vivid picture: “the Face and Colour of the Sky began to change from perfect serene azure blew, to a more dusky livid Colour having an eye of Purple intermixt, and grew darker and darker till the total Immersion of the Sun.”<sup>3</sup> Thus, there was another wonder: the sky that morning was perfectly clear for the duration of the eclipse, although clouds did come later in the day.<sup>4</sup>

This essay provides a brief account of former Lucasian professor William Whiston’s entrepreneurial activities during the eclipse, examines the satirical coverage of the event in the literary newspaper *The Grumbler* and concludes with an assessment of this early instance of the popularisation of science.<sup>5</sup>

### Coffeehouse Astronomy and the Eclipse as Commodity

The first public experimental course taught for fee in London began in 1705. In the 1710s, William Whiston and instrument-maker Francis Hauksbee, Jr., collaborated in an experimental course that was offered at least once a year into the early 1730s. Around the same time, Whiston also began lecturing on astronomy in Button’s Coffeehouse and other venues.<sup>6</sup> Whiston did not fail to capitalise on the eclipse of 22 April 1715 with lectures, broadsheet charts, his “Copernicus” orrery and a public viewing. In March 1715, Whiston began advertising astronomy lectures he would deliver at Button’s Coffeehouse, a favourite venue of literary wits:

Mr. Whiston intends this Day, at Seven in the Evening, to continue his Mathematick Lecture, at Mr. Button’s Coffee-house, near Covent-Garden; and to go on with that part of Astronomy which is necessary to the understanding of Eclipses, and his Co-

<sup>3</sup> Halley, “Observations of the Late Total Eclipse of the Sun on the 22d of April Last Past, Made Before the Royal Society at Their House in Crane-Court in Fleet-Street, London,” *Philosophical Transactions of the Royal Society of London* 29 (1714–1716): 245–62 (247).

<sup>4</sup> Halley, “Observations of the Late Total Eclipse of the Sun,” 252.

<sup>5</sup> This essay had its starting point in my doctoral dissertation written under Simon Schaffer. I well remember sharing my findings from *The Grumbler* with Professor Schaffer in his office at Cambridge HPS. He responded with words to the effect: “Of course, there had to be a journal with that title at that time!” I am both grateful to my supervisor then and for the opportunity now to enlarge on what in my doctoral dissertation amounts to a few lines. See Stephen D. Snobelen, “William Whiston: Natural Philosopher, Prophet, Primitive Christian,” Doctoral Dissertation, University of Cambridge, 2000.

<sup>6</sup> For more on experimental lecture courses in eighteenth-century London, see Jeffrey R. Wigelsworth, *Selling Science in the Age of Newton: Advertizing and the Commoditization of Knowledge* (London: Routledge, 2010); Snobelen, “Selling Experiment: Public Experimental Lecturing in London, 1705–1728,” Master’s Thesis, University of Victoria, 1995; Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge: Cambridge University Press, 1992); and Simon Schaffer, “Natural Philosophy and Public Spectacle in the Eighteenth Century,” *History of Science* 21 (1983): 1–43.

pernicus, just published; with Dr. Halley's and his own Schemes of the next total Eclipse of the Sun. Which Lecture he designs to continue every Wednesday and Friday till that Eclipse, and every Wednesday afterward. The Price as formerly.<sup>7</sup>

In an advertisement for his eclipse charts, in which he was careful to drop the name of Sir Isaac Newton, Whiston announced his intention to use a cannon to shoot "one of his Balls of Fire" from Hampstead Heath "at the middle of the Eclipse, for a Signal to all the remote Observers, and a Specimen how far that Light may be seen at a time of so great Observation."<sup>8</sup>

As the event drew near, Whiston offered a public viewing for fee in the open space of Covent Garden:

Mr. Whiston hereby gives Notice, That he intends to observe the great Eclipse next Friday over the North-West Piazza in Covent Garden. Tickets are delivered out at his own House in Cross-street, Hatton-Garden, and at Mr. Button's Coffee-House near Covent Garden. And Note, That his Second or Easy Scheme, Price 1 s. His Method or, Observations, Price 2 d. and Mr. Senex's Smoak'd Glasses, Price 6 d. are very proper to be had by such as would with any Care observe the same either there or elsewhere.<sup>9</sup>

Fleet Street engraver, map-maker and printer John Senex's specially prepared smoked glasses (probably spectacles darkened by smoke soot) were a necessary accoutrement for viewing the eclipse safely.<sup>10</sup>

Whiston released three eclipse charts in all, including a small one that allowed amateur eclipse viewers to record the times of the eclipse. Edmond Halley, John Flamsteed and others also published charts that predicted the times of the eclipse and the path of the umbra. These charts were all marketed in the London newspapers and created a sense of need. For instance, who would want to be without their own copy of "The Eclipseometer" at this rare event? Whiston's second eclipse chart, *A Compleat Account of the Great Eclipse of the Sun*, includes directions for viewing the eclipse safely such as using smoked glass or a camera obscura, and also appeals to the public to send him their accounts of the eclipse.<sup>11</sup> As others have commented, we see here an early example of what is now called "citizen science." The success of these ventures relied on a new

<sup>7</sup> *The Daily Courant*, Friday 18 March 1715, No. 4180.

<sup>8</sup> *The Post-Man*, 7–9 April 1715, No. 11050.

<sup>9</sup> *The Daily Courant*, Tuesday 19 April 1715, No. 4207.

<sup>10</sup> A cardboard-framed pair of eclipse glasses purchased at Tesco's for 99p allowed my oldest daughter and I to view the 11 August 1999 solar eclipse in our back garden in Cambridge (at 94% of totality) and continue in this tradition.

<sup>11</sup> Alice Walters, "Ephemeral Events: English Broadside of Early Eighteenth-Century Solar Eclipses," *History of Science* 37 (1999): 1–43; Jay M. Pasachoff, "Halley as an Eclipse Pioneer: His Maps and Observations of the Total Solar Eclipses of 1715 and 1724," *Journal of Astronomical History and Heritage* 2 (1999):

socio-commercial ecosystem of printers, engravers, instrument-makers, newspapers, coffeehouses and university-trained lectures in a feedback relationship with a growing public interest in science.

### *The Grumbler's Eclipse Triptych*

The same literary technologies that allowed the entrepreneurs of science to hawk their wares provided the means for lampooners of science to moralise, criticise and satirise. Jonathan Swift, long recognised as the period's most eloquent purveyor of Juvenalian satire, crafted the famous critique of the Royal Society in the portrayals of the ridiculous and impractical philosophers of the flying island of Laputa and the Academy of Lagado found in the pages of *Gulliver's Travels* (1726). The proprietors of the short-lived Whig literary journal *The Grumbler* were among the wits who picked up on fanfare surrounding the spectacular eclipse of 1715. Thomas Burnet and Ambrose Philips wrote the essays that make up the numbers of this journal, which was touted as “no *Party-Paper*, but a true Original of Facts as they are.”<sup>12</sup> The inaugural issue provides a fictional back-story for the *nom de plume* used by these authors: the squire Anthony Gizzard, who descends from a family afflicted with the distemper of grumbling. The names the squire considered for the journal before settling on “The Grumbler” provide some sense of the journal's intended tone: “Grumbletonian,” “Growler,” “Complainer,” “Satyr” and “Lampooner.” “The Growler” was in the running as a tribute to the ancient Greek Cynic Diogenes of Sinope, “who was the greatest *Growler* in the World.”<sup>13</sup> Three successive essays engaging with the 1715 eclipse appeared in *The Grumbler*.

The first essay was written by Philips and published in the 19–22 April 1715 number. It provided a short list of historical eclipses going back to the ancient Greeks that were alternatively met with fear and understanding.<sup>14</sup> Published just before the eclipse took place, the issue is headed with an epigram from Ovid that praises those who first thought to understand the motions of the heavenly bodies (*Fasti*, I: 297–300). The squire's aim was to throw “together such seasonable Reflections and Passages of my Reading, as occur to me upon this Occasion, which may serve (when the Sight is over) to amuse the Curious, and to free weak and ignorant Minds from groundless Apprehensions.” He continued:

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39–54; Maureen Farrell, “Rare Items Relating to William Whiston (1667–1752) in the Houghton Library,” *Harvard Library Bulletin* 24 (1976): 349–59.

<sup>12</sup> Nicholas T. Joost, Jr., “Burnet's ‘Grumbler’ and Ambrose Philips,” *Notes and Queries* (7 August 1948): 340–42; *The Grumbler*, Tuesday 24 March 1715, No. V.

<sup>13</sup> *The Grumbler*, 24 February 1715, No. I.

<sup>14</sup> *The Grumbler*, Tuesday 19 April to Friday 22 April 1715, No. X.

It is the Prerogative of great Philosophers to be placed above the Fears and Surmizes of the Vulgar; they can behold the uncommon Operations of Nature with a Mind unmov'd by any other Passion, but that of Admiration. To the common Herd of Mankind the whole Creation is one continued Scene of Terrors.

He then goes on to recount Columbus using his prediction of the solar eclipse of 1 March 1504 (N.S.) to subdue the natives of Jamaica with fear; the loss of the French and Spanish to the English in the siege of Barcelona immediately before the solar eclipse of 1506; the ability of Thales, Sulpitius Gallus and Hipparchus to predict eclipses; Pericles explaining an eclipse naturalistically during the Peloponnesian War; and the fear of Archelaus I of Macedon on witnessing an eclipse. On the other hand, noting that a solar eclipse cannot happen during a full moon (as at Passover), the squire points to the darkness at the time of Christ's crucifixion as miraculous. In sum, the natural event of an eclipse is not to be feared, while the supernatural event at the death of the Saviour is to be believed.

Despite the sober sermon to the good people of London in *The Grumbler*, No. X, the squire felt compelled to report on the credulous populace in No. XI (also penned by Philips).<sup>15</sup> After an epigram from Pliny the Elder praising those who sought to understand eclipses and release humanity of its fear of them (*Natural History*, 1.2.9), he begins with an autobiographical (perhaps for Philips too) account of Whiston's coffeehouse lectures:

I Have all along been a constant and attentive Hearer of Mr. *Whiston's* Astronomical Lectures; and find it hard to say, whether the Pleasure or the Instruction, which I have received from them, be greater: He has the Art of communicating his Knowledge in such familiar Terms, and in so natural a Method, that even a Female Audience might learn from him the various Motions and Appearances of the heavenly Bodies. I congratulate him and the rest of the ingenious Gentlemen, who give up their Lives to great and sublime Speculations, upon the truth and exactness of their Calculations and Predictions as to this remarkable Eclipse.

As was often the case at the time, the ability of a science populariser to reach a female audience was seen as a litmus test for the success of the popularisation. Alluding to Whiston's appeals for observational accounts, he concludes his discussion of Whiston with the expressed desire: "we await with Impatience for the Observations that will be communicated to the Publick, and the Conclusions that will be drawn from what passed in the Fields of Air upon *Friday* last." While all of this reads like high praise for Whiston – and it may be partly that – the article thereafter descends into whimsical satire.

Gizzard goes on to compare plays and operas unfavourably with the salutary witnessing of a comet or eclipse. He next provides a putative transcript from what was appar-

<sup>15</sup> *The Grumbler*, Friday 22 April to Tuesday 26 April 1715, No. XI.

ently an informal account of the eclipse he heard at Button's Coffee House by "an ingenious Gentleman," recently arrived from Greenwich, "whose Imagination is so delicate as to be strongly affected with Objects, especially when they are new and uncommon." Then comes the evidence that some Londoners were no less superstitious than the Ancients. The writer reveals that he "had planted my Spies in different Stations in and about *London*, to observe and give me notice of what should pass before, during, and after the Eclipse." Amongst the inhabitants some Jacobites "prognosticated an Invasion," a "Stock-Jobber" had sold his stock in a panic, "the Herb-Women in *Covent-Garden*, and the Oyster-Women at *Billingsgate*" for the first time ever were silent, "*Corinna*, who was never so cruel as to refuse a pretty Fellow, made a desperate Vow of Chastity, and kept it very religiously for the space of three minutes and thirty five Seconds" and Gizzard's brother Tom "had his Pocket picked in the very critical Minutes of Darkness."

From these Occurrences (to which I might add as many more of the like Nature) we may see, what pusillanimous and ridiculous Creatures we are upon any extraordinary Event, when bred up in Prejudice and Ignorance. My Countrymen by this time are all of them sensible, *They were more affrighted than hurt*, as the Proverb says.

*The Grumbler*, No. XI, ends with a letter from correspondent "Barnaby Brisk:"

*Honest Grum,*

'You know *Diogenes*, the Prince of *Grumblers*, was very gruff with *Alexander* for standing betwixt him and the Sun. If you are of the true Breed, I expect on *Tuesday* next to hear you reprimand the Moon for what she did on *Friday*, to the prejudice of Thousands as surly as your self.'

Here the reference is to the famous story or legend of Alexander the Great eclipsing Diogenes. The sunbathing cynic so distained status that, with a blithe disregard for the accoutrements of power, he could ask the Macedonian general to move aside so as to stop blocking the sun.

The 26–29 April 1715 issue of *The Grumbler*, written by Burnet, begins with an epigram from Juvenal's Eighth Satire (*Satires*, 8:138–139), which is devoted to exposing the vanity of hereditary titles. This sets up the aim of the essay for No. XII, which is an attack on the narcissistic pomp of both hereditary and honorific titles.<sup>16</sup> The diatribe against titles came from "no small Fit of the *Grumbles*" set off when taking a turn in the park on a beautiful day.

<sup>16</sup> *The Grumbler*, Tuesday 26 April to Friday 29 April 1715, No. XII.

There I met an old Acquaintance, with whom, in former Times, I have drank many a chearful Bottle. A new Title, it seems, had very much weakened his Memory; or else he thought it too great a Condescension to take notice of me. I smiled at the awkward Thing, while, with a supercilious haughty Air, he strutted by, not looking low enough to see an old Friend. The Behaviour of this Wretch made me immediately discover, what a poor Trifle a Title is, when vested in the Hands of a Coxcomb.

After again alluding to Juvenal, “the *Grumbler* of his Age,” the squire (seemingly oblivious to his own title) acknowledges that in some families the posterity continues to uphold the glories that first brought honour to their name. “On the other Hand,” he goes on, we should “look upon the dark side of *Hereditary Honours*,” such as when we see a family in decline.

The squire Gizzard next turns to bestowed honours. Likely having certain contemporary politicians in view, he writes:

let us suppose a Wretch, purchasing the Advantage and Pomp of a Title, by the little Arts of Cunning or Falshood, by betraying the Interest of his Country, or by implicitly resigning the native Freedom of his Conscience to the Will of another. Of such a Man it may justly be said, that he has exchanged a real Jewel for a false one; that he has parted with every Thing in Life, that ought to be dear and valuable to him, as a Price for that, which may indeed make him glitter with Grandeur amongst the unthinking Vulgar, but will, in the Eyes of discerning Men, only Serve to brand him with an *indelible Character* of Infamy.

We deploy those metaphors and analogies that are available to us and so it was with Gizzard. After these strong words, the squire reaches for a tool used in the eclipse:

Notwithstanding the Doctrine I have here laid down, concerning Titles and Honours, I foresee, that without farther Helps, Multitudes of both Sexes will continue to be imposed upon by the false Appearances of Grandeur. I have therefore given Directions to that ingenious Mechanick, Mr. *Senex*, (so famous for those smoaked Glasses, by the help of which we lately viewed the Body of the Sun, and discovered his Spots, without being dazled with the Lustre of his Rays) to prepare for the Publick, a new Set of Glasses, through which an honest Country Gentlemen may venture to look upon a Lord.

Here the referent is those six-pence smoked glasses Whiston in an advertisement for tickets to view the eclipse with him in the northwest Piazza of Covent Garden had promoted “very proper to be had by such as would with any Care observe the same either there or elsewhere.”<sup>17</sup> And the squire is not finished.

<sup>17</sup> *The Daily Courant*, Tuesday 19 April 1715, No. 4207.

In consideration of the fair Sex, these Glasses are so contrived, as to shew a *Beau* without his Dress or Equipage. With every Glass there will, a Paper of Directions how to use it, be given *Gratis*.

Here the "*Beau*" is the fop, whose affectations and attention to attire were much mocked in Restoration drama.<sup>18</sup> If the tolerant reader will forgive a crass anachronism, this is the "metrosexual" of early Hanoverian London. Here, although not named, we sense the age-old critique of Diogenes as recorded by another Diogenes: "Seeing a youth dressing with elaborate care, he said, 'If it's for men, you're a fool; if for women, a knave.'"<sup>19</sup> Although the writer does not provide the cost, a tool that filtered out the pretentious brilliance of the aristocracy and the fine clothes of a young pretender would be of great value as a social instrument.

### The Profits of Eclipse-Mongering

At the end of the above-quoted account of the 22 April 1715 eclipse in *The Weekly Packet*, we read that Whiston's great ball of fire eclipse experiment failed through poor timing:

Mr. Whiston's Fire-Ball was not shot up 'till the Time of the Darkness was just over; so that he has as much fall'n short (tho' he took several of his Admirers into the Secret of parting with their Money) in his Method of discovering the Nature of the Eclipse, as he has hitherto done of the Longitude.<sup>20</sup>

Whiston was in an ambiguous position. On the one hand, his work marketing the eclipse of 1715 helped generate a good deal of fascination in the phenomenon. On the other hand, these very efforts led him to be the subject of amusement on the part of some of his more cynical peers. In his *Memoirs*, Whiston records that he was able in 1715 to generate £120 in income from his lectures, eclipse charts and benefactors – for which he expressed sincere gratitude considering his financial straits after being expelled from Cambridge's Lucasian professorship of mathematics in 1710 for his Arian beliefs.<sup>21</sup> Perhaps in other respects Whiston's timing did not fall quite so short. These financial rewards may have

<sup>18</sup> The OED provides two relevant contemporary uses for "beau:" "1. A man who gives particular, or excessive, attention to dress, mien, and social etiquette" and "2. The attendant or suitor of a lady." Perhaps Burnet means both.

<sup>19</sup> Diogenes Laertius, *Lives of Eminent Philosophers*, transl. Robert Drew Hicks (Cambridge, MA: Harvard University Press, 1972), 55 (6.2: Life of Diogenes of Sinope).

<sup>20</sup> *The Weekly Packet*, 16–23 April 1715, No. 146. Whiston's schemes for determining longitude at sea were well known and sometimes lampooned.

<sup>21</sup> Whiston, *Memoirs of the Life and Writings of Mr. William Whiston* (London, 1749), vol. 1, 238–41.

been enough to offset the abuse this politically vulnerable but admirably irrepressible natural philosopher received from his sharp-witted contemporaries.

As for the wits behind *The Grumbler*, they too traded in the commodity of the eclipse, which provided them with new metaphors to exploit for political satire. The class-leveling spectacles afforded a metaphorical tool that allowed the wit to see as Diogenes had seen the pretensions of humanity. In all of this we see an episode in the early history of the public sphere, as the newspapers and that “publick Mart for News,” the coffeehouse, helped create the conditions for science to be promoted, discussed, debated and used as a vehicle for incisive satire.<sup>22</sup>

<sup>22</sup> For the quotation, see *The Grumbler*, Friday 8 July to Tuesday 12 July 1715, No. XXXIII.

# Foam Glass returning to its natural state through the action of heat

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ADAM LOWE AND CHARLOTTE SKENE CATLING

There is a class of materials ... substances that shift form under everyday conditions and in mundane surroundings, but in ways that cannot easily be predicted simply by analysing their internal structure: pumice, soap, foam, blood, glue, paint, plastic, wax or concrete. Such soft matters are, very often, food and drink: cappuccino and soufflé, whipped cream and meringue, jelly and mayonnaise. Their component particles organise themselves into arrays such as suds or bubbles, whirlpools or vortices. Then it is just such intermediate and mobile forms that drive soft matter's puzzling behaviours. The Nobel laureate who helped define soft matter's properties, Pierre Gilles de Gennes, once compared its world to a frontier zone between empires, yet not a rigid, fiercely walled and defined boundary of bottlenecks, customs posts and border guards, but rather a labile territory of nomads and vagabonds, constantly shifting its controls and patterns, a provocative region that de Gennes saw as "mobile, diffuse and active."

Simon Schaffer, "Soft Matters," in *Anish Kapoor: Unconformity and Entropy* (Madrid: Turner, 2009), 164.



A block of Foam Glass produced by the a chemical reaction in recycled glass.  
This black opaque material is an ideal insulator.



Heated to 740 degrees centigrade over a period of 8 hours.



Heated to 840 degrees centigrade over a period of 8 hours.  
Resisting change but wilting in the heat.



Heated to 900 degrees centigrade over a period of 8 hours.  
Like a dough trying to rise while subject to an irresistible slump.



Heated to 1000 degrees centigrade over a period of 8 hours. Wilting in the heat the matter takes on the form of a cocoon – a strong protective layer containing a liquid core.



Heated to 1100 degrees centigrade over a period of 8 hours.  
Bursting to life, salt escaping from pore, colour appearing at the fringe.



Heated to 1200 degrees centigrade over a period of 8 hours.  
With almost all the air gone, the liquid pools into greenish depth.

# Simon, Artisans, Bodies, and Capital

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MYLES W. JACKSON

I remember when I first met Simon as a first-year graduate student in HPS in the Michaelmas Term of 1987. A good friend of mine, and fellow first-year Lisa Micheli, asked me if I were going to Simon's course on the sociology of science. Having just left a Ph.D. program in molecular biology in the US to start one in HPS, and being deeply committed to a philosophy I did not quite understand, namely naïve realism, I responded: "There is no sociology in real science." Simon overheard the comment as he was walking in the tea room. He looked at me and said, "You speak of the sociology of science much like scientists speak of their investigation of nature: as if it didn't exist." I was intrigued and sat in on the lectures. The rest is history. Simon showed infinite patience with a student who had never taken a course in history. I hope in the end he feels that it paid off. I surely think it did.

Simon's works on scientific instrument makers marked an important episode in the history of science. This aspect of Simon's scholarship greatly influenced my own thinking about artisanal knowledge, its communicability, the recognition and coordination of labor by the State, and the politics of labor. As a result of Simon's scholarship, I researched the importance of the artisanal culture during the Bismarckian and early Wilhelminian Eras and how Germany celebrated their artisto-geniuses. Joseph von Fraunhofer (1787–1826) is a case in point. Orphaned at a young age and having never studied at a university, he created the world's most coveted achromatic lenses. Because his artisanal skill was critical to the economic development of Bavaria, he was knighted by King Maximilian I. In the early *Kaiserreich* both Hermann von Helmholtz in Berlin and Ernst Abbe in Jena celebrated the one hundredth anniversary of Fraunhofer's birth, and commemorated a new age in Germany where skilled labors contributed not only to Germany's newly won fame as a leading nation of science and technology, but also to Germany's financial prowess. The products of their labor were critical forms of capital. And rather than be alienated, their labor was both recognized and coordinated. Many German scientists argued that such recognition would save Germany from repeating the mistakes the British had made with their artisans.

Fraunhofer usurped Great Britain's optical market, and because the recipe for and the practical knowledge involved in making the optical glass were jealously held secrets, the British were at a loss to "reverse engineer" his work. Debates arose in pre-Victorian

Britain about whether or not Fraunhofer's practical knowledge could be communicated by the artifacts themselves. And the responses to that question of such luminaries as John Herschel, Charles Babbage, Michael Faraday, David Brewster and John Dollond map onto critical socio-economic issues of the period, such as mechanization, the reform of the patent laws, royal patronage of the natural sciences, and the politics of labor. A history of optical instrument makers then is simultaneously of labor and its importance to the formation of capital.

Another example of an instrument used by various communities was the reed pipe designed by the leading German experimental physicist, Wilhelm Eduard Weber in the late 1820s. Weber was one of those scientists who argued that Germany's appreciation of artisanal labor was destined to render the nascent nation a challenger to Britain's economy. On 19 September 1828, at the meeting of the *Versammlung deutscher Naturforscher und Ärzte* in Berlin, Wilhelm Weber offered the fruits of his research on reed pipes in a lecture, which was subsequently published in J. C. Poggendorff's *Annalen der Physik und Chemie*, to the physics and chemistry section on the compensation of organ pipes. The largest and most perfect of all musical instruments, the organ, Weber argued, suffered from one major disadvantage: its tones could not gradually swell and diminish. Thus, the range of expression organists could achieve was rather limited. Despite various attempts by artisans and savants to improve pipe design, this problem still remained. The organ pipe, in essence, is a longitudinally vibrating column of air and the volume of its tone increases and decreases by intensifying and diminishing the flow of air respectively. But, by swelling or lessening the flow, the organist actually slightly changed the pitch of the note as well, a fact of which Weber was well aware. After having performed a lengthy series of experiments, Weber determined the laws by which reed pipes sound, and claimed to produce organ pipes which held their pitches constant regardless of the pressure of the air traveling through them.

Weber turned to two mechanics to produce precision instruments, the Berlin mechanic J. August D. Oertling and Johann Christian Hoffmann from Leipzig. Weber cites them in his articles in *Annalen der Physik und Chemie*. Given Weber's guidelines these instrument makers were able to forge amazingly precise apparatuses. Critical to their interaction, Weber's formulas served as the guidelines: he certainly did not think that the rational principles of mathematics and mechanics could replace their labor.

In 1829 he published two articles in *Annalen der Physik und Chemie* detailing how organ builders could use his equations as guidelines for constructing compensated reed pipes for the semitones of several octaves. As organ builders and restorers will tell you, organ pipe making requires superior skills, and reed pipes in particular are very difficult to construct. Makers of good reed pipes were, and indeed still are, highly sought after. Weber's work helped them to hone their superior skills without wasting time and money. He also recommended his reed pipe to musicians for the scientific determination and standardization of concert pitch throughout Europe. Physicists and chemists could also use these equations to determine accurately the velocity of sound in air and other gases, the air pressure present in a sound wave, and the specific heats of elastic fluids.

Weber's collaborations with artisans reflected his political orientation. He was a liberal who strongly felt that artisans unified Germany with the assistance of the natural scientists and engineers. The labor of these artisans was a form of capital that could fuel the German economic ambitions.

More recently, a number of scholars in science and technology studies (STS) and cultural studies have argued that we are in a new age of capitalism. Biological molecules, rather than the products of human hand, are now forms of capital: they are patentable entities. Genes, for example, are accorded value and therefore encourage investment in their owners. Tying in my previous background in molecular biology with Simon's training, I argue that biocapitalism is the product of biotechnology whereby biological entities, such as genes, become a part of scientific projects of profit-making and profit-seeking. On the one hand it harkens back to Karl Marx's *Das Kapital* in which he analyzed the dynamics of labor and commodities, which form the basis of producing and marketing entities, such as today's biomolecules. Biocapitalism, of course, also gestures back to Michel Foucault's concept of biopower as detailed in his *The History of Sexuality*, vol. 1. Biopower refers to the ability of nation-states to calculate subjects' bodies with a view to govern and manage them.

Corporate capitalism and biotechnology are shaping twenty-first-century America. The means of production in biocapitalism are the legal and technical tools – in this case intellectual property law, which results in the commodification of the so-called subjects of labor: natural entities and raw materials. These tools structure the social relationships of those in the biotech world. It is the socio-economic form generated by private enterprise – with the assistance of a laissez-faire government, which only benefits members of that group. Those whose DNA sequences have been patented are truly alienated from the means of production. They do not share in the governance of biomedical research, nor do they reap the profits.

Finally, lately I have been writing about the relationship between physicists, engineers, physiologists, and musicians in the creation of a musical aesthetics in Germany during the early 1930s. That collaboration led to the invention of the trautionium, an electronic musical instrument that was forged in the crucible of the Radio Experimental Laboratory in Berlin during the Weimar Republic, became a favorite instrument of Josef Goebbels during the Third Reich, and enjoyed a life in the Federal Republic of Germany providing musical and sound backgrounds for films, including most famously Alfred Hitchcock's "The Birds" in 1963. I am returning to my work on the relationship between science and music and refocusing on scientific and musical objects, tinkering scientists and engineers, and the politics of knowledge.

Simon, thank you for your generosity not only with your time, but especially with your ideas.

# Truth and Business

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ARNE HESSENBRUCH

Dear Simon,

Behold the consequence of planting stuff in an impressionable young mind. Stuff morphing with the context: from academic history of science, through marketing, online gambling, financial advice, a brothel in Buenos Aires, business consulting, innovation education, to business school projects. Well, maybe not all of those.

Back in the previous century we were concerned with scientific truth, I think it is fair to say. You were of course an exponent of what constitutes such things as facts, and I concluded that commercial interests command consent; those fundamental concepts of radiation that aligned with monetary value had the most staying power.

Working briefly on the 18<sup>th</sup> century, I saw the same thing. When you have a hammer you only see nails. The two Scandinavian states' overwhelming concern was with tax revenue, driving the development of scientific measurement for that purpose – again aligning fundamental scientific concepts with commercial value. In both cases – early 20<sup>th</sup>-century X-rays and 18<sup>th</sup>-century taxation – the state ultimately propped up the discourses sustaining facts, in a sense providing succor for trust distributed throughout society.

Moving to the United States, I was bewildered to find that nobody cared about these questions. It took me a long time to understand what American historians of science did care about, and I failed to adapt.

I did spend three years on the history of materials research, which is actually the hero of this story. I worked with Bernadette Bensaude-Vincent, a historian of chemistry, as you know. Materials research is self-consciously market-oriented, just like chemistry. In our inability to come to grips with this sprawling beast of a scientific discipline, we focused on theory. In the 1990s, two MIT professors had written a textbook by picking out those foundational themes that were common to different classes of materials (metals, semiconductors, glasses, plastics, etc.) Theory is here not seen as God's ideas, but as a guide to designing curricula.

Then the Dibner Institute closed and I had my mid-life crisis. I went into business proper. Selling online gambling was very satisfying in that customers actually wanted the product I was hawking. There was no need to *akribisch* cover all the literature, no meandering of the narrative to satisfy every peer reviewer's idiosyncratic concern, no

waiting for years to see things in print, no sneaking suspicion that the audience would remain forever vanishingly small. (By contrast, the editors of this volume allow a Schivelbuschian romp – yay!)

Online gambling was replete with issues of value, trust, and truth. In the US, it was illegal to offer gambling services to US-based customers. However, US law said nothing about offering gambling services to customers in France, the UK, or Japan. Not illegal means legal. Similarly, in France it was illegal to offer gambling services to customers in France, but the law said nothing about other jurisdictions. Our company solved the issue by having one server in the US serving most of the world and another server outside the US for the US market. One of the key marketing challenges in online gambling was gaining the trust of customers in the absence of a sovereign stamp of approval. And in addition: while all poker players fake, some fake losing big sums as a way to whitewash dirty money. In the desire to continue with an absence of sovereign oversight, the company itself had to police such shenanigans. How to identify fake fakes from real fakes?

To really plumb the depths, I became a financial advisor, which turned out to be selling snake oil. Regulation was nominally in place requiring fiduciary responsibility, but customers were bamboozled by the complexity of planning for the future and the almost as complex financial products. Fiduciary responsibility only had grip when challenged, and customers don't understand enough to do so. Value, trust, inadequate (as always?) government regulation.

Business consulting was the next unfortunate field of activity that I graced. Again, one needs to win the trust of customers, by hook or by crook. As opposed to the commodity trade, the product to be sold is not clearly defined but rather has to be negotiated along with the price. It is very difficult to scale up such products and so one has to set prices at an elevated level to survive. I got a side job in academia, using the X-ray story to teach innovation: as one business case illustrating the mutability of markets, facts, theories, truths, values, and business models over decades. (A side job at MIT helps mightily with the otherwise tricky task of gaining the trust of business consulting customers.) Innovation is barely theorized. There are no facts. By now there is maybe a collection of widely agreed-upon best practices, but no more. Many are captured in fungible bon-mots: “fail early, fail often,” “build it and they will come” (sarcastic), “short feedback-loops,” “getting venture capital is like getting married,” “team first,” or “eyeballs before revenue.”

I next went to Luxembourg Business School, which is a startup. Business is taught without theory. Well, one might argue that finance gets close to theory in a physics sense, but the rest of the curriculum is leadership, psychology, self-improvement. Many a wit has claimed that one learns little in business school; the value lies instead in the acquired network. At any rate, the most common tool for teaching is the business case, which amounts to discussing examples. One might call it an apprenticeship too.

Coming back to the history of materials research: I got roped into editing four volumes covering that topic “comprehensively.” The above-mentioned earlier attempt to provide a common curricular foundation has by now failed. In fact, over the last 20 years the field has sprawled even further. There are new kinds of materials, notably biological

ones, there are new characterization tools, notably scanning probe microscopy, there is a new sense of what it means to “understand,” notably through simulations. (The differential equation decorating Plato’s heaven banished.) Research projects instead draw on tools and people from disparate disciplines, such as growing crystals, molecular biology concepts, and data science.

The Materials Research Society (MRS) is symptomatic of the development, maybe it is even a driver of it. It holds two annual meetings, one in San Francisco and one in Boston. Attendance in the thousands (in pandemic-free times) constitutes the main source of revenues. There are no set topic categories for meetings; they change accordingly every year. Each meeting has 20–30 symposia, each with about half a dozen parallel sessions. Anyone can propose setting up a symposium. The guidelines prescribe that the symposium organizers come from different organizations (interdisciplinary, international) and the MRS gets to accept or reject proposals. There is thus an inbuilt bias towards hot topics, and this alone may go some way towards explaining the protean nature of the field.

In the last few years, the MRS has taken to publish the call for papers, which is a godsend because it dumbs the stuff down enough for us mortals. Let’s take a look at some of the language in the call for papers of the Fall 2020 Symposium called Beyond Lithium-Ion Batteries – Materials, Architectures, and Techniques:

The energy of commercial lithium ion battery (LIBs) systems increases in an evolutionary manner by approximately 7% every year. To achieve revolutionary game-changing advances, however, entirely new paradigms are required that are outside established ceramic high cathodes and predominantly graphite-based anodes. In parallel, emerging stationary applications require a new paradigm in cost effectiveness, requiring transformative approaches toward reducing system watt hours per dollar. This symposium seeks to bridge the two concepts seeking materials and device architectures to bring about revolutionary rather than evolutionary advances in energy, safety, power, cyclability and/or cost, not possible with existing LIB systems. It is recognized that *in-situ* and *operando* imaging, diffraction and spectroscopy, high-throughput calculation, and multiscale characterization are the key towards understanding the structure – electrochemical performance relations for beyond-lithium.

As you can see, the call combines thinking out of the box (by enlarging the problem) with a linkage between material properties and money, and with a quest for understanding – where understanding is above individual theories. Quantum theory, for example, applies to the nanoscale only, and understanding a material requires understanding also micro- and macro-scale phenomena. Understanding thus consists of an assembly of theories along with experimental and simulation input. And the main point of understanding is to guide projects. Plato and Newton this ain’t.

Here’s a nice quote from a psychologist, Kenneth Gergen:

All human intelligibility (including claims to knowledge) is generated within relationships. It is from relationships that humans derive their conceptions of what is real, rational, and good. From this perspective, scientific theories, like all other reality posits, should not be assessed in terms of truth, but in terms of pragmatic outcomes.

That might just do it.

Best, Arne

# Confessions of a Biographer

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GRAHAM FARMELO

Biography is “weak history,” according to Claude Lévi-Strauss. In *La Pensée Sauvage*, he sniffed: “Biographical and anecdotal history ... does not contain its own intelligibility, which it gets only when it is transferred en bloc into a history stronger than itself.” When I first read this dismissal of the literary genre in which I have worked for the past twenty years, I flinched, mainly because I thought he had a point.

Lévi-Strauss might have added that biography is also often weak literature. According to received opinion, the finest writing about human lives is the work of novelists, who have the distinct advantage that they can make everything up. Biographers conventionally play by strict rules: their narratives must be consistent with established fact, and every venture into speculation must be flagged. Among the principal challenges for biographers is that they often have no choice but to work with frustratingly incomplete and unreliable information. As rookie biographers soon learn, friends and relatives of distinguished figures often destroy potentially embarrassing evidence about them after their deaths (I shudder to think of the information we lost about Einstein in the bonfires of his secretary Helen Dukas). Partly for this reason, when I am writing about poorly documented periods in my characters’ lives, I often find myself yearning for the freedom of a novelist, even if I don’t have the imagination to benefit from it.

In my view, even moderately talented novelists are able to conjure their subjects’ internal and external worlds more convincingly than all but the finest biographers, including the great Robert Caro. He has painted impressively vivid pictures of Lyndon Johnson and of American public official Robert Moses, while presenting wonderfully authoritative accounts of their work. It is a mystery to me how Caro is able to forge high art from tens of thousands of dry documents and hundreds of interview transcripts. Claire Tomalin is another biographical artist of the highest order: her lives of Jane Austen, Thomas Hardy and Charles Dickens testify to her unique ability to describe her subjects in deceptively light prose that shimmers with literary sensitivity.

Scientific biography is one of literature’s poor relations, it seems to me. Accounts of the lives of scientists do not generally sell well and they also appear to lack respectability among experts. I have noticed that several historians hold scientific biography in low esteem, partly because the genre reinforces the false belief that science is mainly the work of a few geniuses (a perfectly fair point). Those of us who nonetheless believe that biog-

raphy can be an effective way of presenting scientists a wide audience often struggle to describe difficult science and to give an accurate sense of how research in it is done. Yet there are undoubtedly great scientific biographies, notably Janet Browne's life of Charles Darwin, Ruth Lewin Sime's *Lise Meitner* and John Heilbron's life of Max Planck, *The Dilemmas of an Upright Man*.

I wish I had paid closer attention to the virtues of these books before I began to write my first biography, of quantum pioneer Paul Dirac. Rather, I jumped in with both feet. For some reason, I was confident that I could flesh out this "stick figure of a man," as Tom Stoppard described him, and enable non-specialist readers to appreciate Dirac's contribution to quantum physics. A few leading scientists, including Martin Rees, were quick to advise me that I was wasting my time, simply because Dirac was so dull.

I briefly wavered but then persisted, strongly encouraged by the project's champion, Neil Belton, a publisher of blazing intelligence and ambition. He had a touching faith in my ability to teach myself how to write biographies, though I soon realised that I faced quite a challenge, mainly because I did not know what I was doing. I did, however, have the sense to seek the advice of a historian of science: Simon Schaffer. In a crowded café on Trinity Street one spring afternoon, he talked almost non-stop for an hour over coffee and cake about Dirac and the early history of quantum mechanics. He suggested avenues of research, recommended books I should read and experts well worth consulting. I still have a recording of that conversation, which set the agenda for my research. When I asked what – if anything – made Dirac special among those early quantum explorers, Simon shot back: "He was an outsider. It's gotta be that." It took me four years to appreciate the wisdom of that remark.

My Dirac project would have gone terribly awry had I not benefitted from more than my fair share of beginner's luck. I signed the contract before I had checked that there is a Dirac archive – an act of idiotic negligence, I later realised. When I belatedly located his papers at Florida State University, I was puzzled to learn that none of the people who had examined them were in the least interested in the hundreds of letters Dirac's mother had written to him when he was in his twenties and thirties. These documents had little or no bearing on his science, but they shone a bright light on crucial aspects of his life, especially his relationship with his martinet father and less talented brother, whose suicide was for decades too painful for Dirac to talk about. Anyone who wants to write authoritatively about this deeply private and incommunicative man must read these letters. The same is true of correspondence between Dirac and his first serious girlfriend, Mancí Balázs, later his wife. Their youngest daughter Monica had stored their letters for decades in attics and garages, where the documents could easily have perished. The correspondence clearly refutes the commonly held belief among Dirac's peers and colleagues that he had no sense of romance and no sexual feelings. One physicist even assured me that the fact that Dirac had two biological children was merely evidence that he and his wife had sex twice.

Almost as valuable to me were the testimonies of close friends and family members, who revealed the extent of Dirac's interest in the arts, usually assumed to be zero. After

the book was published, a well-known physicist told me I had been gullible to believe that Dirac was an admirer of Micky Mouse cartoons and of Cher's singing, despite plentiful documentary and oral evidence. Overall, Dirac's private correspondence did more than any other evidence to demonstrate that he existed in the same number of dimensions as everyone else.

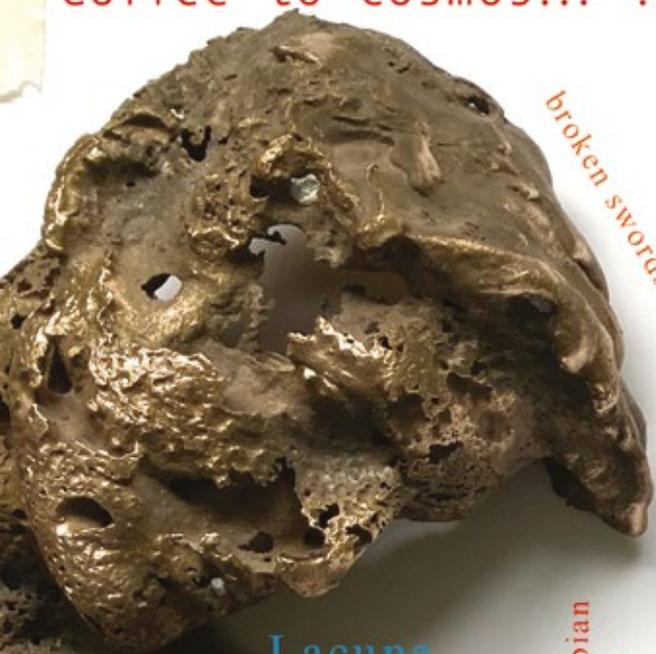
The project certainly had its share of disappointments. I was unable to say much worthwhile about the role of projective geometry in his early work on quantum mechanics (hats off to philosopher of science Tom Pashby, who has recently made valuable progress on this). I wish, too, that I had been able to find much more about the development of Dirac's political views. In the early 1930s, socialist physicist Patrick Blackett strongly influenced Dirac, who supported Stalin's leadership of the Soviet Union until the Molotov-Ribbentrop pact. After the war, Dirac was happy to sign several of J. D. Bernal's petitions in the 1950s. The trail then goes cold until the 1970s, when Dirac the Florida retiree was almost apolitical but quite susceptible to the easy charm of Ronald Reagan.

While I was completing my account of Dirac's life, I began to search for another biographical subject that might be comparably rewarding. None appealed to me until literary agent Robert Kirby e-mailed me out of the blue in January 2019 to ask if I might be interested in writing the authorised biography of Stephen Hawking. A few weeks before, when Martin Rees asked me the same question in his rooms at Trinity College, I had all but rejected the idea, doubting that the public would be interested in yet another account of Hawking's life. I changed my mind only after a meeting in a crowded Starbucks with Kirby and Hawking's daughter Lucy. She won me over with her eagerness to realise her father's wish to be the subject of "a proper, full biography" and an undertaking that the family would cooperate with fully.

A few months later, I learned that Hawking was also concerned that the world already knew more than enough about him. He also had strong views about scientific biography, believing that readers are interested only in the ideas of scientists, not in their lives. This was an odd view, I thought, coming from someone who spent so much time telling us about his upbringing and career. Lucy told me, however, that in his final months, he pondered the possibility of his being the subject of a cradle-to-grave biography. So, a decade after publishing a life of the least well known great theoretical physicist in the past century, I am now writing about the most famous scientist of past half-century. Again, I find myself attempting to make the case that, on biographical matters at least, Lévi-Strauss was wrong.

# PLACES AND PICTURES

Coffee to cosmos... ..



*broken swords*

Lacuna



British Columbian  
copper votives



*making the invisible ...*

Poussin's Grande Machine



*Dance to the music of time*



*Silk has memory...*



Inuit meteoric blades

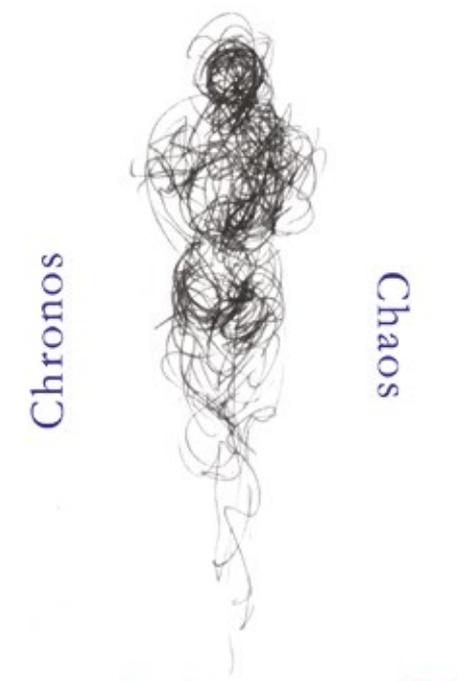


reindeer anoraks



.visible

Promethean ambitions. . .



Chronos

Chaos

ways of seeing . . . ways of being

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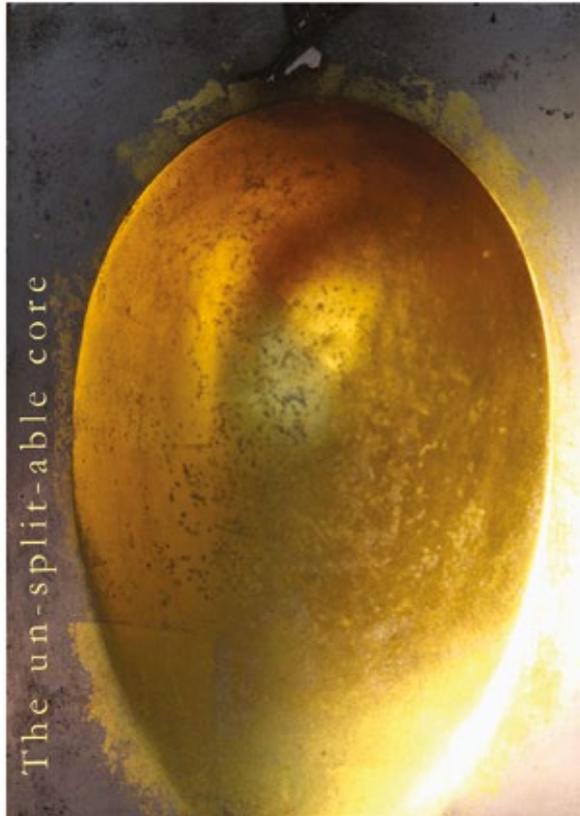
O

W



*drinks anyone?*

presence . . . absence



The un-split-able core

PREVIOUS PAGE: A visual reimagining of inspirational conversations between Simon Schaffer, Jenny Bulstrode, Andrew Lacey and Siân Lewis in Cambridge.

# Simon Schaffer's global turn

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RICHARD DRAYTON

The whole of what is called world history is nothing but the creation of man by human labor, and the emergence of nature for man.

Karl Marx, *Economic and Philosophical Manuscripts*, 139.

There was thus a link between the colonial information order and the empiricist knowledge regime of the late seventeenth century, between forms of epistemology, providentialism and domination.

Simon Schaffer, "Newton on the Beach," *History of Science* 47 (2009): 47.

Simon Schaffer was born on January 1, under the sign of Legba, the dancing trickster god of mediation. Place has always been important in the matter of a life spun between Australia and Brighton, Free School Lane, the Eagle, Albert and George Street in Cambridge, with adventures sitting at the feet of I. B. Cohen in the other Cambridge and of Michel Foucault in Paris. But it has also been key to his thinking, in particular for the last twenty-five years.

In his early work he mapped exchanges between London and Cambridge, Paris and Prague. It was not that he did not already care about the epistemological problems thrown up by exotic longitudes, such as the credibility of an East Indian observation of a new animal.<sup>1</sup> The significance of magnetic poles at Spitzbergen and in the Southern Ocean for seventeenth-century natural philosophy was already clear in his first publication.<sup>2</sup> But only in the 1990s, and especially since 2000, did he deliberately engage with the consequences for science studies of geographies contained in regimes of power, that is to say with imperial and global history.

In his own recollection, the 1991 conference at the Clark Library, which followed acquisition of a facsimile of Joseph Banks's *Florilegium*, was critical.<sup>3</sup> In his afterword to

<sup>1</sup> Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton University Press, 1985), 39.

<sup>2</sup> Simon Schaffer, "Halley's Atheism and the End of the World," *Notes and Records of the Royal Society* 32 (1977): 17–40.

<sup>3</sup> Personal communication, 26 January 2022.

*Visions of Empire* (1996), the conference volume, he took stock of the significance of the empire question.<sup>4</sup> A careful reader will spot how parts of what had been his intellectual periphery, such as C. L. R. James's *Black Jacobins*, were now synaptically repositioned as generative centres of calculation. But in 1990s Cambridge he also responded to those like Richard Grove, Chris Bayly, Michael Bravo, Mike Wintroub and Emma Spary, who were asking questions about science *outramer*, and its implications for science within Europe. By 1992, when I met him in Cambridge, there were even Thursday afternoons when he would skip the HPS seminar to come over to the Commonwealth and Overseas History at St. Catharine's. The significance of St Helena for Halley or the Cape for Herschel, or of the British Empire for electrical physics, were changing for him.

It is difficult to overestimate the importance in this period of his partnership with Anita Herle. Because Simon's intelligence and his power of love are so deeply entangled, it was inevitable that he would become arrested by the problem of anthropology, and its interpolation of European and extra-European measures. Rivers, Haddon, and the Torres Strait became as important to him as Newton, Babbage and the Cavendish. A watershed intervention was a paper he gave in Easter term 1993 to the Social Anthropology seminar, published later as *From Physics to Anthropology and Back Again*.<sup>5</sup> He argued there for the radical comparability and interdependence of the field sciences and the laboratory in an argument which looped between St John's College, Heidelberg, the Torres Strait, New York, and Cambridge today. This had immediate implications for an argument he began to make about physics.

In the late twentieth century, there were some like Lewis Pyenson who argued that unlike "soft" sciences like botany, the "exact sciences" were unaffected by any colonial context. Schaffer began a great body of work which contested this. He sought to reposition Newton and Natural Philosophy in arguments which showed how natural historical curiosity was the vital partner of calculation and measurement, and how both of these had depended on the subordination of free and unfree labour to capital on a global scale, and a related alienation of mind from hand.

Around 1996, Simon came over to Oxford to give a paper on Newton to the seminar on Collection and Comparison in the Sciences that Jim Bennett and I then convened at the History of Science Museum. Speaking from handwritten notes, he directed attention to the key role played by measurements made at distant latitudes and longitudes – pendulum measurements in West Africa and the Caribbean, tidal observations at the Gulf of Tonkin, the Magellan Straits and the Bay of Fundy – in Books 2 and 3 of the *Principia*. Many of these themes would be pursued in the years that followed by those he taught and mentored, in particular Nicholas Dew.

<sup>4</sup> Simon Schaffer, "Visions of Empire: Afterword," in *Visions of Empire: Voyages, Botany and Representations of Nature*, ed. D.P. Miller and P. Reill (Cambridge University Press, 1996), 335–52.

<sup>5</sup> Simon Schaffer, *From Physics to Anthropology and Back Again* (Cambridge: Prickly Pear Press, 1994).

In the arc of his own work a number of brilliant essays anchored aspects of this research programme. In "Golden Means," Schaffer demonstrated how the alchemical and metrological enterprises of Boyle and Newton, and the political economy of Augustan England, were entangled with the predatory apparatus of the Royal African Company, and in particular with the problem of measuring, in this case weighing and assaying gold, at a distance.<sup>6</sup> In its composition, the essay asserts the radical simultaneity of the problem of the fetishes of gold and measurement at imperial centre and periphery. In "Newton on the Ganges," a 2008 lecture at Stanford, later expanded into the essay "The Asiatic Enlightenments of British Astronomy," he similarly explored Newton's fascination with Indian astronomical traditions, and the global knowledge networks on which he depended.<sup>7</sup> In 2010, he returned "home" to Australia to examine the whole problem of colonial observatories, with measurement, as in the case of Parramatta, embedded in the regime of a penal settler colony.<sup>8</sup>

But the most important programmatic statement came in "The Information Order of Newton's Principia," his 2008 Uppsala Lecture, later published as "Newton on the Beach."<sup>9</sup> Its significance was threefold. First, it collected the significance of extra-European information, phenomena and measurement for Newtonian science. Newton, Schaffer reminded us, owned twice as many books on geography, travels and voyages as on astronomy. Second, as elegantly represented in a map, it demonstrated the overlap between these circuits of exotic information and the circulation of commodities within European imperial trade systems. Newton's investments in empire, he showed, were not only intellectual: he was one of a few to own more than £10,000 in East India Company stock, and speculated heavily on the South Sea Company, which projected to harvest a wealth in silver from selling enslaved Africans to Spanish America. But, thirdly, he showed how Newton and the Newtonians by the 1730s sought to obscure the role of curiosity, capitalist interest, exotic places and observers, preferring to construct a myth of a solitary genius founding a mathematical natural philosophy out of pure reason.

<sup>6</sup> Simon Schaffer, "Golden Means: Assay Instruments and the Geography of Precision in the Guinea Trade," in *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*, ed. Marie-Noëlle Bourguet, Christian Licoppe and H. Otto Sibum (New York: Routledge, 2002), 20–50.

<sup>7</sup> Simon Schaffer, "The Asiatic Enlightenments of British Astronomy," in *The Brokered World: Go-betweens and Global Intelligence 1770–1820*, ed. Simon Schaffer et al. (Science History Publications, 2009). See also Simon Schaffer, "Instruments as Cargo in the China Trade," *History of Science* 44 (2006): 217–46.

<sup>8</sup> Simon Schaffer, "Keeping the Books at Parramatta," *The Heavens on Earth: Observatory Techniques in the Nineteenth Century*, ed. David Aubin, Charlotte Bigg and Otto H. Sibum, (Durham, NC: Duke University Press, 2010), 118–47.

<sup>9</sup> Simon Schaffer, "Newton on the Beach."

Schaffer's globalization of the problem of the *Principia* might be seen in part as an extension of the materialist interpretation of Newton and the Scientific Revolution, a line of argument which runs from Boris Hessen to J. D. Bernal's *Science in History* to Jim Bennett's "The Mechanics' Philosophy and the Mechanical Philosophy." But Schaffer's work is equally a tribute to that English tradition of history from below, of Christopher Hill, and especially E. P. Thompson and Roy Porter. Its arrows of desire are shot towards a higher kind of intellectual humanity, in which knowing and feeling, natural sciences and the arts, work and solidarity, are reconciled.

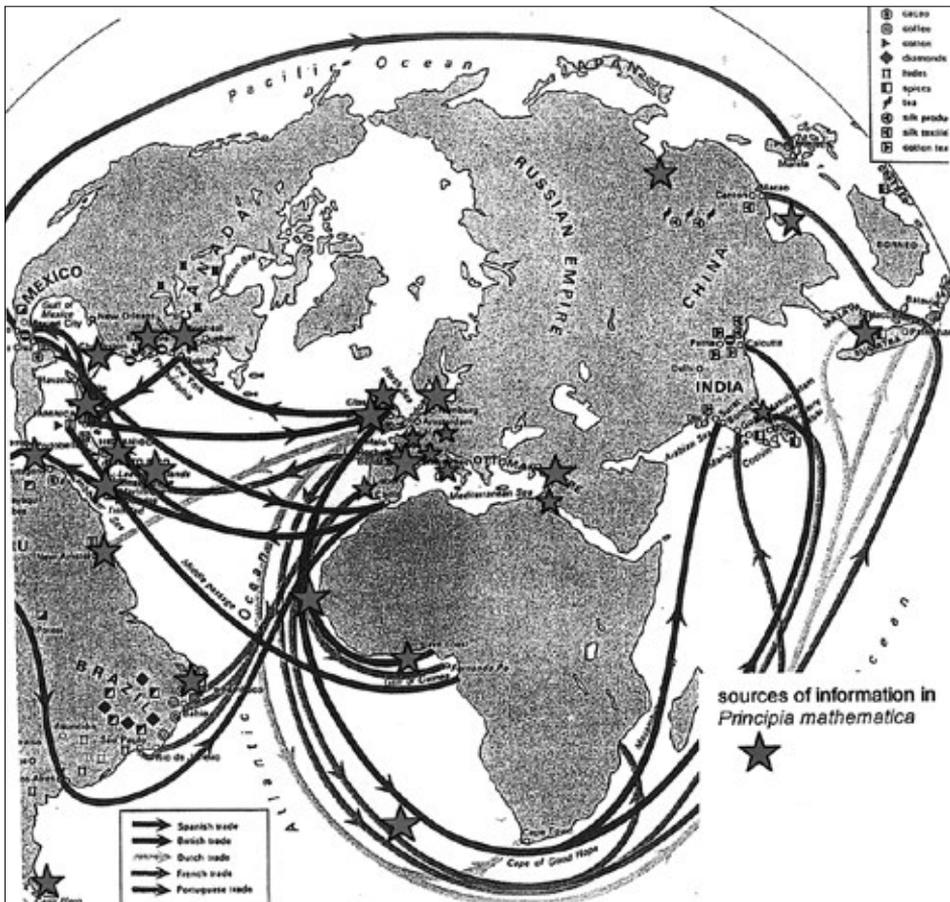


FIGURE 1. • Sources of Information for *Principia mathematica* and the Trade Networks of Early Modern European Empires (From "Newton on the Beach").

# Transit Instruments

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JOSHUA NALL

Museums, Simon has reminded us, are like time machines. Yet the reveries they permit are contingent on the ways in which objects are collected and interpreted. There are many reasons why an instrument may or may not make it aboard the sciences' Ark; and many narratives in which such objects acquire their meaning. So it is worth attending to two senses of museological time when considering the role of material culture in the making of history. Objects embody past relations of peoples and things; but collections shape and bound how we are able to return to the scenes of these entanglements.<sup>1</sup>

Take, for example, two portable transit instruments in the collection of the Whipple Museum (*Fig. 1*). There are many stories that we might tell through these charismatic instruments: of metropolitan expertise, of imperial ambition and folly, of global networks and local knowledges. But before we can do this it is worth dwelling on the complex biographies of the objects themselves. This means following them from their manufacture in 1860s York through to their use in colonial India, and then on to their subsequent lives as mobile museological commodities.

This story begins where most narratives assume an end. The early 1870s, we are often told, marked the completion of The Great Trigonometrical Survey of India (GTS). Begun around 1800, the GTS's ambition to precisely survey the entire Indian subcontinent is typically celebrated as a crowning achievement of Company rule, with its work after the Indian Rebellion of 1857 overshadowed by the heroic eras conducted under George Everest (Surveyor General 1830–43) and Andrew Scott Waugh (1843–61). Consequently, Clements Markham's 1871 lionization of the GTS is easily mistaken for its eulogy: "The story of the Great Trigonometrical Survey, when fitly told, will form one of the proudest pages in the history of English domination in the east."<sup>2</sup> Yet by far the greater volume of maps, data, and reports issued by the GTS post-date Markham's encomium. One reason

<sup>1</sup> Simon Schaffer, "Time Machines," in *The Whipple Museum of the History of Science: Instruments and Interpretations, to Celebrate the 60<sup>th</sup> Anniversary of R. S. Whipple's Gift to the University of Cambridge*, ed. Liba Taub and Frances Willmoth (Cambridge: Whipple Museum, 2006), 345–66; Simon Schaffer, "Object Lessons," in *Museums of Modern Science*, ed. Svante Lindqvist (Canton: Science History Publications, 2000), 61–76.

<sup>2</sup> Clements Markham, *A Memoir on the Indian Surveys* (London: W.H. Allen, 1871), 124. Focus on the GTS before the 1870s is no doubt exacerbated by the scope of R.H. Phillimore's hugely influential five-

for this was Waugh's own damning judgement of the work that had preceded him. The entire eastern portion of the GTS was sub-standard, he declared, "on account of the defective state of instrumental equipments." So Waugh ordered the triangulations re-done "with appropriate apparatus," with the bulk of this work left to his immediate successors, Henry Thuillier (Surveyor General 1861–1878) and James Walker (1878–1883).<sup>3</sup>

Essential for this work was a suite of new instrumentation, commissioned in 1862 and to include not only a new "great theodolite" but also zenith sectors, transit instruments, astronomical clocks, and galvanic registers. The job of procuring this haul was delegated to the veteran surveyor Alexander Strange, a man who had distinguished himself in India "by his uncommon skill in repairing and adjusting scientific instruments," and who upon his retirement to Britain had made a second career out of criticising the quality of apparatus sent east from London. Under the Raj's logic of centralization, this was enough to secure Strange the job of "Inspector of Scientific Instruments, India Department," based out of a new observatory on the grounds of the India Store in Lambeth. Strange immediately abolished longstanding methods of procurement by tender, working instead with a range of hand-picked instrument-makers to develop new designs to his exacting specifications.<sup>4</sup>

Strange's commission included a subset of instruments that were entirely without precedent in India. "The Transit Instruments, Clocks, and Galvanic apparatus," he explained to colleagues, "are intended for the determination of longitudes by Electric Telegraph."<sup>5</sup> This so-called "American method" of longitude determination had been pioneered by William Cranch Bond during work for the U.S. Coast Survey, and involved the determination of time difference between two sites via the mutual signalling of star transits using drum chronographs connected telegraphically. With Raj officials aggressively pursuing the construction of a robust telegraph network within India in the wake of the 1857 Rebellion, the Survey recognised this technique's potential to fix differential longitudes between key stations, and thus, in Walker's words, "to contribute to the science of geodesy determinations of a number of Longitudinal Arcs, which were to supplement and be combined with the time-honoured Meridional Arcs."<sup>6</sup> It took Strange five years to move from a shopping-list to realized designs for this work, with each component manufactured by specialist makers who were mostly new to Survey supply: the

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volume *Historical Records of the Survey of India* (Dehra Dun: Survey of India, 1945–68), which only covers the period up to 1861.

<sup>3</sup> Quoted in: Alexander Strange, "Announcement of New Instruments about to be supplied by Government to the Great Trigonometrical Survey of India," *Monthly Notices of the Royal Astronomical Society* 22, no. 7 (9 May 1862): 261–63, on 263.

<sup>4</sup> Phillimore, *Historical Records of the Survey of India* (n.2), vol. 5: 379; Robert James Mann, "The Lambeth Observatory," *Quarterly Journal of Science* 6 (July 1869): 342–52.

<sup>5</sup> Strange, "Announcement of New Instruments" (n.3): 262.

<sup>6</sup> *Account of the Operations of The Great Trigonometrical Survey Of India*, 19 vols. (Dehra Dun: 1870–1910) Vol. 9: xiii. For the "American method" of longitude determination see: Ian Bartky, *Selling the True Time: Nineteenth-Century Timekeeping in America* (Stanford: Stanford University Press, 2000), 32–44.

three astronomical clocks came from Charles Frodsham, the two chronographs came, extraordinarily, from two Parisian makers, Secretan and Edouard Hardy, and the four transit instruments were manufactured by a relatively untried York maker, Thomas Cooke.<sup>7</sup>

Why Strange ordered *four* transit instruments is not immediately clear. It was common to work with pairs of instruments in the field, so that each could be cross-checked against the other. So for the principal “American” longitude work, Strange designed and commissioned two identical and cumbersome five-foot transit instruments that could, with difficulty, be moved between observing sites and mounted on large brick piers. But he also ordered from Cooke a subsidiary pair of portable transit instruments of a more novel design: what Strange called “two smaller Transit-Instruments (German form).”<sup>8</sup> This latter pair, completed in 1869 and shipped to India in large crates marked “RUSSIAN TRANSIT NO. 1” and “RUSSIAN TRANSIT NO. 2,” are the two instruments that now reside in the Whipple Museum. No purpose or project was ever stated for these more portable transits, and they quickly disappear from the Survey’s accounts of the “American” longitude work. So what survives to us of this enterprise are not actually the primary instruments for its work, but rather a more obscure pair of smaller instruments commissioned at the same time and subsequently much less visible in the textual record than their two five-foot siblings.

Strange’s appellation for the smaller pair, “German form,” and Cooke’s contradictory use of “Russian,” provides one essential clue for discerning their likely intended use. Either name could be used in Britain to denote a pattern of instrument first developed and used at Dorpat and then Pulkovo Observatory under the stewardship of the Baltic German astronomer Friedrich Georg Wilhelm von Struve. Specifically, it designated an atypical design feature favoured by Struve for field instruments, in which, to quote one British admirer, “in the middle of the telescope a prism bent the rays of light at right angles so as to pass out at one of the pivots where was situated the eyepiece.”<sup>9</sup> Such a “diagonal” design allowed a transit telescope to be mounted on a squatter base and, crucially, enabled the observer to sit at the side of the instrument rather than underneath it – a considerable boon in the field, where it mitigated against either the construction of tall piers or the digging of a trench. Struve used a “universal” (i.e. altazimuth) form of this instrument in his legendary Baltic survey work, which established a geodetic arc stretching from north Norway down through Dorpat to the Black Sea. Then, under the patronage of Nicholas I, Struve worked with the instrument-maker Ertel to refine the design, which he promoted theatrically as part of his and the Tsar’s wider campaign of astronomical imperialism. “Notwithstanding its complicated construction,” Struve advised, Ertel’s instrument “is

<sup>7</sup> Alexander Strange, “On a Transit-Instrument and a Zenith Sector, To be Used on the Great Trigonometrical Survey of India,” *Proceedings of the Royal Society of London* 15 (1867): 385–87.

<sup>8</sup> Strange, “On a Transit-Instrument” (n.7): 385. The five-foot transit instruments are described in detail in: *Account of the Operations of The GTS* (n.6), Vol. 9, 1–4. It is not known whether either of these instruments survive.

<sup>9</sup> A. R. Clarke, *Geodesy* (Oxford: Clarendon Press, 1880): 176.

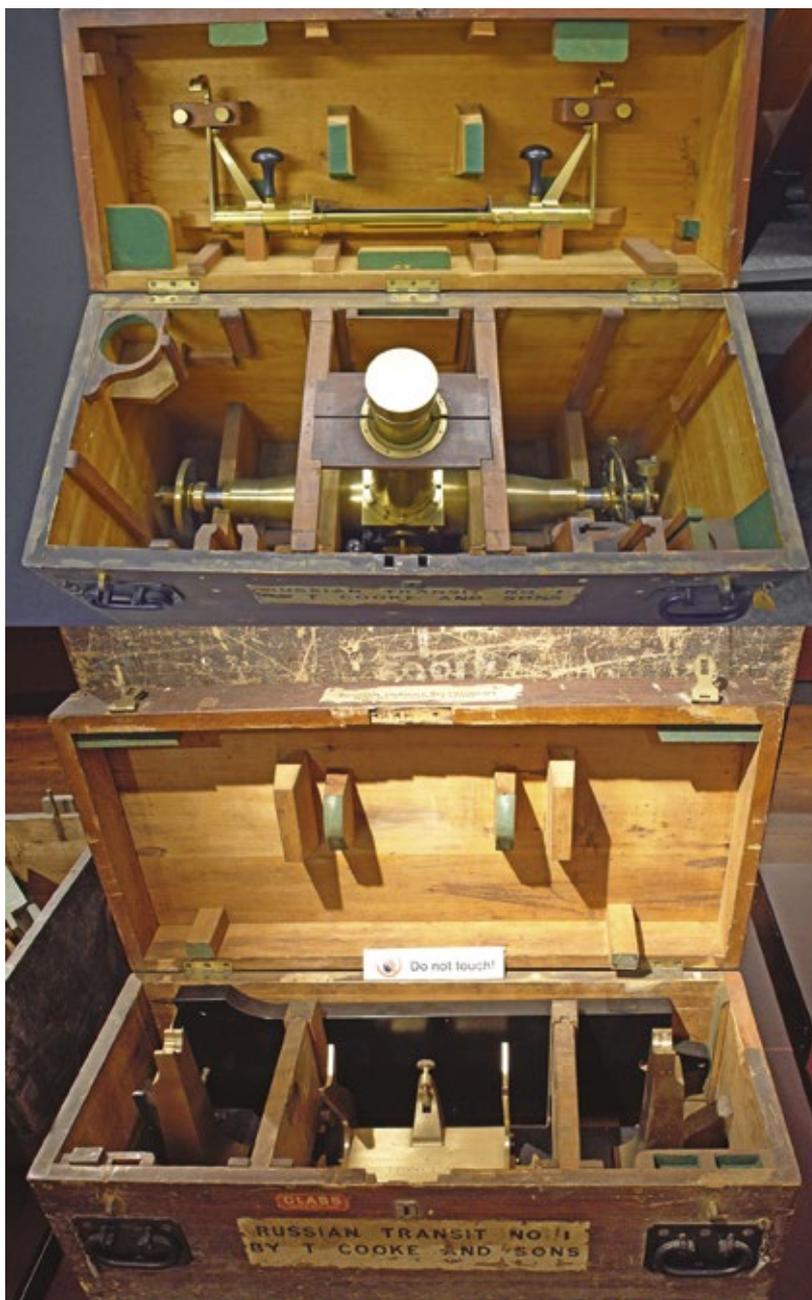


FIGURE 1. • A “Russian-pattern” transit instrument on display in the Whipple Museum’s 2017 exhibition *Astronomy & Empire*. The instrument packs into two large crates holding the telescope, pivots, and level (top), and base and Y-supports (bottom). This is one of an identical pair of instruments manufactured by T. Cooke & Sons in 1869 for the Survey of India. (Image © Whipple Museum, Cambridge (Wh.6641)).

mathematically admirable as a whole, and in its details, and it requires a rational observer who shall have studied it scrupulously. In the hands of such an one it fulfils its functions to perfection.”<sup>10</sup> During a personal tour of Pulkovo in 1847, one such rational observer, Britain’s Astronomer Royal George Bidell Airy, so admired the instrument that he ordered an example for Greenwich, to be made at source by Pulkovo’s principal optician, George Brauer. This instrument was then copied by Airy’s preferred maker, Troughton & Simms, with both examples trialled by the geodesist Alexander Ross Clarke in the Scottish Highlands, where they were used successfully to determine latitude, the direction of the meridian, and to rate the expedition’s chronometers.<sup>11</sup>

So by the early 1860s, when Strange was developing his final specifications for the Survey of India’s new instruments, the “Russian” pattern of transit instrument would have appealed for its relatively compact design and ease of use in the field. In remote locations a transit instrument was a valuable means of regulating timepieces and, if connected up to a telegraph line, they might even serve the same longitude-finding work as their larger five-foot siblings. It was, nonetheless, a bold choice to commission Thomas Cooke to make a novel pattern of instrument that only the more-established firm of Troughton & Simms had any experience of making in Britain. Cooke had first impressed Strange with his stand at the 1862 International Exhibition, where he displayed innovative optical devices manufactured at a large multi-purpose works in York. Credited with introducing the factory system to the British instrument trade, Cooke was known to fine his workmen for swearing, reading on the job, or “for introducing a stranger into the Works without leave.” Strange valued Cooke for his ingenuity, discretion, and because – entirely unusually at the time – Cooke could have every part of an instrument made on his own premises. In particular, as the only British maker to run a forge, Cooke could handle Strange’s exacting demand that the axes of the two five-foot transits be cast from aluminium-bronze as a bulwark against the Indian environment.<sup>12</sup>

But as Simon has taught us, instruments’ capacity to function at a distance raised pressing challenges for both makers and users.<sup>13</sup> It took the metalworkers in York three years to solve the riddle of Strange’s novel axes. And although the Russian transits were completed more quickly, inspection of the finished instruments at Lambeth exposed faults in the central prisms of both. Strange ordered the tricky prisms replaced with

<sup>10</sup> Simon Werrett, “The Astronomical Capital of the World: Pulkovo Observatory in the Russia of Tsar Nicholas I,” in *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture*, ed. David Aubin, Charlotte Bigg, and H. Otto Sibum (Durham: Duke University Press, 2010), 33–57. Struve promoted the instrument in his *Description de l’Observatoire Astronomique Central de Poulkova* (St. Petersburg: Academie des Sciences, 1845), 215–16. Struve is quoted in Clarke, *Geodesy* (n.9), 178.

<sup>11</sup> A. R. Clarke, “On a Determination of the Direction of the Meridian with a Russian Diagonal Transit Instrument,” *Monthly Notices of the Royal Astronomical Society* 37 (1869): 57–74.

<sup>12</sup> Anita McConnell, *Instrument Makers to the World: A History of Cooke, Troughton & Simms* (York: William Sessions, 1992), 51–56. For the quote, see the list of “Buckingham Works Rules and Regulations” reproduced on 54.

<sup>13</sup> Simon Schaffer, “Easily Cracked: Scientific Instruments in States of Disrepair,” *Isis* 102, no. 4 (2011): 706–17.

speculum mirrors, but Cooke took so long to perform the necessary alterations that the instruments missed their intended boat, delaying their arrival in India. Then, when the two larger five-foot instruments were finally shipped out, No. 1 was immediately found to possess “inferior quality” levels and an entire season of observations with No. 2 was rendered useless by a previously undetected splice inserted near the base of the object-end tube. “The existence of such patching,” a GTS Superintendent huffed, “must be considered sufficiently discreditable to makers of the rank of Messrs. Cooke & Son, and it was also imperfectly and clumsily executed.” Local repair of a novel design was a fraught proposition, but F. Doderet, a German instrument-maker employed by the Madras Public Works Department, fixed the splice in time for a successful campaign of chronometric work in 1875–76. But systematic errors soon returned and, despite a second round of remedial work in Calcutta, both instruments were eventually shipped back to York for modifications to their Y-supports and renewal of their micrometer screws. Yet even this costly fix failed to improve performance back in India, with the instruments’ persistent malfunction, according to one user, “wrapped in greater mystery than ever.” The problem was eventually traced to faulty collimator object-glasses, and remedial re-computations recuperated much of the previous decade’s troubled data. But the five-foot instruments never proved entirely trustworthy and they were replaced in 1894 by “more modern forms” constructed by Cooke’s great rival for India work, Troughton & Simms.<sup>14</sup>

In the midst of this farrago the Survey’s engineers searched about for an in-field alternative. Someone remembered the smaller Cooke transits. “There are in the possession of this department two transit instruments of the Russian pattern,” an official report noted, “and in view of their possible employment in future, some experiments were carried on at Mussooree during the recess season to ascertain whether sufficient reliance could be placed on their performances to justify their adoption in the electro-telegraphic longitude work.” The results of these trials were mixed, so the surveyors hedged: the smaller transits were “in many ways suitable,” but “certain simple alterations” were necessary, especially to the “untrustworthy” No. 2 instrument. This remedial work was carried out at the Mathematical Instrument Office in Calcutta, but like that done on the pair’s bigger siblings it does not appear to have worked. Enrolment of the Russian-pattern instruments into the exacting regime of longitude determination by wire and chronograph foundered, and the smaller pair of transits again disappear from the Survey’s voluminous reports.<sup>15</sup>

When the Russian pair next resurface, it is in the form of a diplomatic gift. In 1921, the retired Survey engineer Sir Gerald Lenox-Conyngham was hired as the first Reader in geodesy at the University of Cambridge, following a distinguished career in India. He

<sup>14</sup> McConnell, *Instrument Makers to the World* (n.12), 56; *Account of the Operations of The GTS* (n.6), Vol. 9: 3, 9; Vol. 15: 2, 373–75; Vol. 17: 3; *General Report on the Operations of the Great Trigonometrical Survey of India, during 1870–71* (Dehra Dun: 1871), 51a; & same ... *during 1873–74* (Dehra Dun: 1874), 55a–58a.

<sup>15</sup> *General Report on the Operations of the Survey of India ... during 1887–88* (Calcutta: 1889): 63–64, Appendix ix.

had been courted by Trinity College astrophysicist Hugh Newall, who first bonded with Lenox-Conyngham at the 1898 solar eclipse expedition to Pulgaon, India. Two decades after this social-scientific event, this connection secured Lenox-Conyngham the task of establishing a department from scratch, founded, it was hoped, “to secure for Geodesy that recognition and support in this country which it has long enjoyed in several other countries, notably in India.”<sup>16</sup> Bereft of funds and hired very much with practical tuition in mind, Lenox-Conyngham’s first task was to secure basic instrumentation, most of which had to be gathered by appeal. Local industrialist Horace Darwin gifted a level and staff; another influential friend, Henry Lyons, sent on loan from the Science Museum a set of half-second pendulums; but the largest haul came from the Survey of India, who donated a sidereal clock by Frodsham, a twelve-inch theodolite by Troughton & Simms, and “two ‘Bent’ Transit Instruments, by T. Cooke & Sons.” Packed off from Bombay in October 1922, nine boxes of instrumentation travelled via the India Store Department in London, arriving in Cambridge in time for the start of Lent term. This gift, Surveyor General John Hodgson declared, would support “the existence and welfare of a School of Geodesy in England and the development of a sense of co-operation and understanding between such School and the Survey of India.”<sup>17</sup>

Yet neither of the Russian transit instruments end their journey here. Their transition from imperial time devices to museological time machines was not so straightforward. In 1959, after nearly a century of use, the instruments were still in demand, with No. 2 packed off from Madingley Rise to Oxford on “indefinite loan” for use by another veteran of the Indian surveys, Reader in Geodesy Guy Bomford. No. 1, meanwhile, entered a retirement of sorts only in 1975, being sent from Cambridge on loan to the stores of London’s Science Museum, where it was reunited with No. 2 briefly in 1987, before the then curator of Earth Sciences, Anita McConnell, noticed the duplication and offered No. 2 to the Whipple Museum, as – in the Science Museum’s muddled reckoning – a loan from Oxford. Only after the Whipple’s curator, Jim Bennett, reviewed the trail of paperwork did he make a striking discovery: “The documentation appears to suggest a Cambridge title!” This brought No. 2 back to Cambridge, one hundred and eighteen years after it had left York and sixty-five years since its departure from India. No. 1 had to wait even longer, until a purge of long-term loans at the Science Museum reunited it with its partner instrument in 2015.<sup>18</sup> Only then, after a protracted and improbable journey, could either instrument appear in a public setting as an historical artefact. There, on gallery, these objects can be situated in stories to give them new meanings, only some of

<sup>16</sup> Lenox-Conyngham to Superintendent, India Trigonometrical Survey, 2 Mar. 1923, GBR/0012/MS Add.9249/II/23: Cambridge University Library; C. A. Williams, *Madingley Rise and Early Geophysics at Cambridge* (London: Third Millennium, 2009), 38–62.

<sup>17</sup> Herbert Cowie to Lenox-Conyngham, 23 Nov. 1922, GBR/0012/MS Add.9249/II/11: Cambridge University Library (and for the boxes’ journey, see letters 12–22 in the same series); Williams, *Madingley Rise* (n.16), 56.

<sup>18</sup> Copies of the extensive correspondence between Cambridge, Oxford, and the Science Museum are held in the Object History File for Wh.6641 in the Whipple Museum of the History of Science, Cambridge.

which will accord with the accounts of their users. Where Strange saw unusually *portable* instrumentation, for example, we might interpret the considerable size and weight of the crated Russian transits as evidence of labour and power dynamics uncommented on by his and his colleagues' reports.

There is a fallacy in science studies that things have agency like people do – that objects can as it were “talk” if only we develop the right skills with which to listen. This is not only a category error but a failure of historical reasoning, condemned to follow a determinist logic in which large-scale atrocities like Raj rule in India are explained away as a function of material and environmental processes. Furthermore, as Simon has noted, this “heresy of hylozoism” tends to erase the messy human labour – the power relations, wilful acts, and unconscious processes – that underpins the tidy conclusions of men like James Walker and Gerald Lenox-Conyngham.<sup>19</sup> To these men, the lessons of the transit instrument are self-evident: when a star crosses its crosshairs in Dehradun it performs the same function as the equivalent instrument in Greenwich. The difference between the two is a difference in longitude. But as Simon has shown us, no instrument is so powerful as to have the same effect everywhere; nor is any instrument so weak as to be completely dependent upon each and every local context of use.<sup>20</sup> So it pays to follow the working lives of instruments closely, so that we might better understand the open-ended dynamics of these social-material practices. It also pays to keep following these objects out of the field and into the museum, so that we might see how collections of things shape and bound our journeys back in time.

<sup>19</sup> Simon Schaffer, “The Eighteenth Brumaire of Bruno Latour,” *Studies in History and Philosophy of Science* 22, no. 1 (1991): 174–92, on 182.

<sup>20</sup> Schaffer, “Object Lessons,” (n.1): 61.

# Simon in Calcutta

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ROHAN DEB ROY

Simon visited Calcutta in the winter of 2014. He flew in from New Delhi, where we (Sujit Sivasundaram, Devyani Gupta, Simon and I) had just co-organized a well-attended conference on the “global histories of science.” Simon visited Calcutta at the invitation of two leading academic institutions in the city: Presidency University, and the Centre for Studies in Social Sciences. At Presidency, he spoke on the global historiography of science. The following afternoon, at the Centre, he gave an awesome talk on the cultural histories of automata in modern Europe. On both occasions, Simon addressed a packed audience. Obviously, colleagues in the city were totally smitten by one of the field’s most erudite and generous ambassadors. Since then, Simon has continued to mentor scholars based in Calcutta and New Delhi, some of whom have already gone on to publish major books. In between these lectures, Simon led a group of historians of colonial science into a short trip of some of the city’s major landmarks; sites which indicate the entanglements between science and empire: the river Ganges, the Old Park street cemetery, the botanical gardens, the Indian Museum and the National Library. In Cambridge, I have experienced some magical moments with Simon. I still vividly remember, for instance, one summer evening in 2012 when, at the end of the departmental garden party, Simon pointed us towards the night sky and talked about some of its celestial inhabitants. But, spending time with Simon in Calcutta in the midst of decaying British imperial monuments was something else. In Simon’s company, we discovered how some of my familiar spots in the city witnessed the interactions between intellectual history and material culture, and how those sites bore traces of historical processes such as circulation, collection, exchange, translation, environmental agency and change. At the end of a few eventful weeks, Simon wrote to me from the Calcutta airport on his way back to England, quoting Rabindranath Tagore, “Rest belongs to the work as the eyelids to the eyes.”

I leave you with some memories of that visit.



FIGURE 1. • At Presidency University, Calcutta, December 2014.

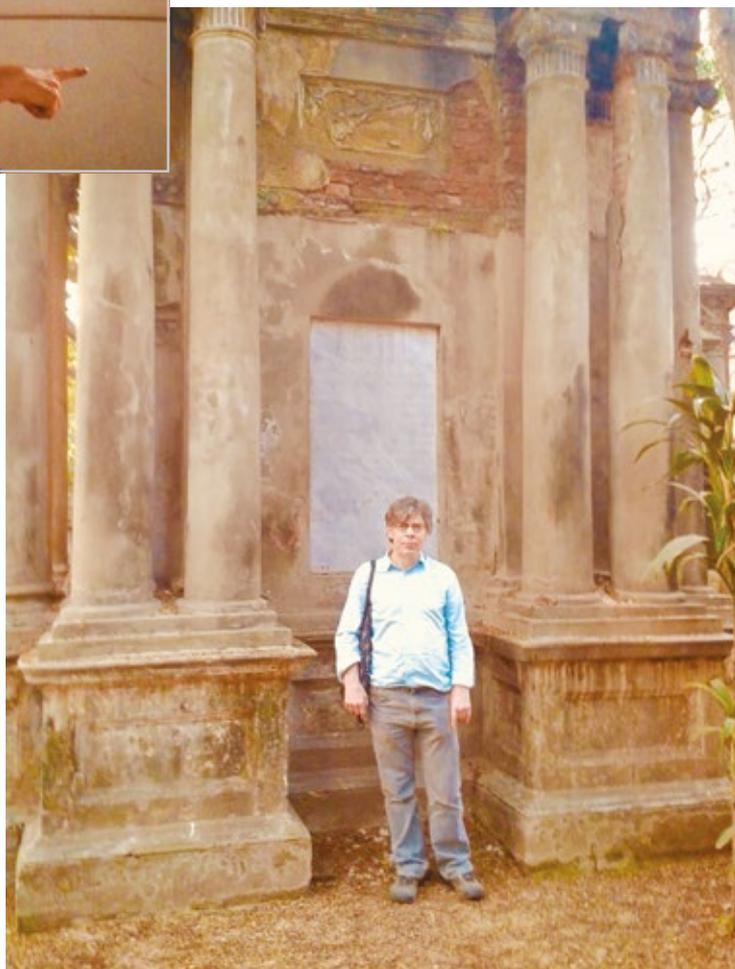


FIGURE 2. • At the Old Park Street cemetery, Calcutta.

FIGURE 3. • The Great Banyan Tree at the Botanical gardens, Calcutta.

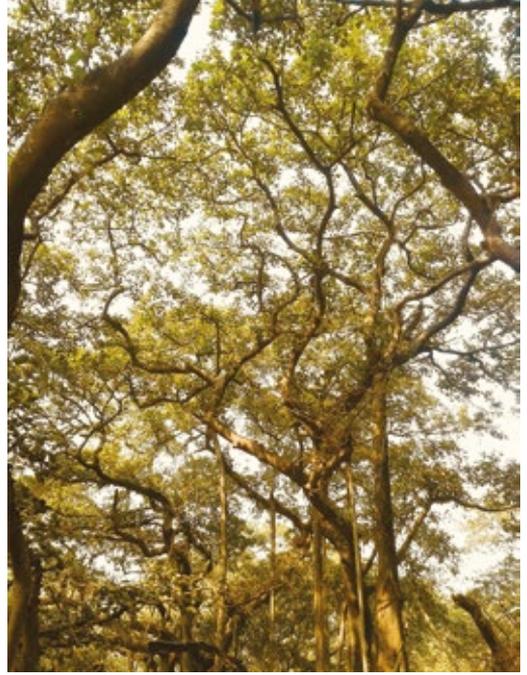


FIGURE 4. • Simon on the Ganges.



FIGURE 5. • With Marine Bellego and Shinjini Das, historians of colonial science in South Asia.



FIGURE 6. • Sunset in Calcutta, December 2014.

# On being there ...

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EIVIND KAHRS

In September 1991, Simon accompanied Anita to Australia, where she had to oversee the hand-delivery of a canoe prow. On the way back, they made a stopover in Delhi, meeting up with me and our mutual friend Nigel, who had come with me to India a few weeks earlier. Since then, more than three decades of two centuries have passed. I had been to Delhi before and I've been to Delhi numerous times since, and I would happily do that particular trip again, not least because of Simon's applied wit and good humour, which have thankfully not left him yet.

Visits to obvious sites in New Delhi took place, with an unrestored Connaught Circus, Lutyens' Delhi, and the Jantar Mantar, one of four astronomical observatories built by Maharaja Jaisingh II of Jaipur in 1724, today known more as an assembly point for political protest.

On seeing Lutyens' Delhi, Simon exclaimed: "I hate to admit it, but it's great!"

The visit to the Jantar Mantar provided the closest I've ever come to anything like an *in situ* HPS lecture – by Simon, of course, with the workings of the observatory patiently explained. In fact, it was in a different league than anything approaching an explanation – the details of its workings, but also how it was done and why it was done, and the political, astronomical, and contextual ramifications at that time in history, all the while with a sideshow referring to Jaisingh II's parallel in Jaipur.





Time constraints entailed choices, and it was decided to make an overnight excursion to Agra – for the Taj Mahal, Agra Fort, and Fatehpur Sikri, and we had a brilliant time after a somewhat tortuous bus ride.

The bus ride to Agra was soon forgotten.

The Taj was as splendid as ever, as were Agra Fort and Fatehpur Sikri, Akbar's old capital from 1571, finally abandoned in 1610, and since then having had various uses.



The Taj was as splendid as ever, its visitors maybe not.

At the Taj, the owner of “The dusty rose” – who was suffering from a sore on his lip – was accosted by a group of youths trying to stir up trouble: “Sir, you look like Hitler.”

Simon retorted quickly from the sidelines: “You’re completely mistaken. Hitler was a diminutive Austrian housepainter with a toothbrush moustache.” Their provocative stance fizzled out.



Good humour was retained throughout.  
And new possibilities were explored.



“Anyone for breakfast?”

On the bus back from Agra – definitely a slow coach – only the back seat was available, and an open vent kept blowing ice-cold air directly onto my shivering skull; it was hot outside but not on the bus. Just because you're that bit taller, it doesn't mean that anyone else should feel obliged to take the blast voluntarily. Simon insisted we swap. A friend in need is a friend indeed ...

In spite of its rectilinear motion, it took the bus seven hours to reach Delhi. Seven long and tortuous hours from Agra to Delhi in the back seat of a bus.

When we came back to Simon and Anita's hotel, time had gone past midnight, but it was still possible to get a bite to eat. While we waited, Simon had the presence of mind to alert the house band in the next room discreetly to the fact that it was by now Nigel's birthday, something they duly implemented in their impromptu performance. An unforgettable surprise.

The grand tour had come to an end, but not Simon's wit, presence of mind, and grasp of the history of astronomical science and other branches of knowledge – and not his curiosity and kindness of heart. On call or not on call – just being there. "Of course, dear."

They agreed that it had been a grand day out before it was handed back to the dark of the night.

Simon, I wish you a long and lustrous retirement!



# Simon and the Orientalists: India 1991

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NIGEL LEASK

At the time of writing I haven't been out of Scotland for over two years, mainly due to the pandemic, so have only had a chance to catch up with Simon and Anita on zoom. This I greatly regret, and look forward to visiting Cambridge again soon to see them, and other old friends. But despite lockdown my mind has been on travel, and as part of my current research on the 18<sup>th</sup>-century Scottish Tour, I've been working on the manuscript of Warren Hastings's 1787 two-week "petit tour" from Edinburgh through the southern Highlands, conducted between his arrest in May 1787 and the start of his long drawn out impeachment in February the following year. Hastings was accompanied on tour by his loyal East India Company colleagues David and James Anderson, who hailed from Edinburgh. Unfortunately he has disappointingly little to say about India, preferring to describe the Carron Iron Works, the mechanics of the town pump in Perth, and to dodge various Scottish aristocrats like the Duke of Argyll who supported the impeachment.

Following the trail of Hastings, the patron of Bengal orientalism, and David Anderson led me back to Simon's wonderful 2009 essay "The Asiatic Enlightenment of British Astronomy" in *The Brokered World*, co-edited with Lissa Roberts, Kapil Raj, and James Delbourgo. It's a typical Schaffer tour de force, a "monograph in miniature" (at 54 pages, its footnotes are characteristically on an encyclopaedic scale), and offers a magisterial analysis of the chiasmic relationship between Company orientalist in 18<sup>th</sup>-century Calcutta and their Asiatic "go-betweens." While the orientalist sought to reconstruct an ancient version of a universal Newtonianism promoted by "Chaldeans, Egyptians, Pythagoreans and Buddhists," contemporary Shi'ite scholars (especially the 'erudite and reliable go-between' Tafazzul Hussain Khan, translator of Newton's *Principia* into Arabic in 1789) "endeavoured to make sense of some fascinating hardware and printed materials that had reached south Asia: 'great Copernicus' and 'greater Newton.'"<sup>1</sup> Tafazzul's intrigues on behalf of the Company with his associate David Anderson, his procurement of oriental manuscripts for Hastings, and his involvement with members of the Asiatic Society, such as the crazy Yorkshire mathematician and syncretist Ruben Burrow, demonstrate the power and importance of brokered knowledge in the colonial contact zone.

<sup>1</sup> Simon Schaffer, "The Asiatic Enlightenment of British Astronomy," in *The Brokered World: Go-Betweens and Global Intelligence, 1770–1820*, ed. Simon Schaffer et al. (Sagamore Beach: Watson Publishing, 2009), 53.

Simon describes how Burrow was engaged in writing a treatise on the “Principles of Ancient Hindu Astronomy,” although his extravagant claims to have discovered an ancient “global Newtonian Buddhism” rather alarmed his mentor, the celebrated orientalist Sir William Jones. I’d encountered Burrow before, when researching an essay on “Francis Wilford and the Colonial Construction of Hindu Geography” published in 2000. Burrow cited his fellow Calcutta orientalist Wilford in proclaiming “that the Druids of Britain were Brahmins is beyond the least shadow of doubt.” Wilford’s 600-page treatise “On the Sacred Isles of the West,” published in *Asiatic Researches* between 1805–10, supported Burrow’s belief in arguing that the “White Isles of the West” (aka Britain and Ireland) were the home of Vishnu, source of the Vedas, and that “there is a tribe of Brahmins in India to this day, actually descended from a sacerdotal tribe residing originally in the white islands.” Wilford’s essay was however severely compromised by his admission that he had detected his unnamed Brahmin *pandit* in the act of forging evidence to lend support to his syncretist fantasies: he was the victim of what Simon would call a “leaky” go-between (in contrast to Tafazzul), who in the end caused Wilford’s scholarly ship to sink, however much his romantic mythography appealed to poets like Southey, Coleridge and Shelley. In an embarrassed recantation of his earlier enthusiasm for Wilford’s researches, in 1812 the outraged Anglican mythographer Thomas Maurice published *Brahminical Fraud*, exonerating the European scholar and laying the whole blame for the deception on the mendacity of his Asian informants.

Another wonderful example of the risks of transcultural confusion in a colonial context is Simon’s account of the British (mis)understanding of Jai Singh’s astronomical observatories, constructed in the mid-18th century in Jaipur, Delhi, Ujjain, Benares and Mathura. Jai Singh’s astronomy updated *jyotihśāstra* using Islamic material: but crucially, he was also well-informed by Portuguese Jesuits about the development of the celestial sciences in Europe. An Indian delegation visited Lisbon in 1731, bringing back de la Hire’s celestial tables, and French Jesuits arrived in Jaipur in 1734, with “telescopes, quadrants and expert advice.” At Jai Singh’s death in 1743, “northern India could [thus] boast a co-ordinated and systematic astronomical network, committed to the production of celestial data which combined ingeniously the received Sanskrit calendars, updated tables from Islamic astronomers, and planetary and lunar elements derived from heliocentric French models. Absolutely none of this seems to have been known to the British astronomers who first saw the relics of Jai Singh’s programme barely three decades later.”<sup>2</sup> Obsessed by antiquarian fantasies about India, the veteran EIC artillery officer Thomas Pearce argued that the ancient Hindus had possessed powerful telescopes and had even correctly predicted the existence of the sixth moon of Saturn (patriotically named “George” by Herschel in 1789, although the royal denomination was soon rejected in favour of “Uranus”). But Pearce’s Burrowian reveries were soon rumbled by William Hunter, who had actually met the grandson of Jai Singh’s astronomer, and dis-

<sup>2</sup> Simon Schaffer, “The Asiatic Enlightenment of British Astronomy,” 82.

covered “the decisive role that European astronomy, telescopic and tabular, had played in Jai Singh’s project ... Hunter and his colleagues now opted for a Eurocentric judgement.” At about the same time, Hunter expressed his admiration for Tafazzul’s Newtonian translation project which he read as a “sign of voluntary submission to European grandeur.” His conclusion wasn’t that different from Maurice’s detection of “Brahminical Fraud” in the case of Wilford’s “Sacred Isles:” “what Brahmins were now newly learning from their British interlocutors would then somehow turn up in their overwrought version of supposedly ancient Sanskrit texts.”<sup>3</sup>

Just over thirty years ago, in September 1991, I paid my first visit to India, spending three weeks travelling with my friend, Norwegian Sanskritist and fellow Queens’ man, Eivind Kahrs. Eivind has provided his own account of the trip in this volume, accompanied by some wonderful photos, so I hope our two narratives are complementary, or at least not contradictory! These were the good old days when academics could spend three weeks in September travelling the world uninterrupted by emails, students, university line managers and administrators, etc. etc. How times have changed. After staying with Indian friends in Delhi, we travelled to Maharashtra to visit the Ellora and Ajanta Caves, to lecture at the University of Pune, and then continued south to Bangalore, Mysore, Coorg and Tamil Nadu. It was an especially poignant trip for me, visiting my father Reay Mackay Leask’s birthplace at “Ooty” (Ootacamund) on his birthday, 24th September, given that he had sadly died a few months earlier – a planned joint trip to India had never materialised. I kept a detailed journal of the trip, unusually for me, as I’m generally a poor diarist, unlike the literary travellers whose work I study, and a good number of photographs are bound together in a special “India 1991” album.

On the final leg of the tour, Eivind and I returned to Delhi, where, on the evening of 26th September, my diary records that we had the pleasure of meeting up with Simon and Anita, who had stopped off on their return journey from a trip to Australia, and honeymooning in Thailand: they were booked into the Imperial Hotel (rapidly dubbed “the Imperialist”). We planned to spend our few days together being tourists: forget about the fact that we were a historian of science, an anthropologist, a Sanskritist, and a Romanticist: more to the point, we were a bunch of good friends on holiday. Next day we embarked on a tourist bus for Agra at crack of dawn, swapping travellers’ tales en route: I’m glad to say that I noted of Simon and Anita “they’re both in very good form and behaving as honeymooners should!” At the Taj Mahal, Simon rescued me from abuse by a tourist tout, who accused me of resembling Hitler – Eivind has related the circumstances in all their humorous detail, better than my diary records. We laughed about this as we knocked back “Black Label” beers in the hotel bar afterwards, pondering the Indian “law of contradictions,” probably with as much cultural insight as 18<sup>th</sup>-century Asiatic Society orientalists. Next day we were off to Fatipur Sikri, one of the highlights of the trip, which helped me grasp that Akbar was the inventor of syncretic orientalism, with its interweav-

<sup>3</sup> Simon Schaffer, “The Asiatic Enlightenment of British Astronomy,” 88.

ing of Islamic, Hindu, Chinese, Jewish, and Christian motifs and designs (hardly a new perception, but as a student of romantic orientalism, I recall it made quite an impact on me). And obviously this was a big inspiration for Lutyens's New Delhi, which Modi now plans to demolish – unfortunately as much on account of its Indo-Muslim, as its colonial connotations.

The photos in Eivind's piece show the four of us posing in the standard location in front of the Taj, all looking (horrendously) fresh-faced and youthful, and there are a couple of great shots of Simon in his white jacket at Fatipur Sikri. I'll spare you the antiquarian details of that visit, entered painstakingly in my diary, and my fellow travellers will require no further information about "the raw-hide bullock whip episode" as we approached the Fort, the source of much subsequent merriment. Eventually, after the nightmare journey described by Eivind, the bus delivered us back to "the Imperial" in Delhi, but unfortunately I had eaten a dodgy biriani en route which assaulted my bowels the next day: unfortunately, also my 33<sup>rd</sup> birthday. But thanks to immodium, and my supportive fellow travellers, I had an enjoyable birthday the next day, and we visited the National Museum, admiring the Chola bronzes, Buddhist paintings and Mughal miniatures, although Anita was underwhelmed by the Naga collection for reasons which she probably remembers. Later, we photographed her up at the Lutyens project at Raisina Hill under the "Canada to India" pillar. At a lovely vegetarian restaurant in the Ambassador Hotel, Simon has us all in stitches with his account of Psalmanazar, the most bogus of all 18<sup>th</sup>-century orientalisists. My diary records that back in the hotel, we played a game in which anyone who mentions the word "stomach" paid a forfeit by buying a round of drinks! I have no recollection of this episode.

Next day, a bit hung-over, we continued our touristic activities, shopping in the emporia, and after the Hanuman Temple, we visited the Jantar Mantar, Jai Singh's observatory near Connaught Place (see above). Simon gave us chapter and verse during the visit, and there's a better informed account of the visit in Eivind's contribution here – unfortunately not much trace of Schaffer erudition survives in my impressionistic diary entry: "The Jantar Mantar is a remarkable place, constructed in 1725, and dominated by a gigantic gnomon looking like a swimming pool diving board [I'd obviously spent too much time in the pool of the Imperial, with its memorable slogan "the Riviera meets the Raj"] ... an ochre-painted coliseum-type building ... the effect of the whole is very much that of a painting by De Chirico." (But at least I didn't claim it was two thousand years old and representative of "global Newtonian Buddhism," like Messrs Burrow and Pearce. How could I have made such an orientalist mistake with Simon as my dragoman?) After a wonderful final dinner in "The Frontier" Restaurant in the Ashoka, Simon and Anita headed off for the airport to catch the 3.30am flight (yes, apparently!) back to London. Next day Eivind and I in turn took the "Pink City Express" to Jaipur to spend our final few days there before following our friends home on 6th October for the start of term. "I've been into college and opened my mail – what a marathon task!" I wrote in the final entry. These were indeed innocent times!

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Over the years, memories of these wonderful days in and around Delhi have remained with me, and anecdotes have resurfaced over a few drinks when we've been reunited, doubtless trying the patience of our long-suffering partners Evelyn and Sudeshna. It was just one of several fantastic trips we made together – there's a whole other story to be told about travelling with Simon and Anita in Mexico: and let's hope there will be more in future. But what a pleasure it was to be tourists together in India in September 1991. We had a hell of a lot more fun than Warren Hastings had touring Scotland in 1786: but there again, no one was about to be impeached. Tourism might be a form of neo-colonialism, but I doubt we'd done anything that would have offended Edmund Burke. Simon was then, as he is now, an inspirational friend, funny, clever, humane, and above all sane (in a crazy world), and I wish him good health, happiness, and a joyful retirement.

# The colonial origins of novel coronaviruses

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MARY AUGUSTA BRAZELTON

Simon Schaffer's publications have explored the early modern, often imperial origins of systems we take to be unquestionably modern. To give just one memorable example, writing on nineteenth-century British debates over machine intelligence, he notes that Turing's "imitation game was but one of a long series of projects in technical fakery – Swift's speculations on whether Gulliver was man, machine, or horse; Vaucanson's automata; Babbage's analytical engines; Keaton's acting; Warhol's soup tins."<sup>1</sup>

I doubt that it is possible to contribute anything here that gives due honour to Schaffer's achievements; an attempt follows nevertheless. One of the more significant events of the past few years, the Covid-19 pandemic, is generally taken as a product of very recent processes. The emerging scholarly consensus is that, like SARS-CoV-1 in 2003, SARS-CoV-2 is the consequence of transgressive interspecies encounters within the People's Republic of China, in which the cultivation of exotic animals intersected fatally with economic and agricultural reforms of the 1980s and 1990s.<sup>2</sup> Here, I argue that this apparently recent epidemiological trend has a history more extensive than the decades of the post-Mao era. Specifically, I would like to suggest that the outbreak of Covid-19 can be productively contextualized in the governance of China's Qing dynasty (1644–1911) in its southwestern borderland, Yunnan.

Why Yunnan? A mineshaft in that province's Mojiang County has the dubious distinction of being the site where, in 2012, a novel coronavirus was found in horseshoe bat populations after it infected six miners via zoonotic transmission. In 2020, that virus was found to share about 96 percent of its genome with SARS-CoV-2.<sup>3</sup> A World Health Organization team posited in 2021 that it was possible that Covid-19 jumped from bats

<sup>1</sup> Simon Schaffer, "OK Computer," in *Ansichten der Wissenschaftsgeschichte*, ed. Michael Hagner (Frankfurt: MS Fischer, 2001), 393–429.

<sup>2</sup> Mei Zhan, "Civet Cats, Fried Grasshoppers, and David Beckham's Pajamas: Unruly Bodies after SARS," *American Anthropologist* 107, no. 1 (2005): 31–42; Amy Maxmen, "Wuhan market was epicentre of pandemic's start, studies suggest," *Nature*, 27 February 2022, <https://www.nature.com/articles/d41586-022-00584-8>.

<sup>3</sup> Peng Zhou, Xing-Lou Yang, Zheng-li Shi, et al., "Addendum: A pneumonia outbreak associated with a novel coronavirus of probable bat origin," *Nature* 588 E6 (2020). <https://doi.org/10.1038/s41586-020-2951-z>

like those in the mineshaft to an intermediary host before its transmission to humans at Wuhan's Huanan market: "The scenario including introduction through an intermediary host was considered to be likely to very likely ... there was evidence for supply chains leading to wild-life farms from provinces where the higher prevalence of SARSr-COVs have been detected in bat surveys [i.e. Yunnan]."<sup>4</sup>

Although the interspecies relationships leading to the outbreak of this global pandemic are both irrecoverably complex and very recent, they are also a consequence of long-term economic and environmental processes in China's southern and southwestern provinces. It was the last imperial dynasty, the Qing, that most firmly integrated Yunnan into what is now thought of as China through its consolidation of power there. Schaffer has called attention to the significance of that dynasty's technical resources.<sup>5</sup> The southwest frontier was a key site for the empire's application of empirical knowledge in service of its expansion, demonstrated in ethnographic and cartographic projects to assimilate Guizhou, the province neighbouring Yunnan.<sup>6</sup>

Three aspects of Yunnan's colonial experience are relevant here: extractive mining, the state's intrusion into longstanding sites of endemic disease, and economic integration into a market system centred at Hankou (one of three cities comprising the contemporary metropolis of Wuhan). The mine shaft where the retrospectively portentous bats were found reflects Yunnan's long history as a source of copper for China. It's not clear what remains of Qing-era copper mines there; twentieth-century industrial mining projects probably obliterated many of them from the landscape.<sup>7</sup> But it was the Qing state's need for cash that made Yunnan a major mining site in the first place. In the bimetallic currency system of imperial China, one string of a thousand copper cash coins (actually cast using complex and varying mixtures of copper, tin, and/or zinc) was equal, legally if not always practicably, to one silver tael or ingot. In other words, coins needed to be widely available in large quantities. Meeting this need proved a challenge for the Qing state. By the early eighteenth century, the more accessible copper mines of southeast and south central China had been mostly worked out, and Japan's Tokugawa shogunate began to limit its copper exports. Consequently, the Qing bureaucracy began the work of turning a rebellious and epidemic-prone southwestern borderland, populated by a variety of non-Chinese groups, into a productive source of ore.<sup>8</sup> This was not a peaceful

<sup>4</sup> "WHO-Convended Global Study of Origins of SARS-CoV-2: China Part, Joint WHO-China Study, 14 January – 10 February 2021, Joint Report," 116. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/origins-of-the-virus>.

<sup>5</sup> Simon Schaffer, "Instruments as Cargo in the China Trade," *History of Science* 44, no. 2 (2006): 217–46.

<sup>6</sup> Laura Hostetler, *Qing Colonial Enterprise: Ethnography and Cartography in Early Modern China* (Chicago: University of Chicago, 2001).

<sup>7</sup> Nanny Kim, "Fuel for the Smelters: Copper Mining and Deforestation in Northeastern Yunnan during the High Qing, 1700 to 1850," in *Southwest China in a Regional and Global Perspective (c. 1600 – 1911): Metals, Transport, Trade, and Society*, ed. Ulrich Theobald and Cao Jin (Leiden: Brill, 2018), 95.

<sup>8</sup> Niv Horesh, "The Monetary System of China Under the Qing Dynasty," in *Handbook of the History of Money and Currency*, ed. S. Battilossi et al. (Springer Nature, 2020), 556–7; C. Patterson Giersch, "Cotton, Copper, and Caravans: Trade and the Transformation of Southwest China," in *Chinese Circulations: Capi-*

process. The governor-general E'ertai mounted violent military campaigns in the 1720s; in the 1760s, the Qianlong emperor used Yunnan as a base from which to wage unsuccessful war with Myanmar; and in 1856, anti-Muslim policies provoked Hui Yunnanese to lead the province-wide Panthay Rebellion, which was quelled harshly in 1873. The Qing also undertook a process of settler colonialism that made the Han Chinese ethnic group, insignificant compared to the diverse range of non-Chinese peoples who'd long inhabited Yunnan at the dynasty's start, predominant by 1850.<sup>9</sup>

Over the eighteenth century, copper mining became big business in Yunnan. By 1738, ores from Yunnan supplied central government mints and increasing numbers of provincial mints. Pat Giersch notes the Qing bureaucracy's assumption that "state control of copper coinage ... was central to maintaining order."<sup>10</sup> As the commercial economy grew, so did the need for cash, which fed the expansion of mining in Yunnan, and so thousands of Han Chinese migrated there to supply the necessary labour. Opening and running mines required the establishment of new transport infrastructure and increased agricultural cultivation in the province, processes which accelerated deforestation and environmental degradation.<sup>11</sup>

Then as now, epidemics accompanied environmental crisis. The range of diseases long known to be endemic to Yunnan, especially the malaria-like illnesses called *zhang*, had long impeded colonization by Han Chinese, so the Qing administration came up with systems of settlement and governance that adapted to regional epidemiology.<sup>12</sup> The governors-general of Yun-Gui continued a pre-existing system of native chieftainships to directly administer the *zhang* areas. Qing officials generally believed that Han people could not stay in these regions without becoming sick, whereas non-Han indigenous peoples had constitutional resistance to local diseases. Administrators dismissively sought to replace the latter peoples' (comparatively sustainable) methods of farming with the expansion of agrarian cultivation. Their strategy was part of a broader civilising mission that had the long-term goal of making native chieftains more controllable. Further settlement would in turn address the problem of epidemics which was itself originally constructed by colonisation and which had mandated the chieftain system's implementation in the first place. "As the density of human habitation steadily flourishes, the mists and mias-

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*tal, Commodities, and Networks in Southeast Asia*, ed. Eric Tagliacozzo and Wen-Chin Chang (Durham and London: Duke University Press, 2011), 42; and Nanny Kim, "The Tangdan Copper Mines and the 1733 Earthquake: A Mining Community before the Boom in the Far Southwest of Qing China," *Cross-Currents: East Asian History and Culture Review* 4, no. 1 (2015): 287.

<sup>9</sup> C. Patterson Giersch, *Asian Borderlands: The Transformation of Qing China's Yunnan Frontier* (Stanford, CA: Stanford University Press, 2006), 2; Yingcong Dai, "A Disguised Defeat: The Myanmar Campaign of the Qing Dynasty," *Modern Asian Studies* 38, no. 1 (2004), 145–89; and David G. Atwill, *The Chinese Sultanate: Islam, Ethnicity, and the Panthay Rebellion in Southwest China, 1856–1873* (Stanford, CA: Stanford University Press, 2005).

<sup>10</sup> Giersch, "Cotton, Copper, and Caravans," 41–43.

<sup>11</sup> Giersch, "Cotton, Copper, and Caravans," 44; Kim, "Fuel for the Smelters," 120–21.

<sup>12</sup> David Bello, *Across Forest, Steppe, and Mountain: Environment, Identity, and Empire in Qing China's Borderlands* (Cambridge: Cambridge University Press, 2015).

mas will dissipate on their own,” confidently predicted Yun-Gui governor-general Gao Qizhuo in the mid-1720s.<sup>13</sup>

These strategies apparently worked, at least in the short term. Yang Bin describes the retreat of *zhang* diseases as Qing colonization reached further into Yunnan’s mountainous terrain. He attributes the lower reported incidence of *zhang* to the deforestation and environmental contamination caused most directly by colonial mining, which forced animals to move out of their conventional habitats (hence, perhaps, bats’ adaptation to mine pits and shafts as alternatives to caves) and brought human settlers and merchants to new territories. Consequently, the belief grew among Han people that “the *zhang* could do nothing other than strengthen the determination of Chinese migrants to civilize the south.”<sup>14</sup> This may have been a premature declaration of victory, since infectious diseases other than *zhang* continued to arise in the southwest, most infamously the Third Plague Pandemic of the mid-nineteenth century, which originated in Yunnan and subsequently circulated around the world.<sup>15</sup>

“Civilization” had its costs. By the early-twentieth-century fall of empire, Yunnan was among the poorest provinces in China. Although the Qing had brought remarkable commercialization, state corporations and private shareholding partnerships both extracted resources from and displaced the leaders of non-Han communities.<sup>16</sup> The establishment of transportation networks in service of the mining industry worked to integrate Yunnan, long economically connected to South and Southeast Asia, more firmly into Chinese trading networks. Local goods – tea, copper and tin, and eventually opium – were shipped on to markets through the major regional trading centre at Hankou, the transshipment hub on the Yangzi River. Yang Yuda has shown that from the mid-Qing, Yunnan “private copper,” mined illegally, met the demands of the Qing’s growing craft industry through its shipment to Hankou, where it entered the legal commercial trade.<sup>17</sup> In the late seventeenth century, state actors and local elites undertook engineering projects to make the Yangzi River easier to navigate from its upper reaches in Sichuan; in Yunnan, merchant guilds, philanthropists, and local organisations maintained and improved the system of roads that enabled pack mules, horses, and porters to access river systems in

<sup>13</sup> Bello, *Across Forest, Steppe, and Mountain*, 169–190, 206–210; translated quote 189, original source Gao Qizhuo 高其倬, ‘Chouzhuo Lukuishan shanhou shu’ 筹酌鲁魁山善后疏 [Deliberation of Lukuishan’s reconstruction], in Fang Guoyu 方国瑜, ed., *Yunnan shiliao congkan* 云南史料丛刊 [Collection of Yunnan historical materials], vol. 8 (Kunming: Yunnan daxue chubanshe, 1998), 446–7.

<sup>14</sup> Bin Yang, “The “Zhang” on Chinese Southern Frontiers: Disease Constructions, Environmental Changes, and Imperial Colonization,” *Bulletin of the History of Medicine* 84, no. 2 (2010): 189–91.

<sup>15</sup> Carol Benedict, *Bubonic Plague in Nineteenth-Century China* (Stanford, CA: Stanford University Press, 1996).

<sup>16</sup> C. Patterson Giersch, *Corporate Conquests: Business, the State, and the Origins of Ethnic Inequality in Southwest China* (Stanford, CA: Stanford University Press, 2020), 6.

<sup>17</sup> Yang Yuda 杨煜达, ‘Diantong, hantong yu qingdai zhongqi de Hankou tong shichang’ 滇铜, 汉铜与清代中期的汉口铜市场 [Yunnan copper, Hankou copper, and the mid-Qing copper market in Hankou], *Qingshi yanjiu*, no. 2 (2013): 88–100. For further study, one might consult Wu Qijun 吴其濬, *Dianan kuangchang tulüe* 滇南矿厂图略 [Illustrated Account of Mining in Yunnan Province], 1844.

the Yangzi basin that would carry goods to Hankou and onwards. The high cost of using these transport networks meant that their use for markets other than mining products was limited; yet Nanny Kim observes that “cultural choices and market demands appear to have played an important role in the trade of medical products, furs, and exotica from the Southwest” which occurred in significant volumes.<sup>18</sup>

This piece has briefly discussed a few consequences of Qing governance in Yunnan for economy, environment, and epidemiology. Twentieth-century narratives certainly speak more directly to the processes of interspecies encounters and agricultural intensification that I have mentioned as more proximal causes of our current pandemic predicament.<sup>19</sup> Yet taking a perspective from the Qing allows us to see the long history of human intrusions into, and disruptions of, southwestern environments which have long acted as disease reservoirs for the sake of economic profit. It also indicates the long shadow cast by work to integrate this place, its peoples, and its products over long distances into the polity we now understand as China. I have tried to suggest that these dynamics have a history, one inextricably tied to the construction of imperial power and knowledge.

<sup>18</sup> Nanny Kim, *Mountain Rivers, Mountain Roads: Transport in Southwest China, 1700–1850* (Leiden: Brill, 2019), 231–328, 510.

<sup>19</sup> Liz Chee, *Mao's Bestiary: Medicinal Animals and Modern China* (Durham, NC: Duke University Press, 2021); Lyle Fearnley, *Virulent Zones: Animal Disease and Global Health at China's Epidemic Epicenter* (Durham, NC: Duke University Press, 2020); and Katherine Mason, *Infectious Change: Reinventing Public Health after an Epidemic* (Stanford: Stanford University Press, 2016).

# Reassessing Virtue

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DEBORAH R. COEN

In 1990 the Intergovernmental Panel on Climate Change published its First Assessment Report, predicting a one-degree rise in global average temperatures by 2025 if no action were taken to reduce greenhouse gas emissions. The overview included two sentences about impacts on human health, compared to ten sentences characterizing the uncertainty of the panel's conclusions.<sup>1</sup> That same year brought a more probing reflection on the science of the atmosphere in relation to health: Simon Schaffer's "Measuring Virtue: Eudiometry, Enlightenment, and Pneumatic Medicine."<sup>2</sup> At the time, it would have been hard to see any connection between these publications. Schaffer concerned himself with a failed science, one that had the audacity to dispute modern analytical chemistry – the firm scientific grounding to the IPCC's otherwise "uncertain" report. Schaffer recalled a time when "air" denoted not a mixture of neatly ordered gases, but rather an element, a nutrient, a vital principle. To readers in 1990, and perhaps still to readers today, this would have seemed a quaint way of thinking, destined to be displaced by hard science. Yet I will propose that Schaffer's essay has come to resonate in surprising ways over the past thirty years.

"Measuring Virtue" helped to chart a new course for the history of science and medicine. Schaffer redirected the attention of historians of chemistry beyond Lavoisier's laboratory: into the manufacturing centers of eighteenth-century Britain, and to the battlefields and spas of continental Europe. Alongside colleagues like Ludmilla Jordanova and Roy Porter, Schaffer set into dialogue two previously siloed fields, the history of the physical sciences and the history of medicine. He showed how Foucault's framework of biopower could be used to interpret research that had not previously registered as political – in this case, research into schemes to sort bad air from good. According to his eighteenth-century practitioners of pneumatic medicine, airs could heal or sicken, and they could also strengthen or corrupt human virtue. This observation underscored the significance of the history of moral theory to the history of science and medicine. In

<sup>1</sup> IPCC, "Overview," in First Assessment Report (Geneva: WMO, 1990).

<sup>2</sup> In *The Medical Enlightenment of the Eighteenth Century*, ed. Andrew Cunningham and Roger French (Cambridge: Cambridge University Press, 1990), 281–318. See too Simon Schaffer, "Priestley's Questions: An Historiographic Survey," *History of Science* 22 (1984): 151–183.

dialogue with the French cultural historian Jean Corbin, Schaffer showed how Enlightenment-era science gained authority over intimate and quotidian matters by identifying material influences on the mind. He paved the way for subsequent investigations by scholars like Alison Winter, Jan Golinski, and Vladimir Jankovic, each of whom explored British theories of the mutual influence of bodies, minds, and atmospheres.<sup>3</sup>

“Measuring Virtue” also made an important contribution to Science and Technology Studies by attending to the fraught role of experimentation in pneumatic medicine. Schaffer showed just how fragile experimental knowledge proved to be: the “eudiometer” was a fickle instrument, demanding skilled manipulation and frustrating replication. In this respect, Schaffer’s essay also resonated beyond academia. It aligned with the anti-nuclear and environmental movements of the early ‘90s. Faced with experts dismissive of the public’s concerns, these activists were intent on challenging the authority of the scientific establishment and revealing the inadequacies of regulatory science. Only a decade or so later would the doubt-mongering tactics of the fossil fuel industry drive many activists and scholars alike to trade critique for a defense of consensus science. Arguably, as we “marched for science,” we sacrificed much of the nuance of Schafferian analysis.

Schaffer’s insights into biopolitics and experimental skill remain powerful more than three decades later. Yet other elements of his essay stand out in new ways today. Thirty years ago, the concern of eighteenth-century men of science with the quality of the air they breathed might have seemed as petty to a scholarly reader as their interest in the vintage of a wine. Today’s reader, by contrast, steeped in the increasingly dire warnings that have followed that first IPCC report of 1990, might find something poignant about that earlier sense of vulnerability to the atmosphere. From the vantage point of 2022, there is something arresting about the depth of their awareness that air is a source of sustenance to living things. For many people today, climate change remains an abstract scientific concept. Others do not have that privilege. Millions have already felt the impact on their health from heat waves and other extreme weather events, the exacerbation of air pollution in urban areas, the spread of vector-borne diseases, food insecurity, and the stresses of living with these threats. Climate scientists and policy-makers alike often speak of “vulnerability” to climate change. They tend to treat it as a quantifiable and neatly differentiated category, a condition projected by those making the calculations onto populations elsewhere.

By contrast, the atmospheric sensibility theorized and experienced in the eighteenth century was universal, a condition common to humans, animals, and plants. The emphasis was on the presence or absence of sensibility rather than its intensity. To be sure, sensibility also took pathological forms; by the early nineteenth century, medical men regularly invoked pathological sensitivity to atmospheric fluctuations as a means

<sup>3</sup> Alison Winter, *Mesmerized: Powers of Mind in Victorian Britain* (Chicago: University of Chicago Press, 1998), Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: University of Chicago Press, 2007), Vladimir Jankovic, *Confronting the Climate: British Airs and the Making of Environmental Medicine* (New York: Palgrave, 2010).

of justifying slavery and naturalizing hierarchies of race and gender. Eventually, sensibility became a matter of degree. As Schaffer has more recently pointed out, such global schemes of measurement have been a core contribution of modern climate science to industrialization and colonization. The earlier discourse stressed instead that receptivity to atmospheric influence was a common property of living things.

As Schaffer revealed, air played multiple vital roles in the eighteenth century. The progenitors of the science of eudiometry were typical of their contemporaries in thinking of air as simultaneously a nutrient, medicament, stimulant, and constituent of living things. The new science of physiology worked with a deeply rooted analogy between animals and plants, underscoring the life-giving properties of air for both kingdoms. Air flowed in and between living bodies. For plants, the motions of the atmosphere made up for a lack of muscles: in the words of Duhamel du Monceau, the wind that rustles a stem has “the same effect on the liquor of plants as the action of the muscles on the liquor of animals.”<sup>4</sup> As La Mettrie explained of animals, “The lungs are our leaves; they take the place of this organ in plants, as for us they make up for the leaves we lack ... Does the heart beat in every animal? Heat, nature’s other heart, this fire of the earth and sun ... likewise causes juices to circulate in the tubes of plants, which breathe as we do.”<sup>5</sup> While Enlightenment thinkers vigorously debated how and what plants ate, they did not doubt that air was among the necessary nutrients. Eighteenth-century botanists likened plants to the tubes and vessels of pneumatic science, optimally designed to facilitate air flow. Like plants, animal bodies were porous to the atmosphere. In his influential *Elements of Medicine*, John Brown advised that pure air provided a “salutary stimulus” that was a “necessary” part of many medical cures.<sup>6</sup> This conviction finds a belated echo in the most recent report of the IPCC, which concludes “with very high confidence” that climate-related illnesses are increasing.<sup>7</sup>

A more surprising resonance of eudiometry today lies in the historical vision it inspired. What are we to make of the closing lines of Felice Fontana’s 1779 treatise on eudiometry?

This curious enquiry, together with the method, &c., are the production of this eighteenth century, and our descendants must have some gratitude for the philosophers who found out, as well as for those who improved it. If our ancestors had known and transmitted it to us, we should perhaps, at present be able to judge of one of the greatest changes of our globe, of a change which very nearly interests human life.<sup>8</sup>

<sup>4</sup> Quoted in François Delaporte, *Nature’s Second Kingdom: Explorations of Vegetality in the Eighteenth Century*, trans. A. Goldhammer (Cambridge, Mass: MIT Press, 1982), 44.

<sup>5</sup> Julien Offray de la Mettrie, “L’Homme Plante,” in *Œuvres philosophiques de La Mettrie* (London: Jean Nourse, 1751), p. 254–5.

<sup>6</sup> John Brown, *The Elements of Medicine* (Philadelphia: Thomas Dobson, 1795), 132.

<sup>7</sup> IPCC, Summary for Policymakers, in *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, in press).

<sup>8</sup> Quoted in Schaffer, “Measuring Virtue,” 309.

From the perspective of 1990, Schaffer read this “dramatic statement” as an admission of defeat for eudiometry. Fontana seemed to concede that it was impossible to compare the salubrity of air between one location and another. Yet Fontana was proposing that the most valuable measurements would be of variations in the earth’s atmosphere over long intervals of time. From where did he derive this vision of the *history* of the atmosphere? Likely from Buffon, who would have added that the future virtue of the atmosphere would be determined in part by human actions.<sup>9</sup>

In short, today’s reader might be inclined to spend some time with the idea, so dear to eighteenth-century men of science, that their bodily and spiritual health was sensitive to the “purity” of air they inhaled. We might begin to wonder: What happened to that conviction? Why were scientists like Priestley so quick to condemn the eudiometer as unreliable and to abandon research on air quality? How did biological scientists come to recast the atmosphere in value-neutral terms as a mere “biotic factor?” How did physical scientists lose sight of the healing and nutritive properties of the atmosphere and come to study it exclusively as a hazard? In short, how did air lose its virtue?

This remains an open question, one that deserves renewed attention today. Indeed, ecologists and atmospheric chemists have recently found that the atmosphere varies significantly in its composition close to the earth’s surface, in the presence of vegetation, and on seasonal time-scales. Their data echo the lesson that Ingen Housz drew from his extensive eudiometric studies: “I am more and more induced to believe that our atmospheric air is a substance of a very changeable nature.”<sup>10</sup> In fact, the “changeability” recorded by eudiometry now appears to be a real phenomenon and one with important implications for human health. Meanwhile, the rash rejection of eudiometry circa 1800 reverberates today for communities afflicted by air pollution. Given the need for fine-grained observations of spatially and temporally localized pollution events, it remains difficult to challenge official science on this score. In short, the concerns of eudiometry remain salient today.

<sup>9</sup> Fabien Locher and Jean-Baptiste Fressoz, “Modernity’s Frail Climate: A Climate History of Environmental Reflexivity,” *Critical Inquiry* 38 (2012): 579–98, on 579; Noah Heringman, “Deep Time at the Dawn of the Anthropocene,” *Representations* 129 (2015): 56–85.

<sup>10</sup> Jan Ingen Housz, *Experiments Upon Vegetables* (London: Elmsly, 1779), 290.

# On the Verge of the University

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ANDREW BARRY

In July 2021 Cambridge City Council, following many years of pressure from Pesticide-Free Cambridge and partner groups, agreed to conduct a field trial in two electoral wards of the city, Arbury and Newnham, and to a city-wide herbicide ban by the end of 2022.<sup>1</sup> Sixty years following the publication of Rachel Carson's celebrated critique of the agro-chemical industry, *Silent Spring*, the Council agreed to end its use of herbicides in these areas of the city and maintain its verges, pavements and streets by human or mechanical rather than chemical means. Historians of science might observe that the Cambridge City Council's "herbicide-reduction plan" involves a form of public experiment.<sup>2</sup> For it entails an exercise in demonstrating the feasibility of a non-chemical approach to the management of verges and urban spaces, an event whose witnesses were not just the council but, above all, environmental campaigners, local residents' groups and the citizens of Cambridge.<sup>3</sup>

The Cambridge trial was certainly not a first, and arguably replicated experimental trials and decisions by other Local Authorities in the UK and Europe to manage their cities without the use of herbicides.<sup>4</sup> For example, the South London borough of Lambeth ended its use of herbicides following a ruling in a US court that, according to the *Wandsworth Times*, ordered Monsanto to pay \$289m (£226m) "damages to a former school grounds keeper who claimed herbicides containing glyphosate had caused his cancer."<sup>5</sup> And even in Cambridge, the Fellows of King's College, whose pristine back lawn figures frequently on postcards and stock photo images, resolved to turn the lawn into a wild

<sup>1</sup> This essay is indebted to an ongoing conversation and collaboration with Julia Shaw, Institute of Archaeology, UCL, and founder of Pesticide-Free Cambridge, <https://www.pesticidefreecambridge.org/>, Julia Shaw and Andrew Barry, "Pesticides, Toxicity and Urban Nature," paper presented at workshop on *Chemical Exposures*, UCL, June 2022. My thanks to Julia Shaw, Jenny Bulstrode and Chris Evans for their comments on an earlier draft. The title of the essay is inspired by <https://www.onthevergecambridge.org.uk/>.

<sup>2</sup> <https://www.cambridgeindependent.co.uk/news/herbicide-free-trials-to-begin-in-two-cambridge-wards-and-9238734/>.

<sup>3</sup> Shaw and Barry, "Pesticides, Toxicity and Urban Nature."

<sup>4</sup> <https://www.pesticidefreecambridge.org/post/pesticide-free-cambridge-record-of-meetings-updates-2021>.

<sup>5</sup> <https://www.wandsworthguardian.co.uk/news/16588471.lambeth-council-moving-away-herbicides/>.

meadow. As the College observed, “a large swathe of Cambridge’s most iconic lawn was transformed this year [2020] into an ecosystem rich in biodiversity that has seen poppies, cornflowers, scentless mayflowers, corn cockles and more.”<sup>6</sup> Nonetheless, the City Council’s decision was a significant departure locally. Elsewhere, Cambridge was marked by relentless growth, an “energetic urbanization” that was partly driven by the success of the University city as a centre for technoscientific enterprise, and partly by rising property values and the consequent lack of affordable housing for scientific workers.<sup>7</sup> The fields that once lay between the villages of Girton and Madingley became divided not just by the M11 motorway, completed in 1980, but by a new area of the city, Eddington, named after Sir Arthur Eddington (1882–1944), fellow of Trinity College and Plumian Professor of Astronomy and Experimental Philosophy.

The University of Cambridge is celebrated for its tradition of disciplined and rigorous astronomical observation and it is perhaps no wonder that it chose to name a new suburb that is intended to establish a sustainable community for University workers after an astronomer who so evidently embodied the virtues of objectivity.<sup>8</sup> Yet the name of the development also derived from more earthly records of disciplinary history. After all, “the naming of the new campus settlement directly stems from the [Cambridge Archaeological Unit]’s 2010 investigations in the grounds of the University Observatory,” of which Eddington became Director in 1913. “There, digging a dense series of Late Medieval quarry pits (backfilled with Roman and Iron Age finds), this [investigation] also exposed the circular foundations of the Newall Telescope that had been erected there in 1889.”<sup>9</sup>

Eddington drew a sharp distinction between the language of physics and concepts drawn from the everyday “other world,” which he termed “a contamination.” In the *Nature of the Physical World*, he informed his readership that “his [the scientist’s] raw materials are aether, electrons, quanta, potentials, Hamiltonian functions, etc., and he is nowadays scrupulously careful to guard these from contamination by conceptions borrowed from the other world.”<sup>10</sup> Yet if Eddington sought to purify the language of physics, the political economy of science came to generate new hybrids in the city’s vicinity. The remarkable marquee structure of the Schlumberger oil exploration company’s research centre was built on the other side of the Madingley Road from the Cambridge observatory. And further south along the M11 from the suburb of Eddington, the site of the former

<sup>6</sup> <https://www.alumni.cam.ac.uk/festival/events/kings-college-wild-flower-meadow>.

<sup>7</sup> Cf. Simon Schaffer, “Enlightenment Brought Down to Earth,” *History of Science* 41, no.3 (2003): 258.

<sup>8</sup> <https://eddington-cambridge.co.uk/about-us/our-vision-and-history>.

<sup>9</sup> [https://eddington-cambridge.co.uk/wp-content/uploads/archaeology\\_nwc\\_booklet\\_autumn\\_2017.pdf](https://eddington-cambridge.co.uk/wp-content/uploads/archaeology_nwc_booklet_autumn_2017.pdf). For a full account of the archaeology of the observatory see Christopher Evans and Richard Newman, “An ‘Imperial Philosophical Machine’ and the Archaeology of the Cambridge Observatory and Early Modern Science,” *Antiquity* 85 (2011): 1369–84; and Christopher Evans and Gavin Lucas, *Hinterlands and Inlands, The Archaeology of West Cambridge and Roman Cambridge Revisited* (Cambridge: MacDonald Institute for Archaeological Research, 2020), 495–8.

<sup>10</sup> Arthur Stanley Eddington, *The Nature of the Physical World: Gifford Lectures (1927)* (Cambridge: Cambridge University Press, 1928), xv.

Bayer agrochemical plant at Hauxton was “remediated” and designated suitable for house building despite, according to environmentalists, the continuing presence of pesticides in the soil.<sup>11</sup> If we are to trace the history of science in Cambridge, it would be wise to give due attention to agronomy as well as astronomy, to toxicology as well as topology, and to plants as well as particles. After all, the most iconic image of the University turns out not to be a laboratory or a telescope, but a lawn.

Historians and sociologists of science have, of course, long been concerned with the formation of laboratories and observatories as enclosed spaces within which conditions can be managed, contamination minimised, and robust skills fostered and reproduced. The focus has been on the inside of laboratories, such as those on Free School Lane, not the lawns and common rooms of King’s and Trinity a few hundred yards away, or the fields that have now been transformed into the suburb of Eddington to the north-west of the city, and the biomedical campus of Trumpington to the south. Yet if laboratories are spaces in which facts are rendered free from contamination, so too is the infrastructure of buildings, pathways, and service roads within which laboratories are situated and their workers come to be housed.

Eddington counted on the virtues of observation, famously seeking to confirm the predictions of Einstein’s general theory of relativity by leading an extraordinary expedition at the end of the first world war to the island of Príncipe in the Gulf of Guinea, close to the equator. Yet, as the anthropologist Gisa Weszkalnys recalls, Eddington’s visit followed a controversy over facts about the condition of plantations, not the motion of planets, about political economy, not physics, which ultimately led to a legal, not a scientific trial.<sup>12</sup>

Around 1905, the young British journalist Henry Nevinson called attention to the appalling conditions in the Portuguese colonial plantations, alleging infringement of 19th-century international treaties on the abolition of slavery. These allegations indicted chocolate manufacturer Cadbury Brothers, which drew a large part of its supply from Príncipe, forcing the company to justify its use of Portuguese cocoa before an English court.<sup>13</sup>

Nevinson had documented the ongoing slave trade in Sao Tomé e Príncipe and made his conclusions clear about both its violence and its economy: “the islands of San Thomé and Príncipe,” he argued, “have been rendered about the most profitable bits of the earth’s surface, and England and America can get their chocolate and cocoa cheap.”<sup>14</sup>

<sup>11</sup> <https://www.pesticidefreecambridge.org/post/pesticide-free-cambridge-record-of-meetings-updates-2021>.

<sup>12</sup> Gisa Weszkalnys, “Príncipe Eclipsed: Commemorating the Confirmation of Einstein’s Theory of General Relativity,” *Anthropology Today* 25, no. 5 (2009): 11.

<sup>13</sup> Richard Ellis, Pedro G. Ferreira, Richard Massey and Gisa Weszkalnys, “90 Years on: The 1919 Eclipse Expedition at Príncipe,” *Astronomy & Geophysics* 50, no. 4 (August 2009): 12–15.

<sup>14</sup> Henry Nevinson, *A Modern Slavery* (London: Harper and brothers, 1906), 144.

As the story of Nevinson's investigation suggests, influential facts have been grounded not just in the tough ethics of disciplined observation, but also derived from recognisably unscientific practices, even those that are contaminated by politics. Such practices include investigations of slavery and labour conditions, such as Nevinson's, and the conduct of fact-finding missions developed by human rights activists. More recently, it has included the "investigative aesthetics" of groups such as Forensic Architecture who have gathered evidence of environmental violence through social media and "material witnesses" such as radioactive materials and the clouds of dust produced by the destruction of buildings.<sup>15</sup> And as sociologists have documented at some length, the practices of *Gegenwissenschaft* and *recherche de plein air* generate vital knowledge about pollution in the field. So a further lesson follows from the Cambridge City Council's herbicide-free trials. Namely, they draw attention to the importance of ways of knowing that exist on the verges of the University, and perhaps barely could be considered scientific at all. These include the observations of local residents, of course, about the prevalence and decline of bees, flowers, and weeds as well as the evidence generated by environmental activists observing the increasing levels of pollution in the Cam.<sup>16</sup> And they also include field experiments by radical horticulturalists such as the community farm (Cofarm), part of "a distributed network of community-based agroecological farms across the UK," situated in Abbey ward right next to Coldhams Common, on the other side of the city from the mown lawns and sports grounds of west Cambridge and the decontaminated spaces of the University's laboratories.<sup>17</sup> Historians have been concerned with both the local ecology of laboratories, field stations and observatories and with their relation to imperial spaces of rule. But an investigation of Cambridge science necessarily take us beyond the confines of laboratory science to consider the chemical geography of the lawn, the field, and the suburb – on the verges of the University. As Simon Schaffer once reminded us, studies of the production of knowledge need to be brought "down to earth."<sup>18</sup>

<sup>15</sup> Susan Schuppli, *Material Witness: Media, Forensics, Evidence* (Cambridge, MA: MIT Press, 2020).

<sup>16</sup> Shaw and Barry, "Pesticides, Toxicity and Urban Nature."

<sup>17</sup> <https://www.cofarm.co/cofarm-estate>.

<sup>18</sup> Schaffer, "Enlightenment Brought Down to Earth."

# Suburban Islanding

## Henslow's Legacy, Coproliting and the Archaeology of Cambridge's Darwin Family Estate

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CHRISTOPHER EVANS

John Stevens Henslow (1796–1861) was many things: Cambridge's Professor of Mineralogy and, then, Botany, while simultaneously ordained into the church in 1824 (serving as Rector of Hitcham, Suffolk from 1837) and, in addition, was something of an antiquarian/archaeologist. He is best known for the establishment of the University's Bate-man Street Botanic Gardens, and for inspiring and mentoring the young Charles Darwin.<sup>1</sup> These have duly overshadowed his antiquarian pursuits, which became closely tied to his ministerial role. Yet, there is also Henslow's wider, unintentional impact upon archaeology. This involves no small irony. In his fostering of coprolite mining, if indirectly, he could be held responsible for the wholesale destruction of many of the region's sites.

### Clerical and "Scientific" Archaeology

Apparently first inspired by his father, it was during the 1830s that Henslow's interest in the region's antiquities seriously took root. In that respect, aside from a number of local findings, he is known for conducting excavations on the three Roman-period barrows at Eastlow Hill, Rougham in 1843 and 1844 (*Fig. 1*), and as having been instrumental in the founding of both Ipswich Museum and The Suffolk Archaeological Association (later variously renamed, today, The Suffolk Institute of Archaeology and History).<sup>2</sup>

<sup>1</sup> Albeit a minor contribution to "The Archaeology of Early Modern Science" (see C. Evans and R. Newman, "An 'Imperial Philosophical Machine': The Archaeology of the Cambridge Observatory and Early Modern Science," *Antiquity* 85 (2011): 1369–84), the recent excavations at Cambridge's New Museum Site and the location of the Medieval Austin Friars monastery – and, thereafter, that of the University's original Botanic Gardens – exposed the brick foundations of its greenhouses. See Rev. L. Jenyns, *Memoir of the Rev. John Stevens Henslow* (London: John Van Voorst, 1862); S. M. Walters and E.A. Stow, *Darwin's Mentor: John Stevens Henslow, 1796–1861*. Cambridge: Cambridge University Press, 2001).

<sup>2</sup> J. Fairclough, "Felixstowe Roman Port," *Proceedings of the Suffolk Institute of Archaeology and History* 42 (2011): 253–76; S. J. Plunkett, "The Suffolk Institute of Archaeology: Its Life, Times and Members," *Proceedings of the Suffolk Institute of Archaeology and History* 39 (1998): 165–207; Walter & Stow, *Darwin's Mentor*, 125–6 and 221–2. Concerning such "still-life-type" depictions of grave goods as the left-side lithograph of *Fig. 1*, see C. Evans, "'Delineating Objects': Nineteenth Century Antiquarian Culture and the



Apart from hand-axes collected during visits to French gravel quarries, as shown in Figure 2, his donations to the Cambridge Antiquarian Society's collections (later transferring to the University Museum of Archaeology and Anthropology) well-represent his interests.<sup>3</sup> There is a vial of clear liquid recovered from a Roman grave good vessel during the excavation of the Bartlow Hill Roman barrows at the Cambridge/Essex border. With Henslow also donating a cock's leg from it, together with Sedgwick and others, he attended the opening of the first of its great barrows during Gage's 1835 investigations (and those of the other three thereafter, in 1838 and 1840).<sup>4</sup> With the remains of box, *Buxus sempervirens*, accompanying one of its interments, in his report Gage related that he had been informed by Henslow that box had been recovered from a Romano-British burial in Chesterford, whose specimens are extant within the University's Herbarium.<sup>5</sup> The Museum also has a lock of hair given by Henslow from his Eastlow Hill's excavation (the main barrow's skull going to Cambridge's then Anatomical Museum and its lead coffin to the Fitzwilliam Museum). Together with the vial-held liquid and cock's leg, this reflects a "biological slant" to his archaeological interests and, certainly, these are not the kind of findings that would further the day's typological studies.<sup>6</sup>

Essentially rising to the pressing needs of a local rescue-threat, Henslow only undertook the work on Rougham's barrows when the landowner's workmen (reducing their mounds for agriculture) struck the main chamber. While Henslow himself only admitted to a "very slight acquaintance with antiquities," based on his fieldwork there he has been accredited as "the father of scientific archaeology in Suffolk."<sup>7</sup> Up to a point that is valid. Yet, although detailing the barrows' grave goods and furnishings, given his knowledge

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Project of Archaeology," in *Visions of Antiquity: The Society of Antiquaries of London 1707–2007* (*Archaeologia* 111), ed. S. Pearce (London: Society of Antiquaries of London, 2007), 266–305, esp. 280–1.

<sup>3</sup> In the last years of his life, albeit not as major "player," Henslow, became involved in the debates arising from the recovery of hand-axes – together with the bones of extinct mammals – within gravel quarries in France and, too, those found earlier at Hoxne, Norfolk in 1800. Henslow visited the Hoxne site in 1859 and, anticipating a lecture, the gravel pits at Amiens and Abbeville in the following year. In a series of letters to the *Athenaeum*, he disputed Prestwich and Evans' "official" adjudication that the axes' depths attested to the (very) "deep time" antiquity of man. See e.g. Jenyns, *Memoir*, 214–19; A. B. van Riper, *Men Among the Mammoths: Victorian Science and the Discovery of Human Prehistory* (London: University of Chicago Press, 1993), 125–27, 233 and 236; see also e.g. Jenny Bulstrode, "The Industrial Archaeology of Deep Time," *The British Journal for the History of Science* 49 (2016): 1–25; his correspondence from those years include letters from John Evans on that issue.

<sup>4</sup> J. Gage, "A Letter ... containing an account of further discoveries of Roman sepulchral relics at the Bartlow Hills," *Archaeologia* 28 (1838): 1–6.

<sup>5</sup> Walters and Stow, *Darwin's Mentor*, 125–6, fig. 21; see also 90–1 for Henslow's previous Roman snail researches.

<sup>6</sup> On Faraday's test-analyses of materials from the Bartlow Hill's excavations, see G. Moshenska, "Michael Faraday's Contributions to Archaeological Chemistry," *Ambix* 62 (2015): 266–86. Aside from a Roman bronze arm ring found at Felixstowe, Ipswich Museum's Henslow materials are almost entirely "biological." In addition to various plant specimens and illustrations, they include casts of potatoes and a whale's ear.

<sup>7</sup> E. Martin, *Hitcham: A Landscape, Social and Ecclesiastical History of a Suffolk Clayland Parish* (Ipswich: Suffolk Institute of Archaeology & History, 2021).



FIGURE 2. • Cambridge University Museum Donations: top, Henslow's, including the cock's leg and liquid-vial from the Bartlow Hills (Z 22653 & Z 22654), and centre, lock of hair from the Eastlow Hills Barrow (Z 24767); below, Horace Darwin's pottery forthcoming from groundworks at Cambridge's Darwin Family Estate.

of geology, the paucity of soil descriptions and any accompanying section drawings in his accounts is surprising (aside from the left-side watercolours, Figure 1's illustrations amount to totality of those in his reports).<sup>8</sup> These, however, were common omissions at the time and were, for example, also true of Bartlow Hills' reportage (Gage effectively being Henslow's archaeological mentor).<sup>9</sup>

There is also the manner in which Henslow published his site work. Issuing pamphlets on a variety of subjects, this is how his first year's results appeared, with a letter in the *Bury Post* sufficing for the second. (Notices of the work also appeared in the *Gentlemens Magazine* for those years; Henslow's two reports were only brought together and more formally presented by Churchill Babington in 1874, with a lengthy summary appearing in Jenyns' 1862 *Memoir*.)<sup>10</sup> Crucially, the initial season's pamphlet was sold in support of Suffolk General Hospital, where a display of the site's findings was mounted (including a model of its chamber); just as many hundreds of members of the public apparently attended the opening of the main barrow in the following year.<sup>11</sup> Henslow was very active in his parish, founding a village school, organising educational initiatives, clubs, excursions and agricultural improvements.<sup>12</sup> With his various past pursuits readily accommodated within an ethos of Christian liberal "public good works," the question then becomes whether he practiced archaeology as scientist, educationalist, a "man of the cloth" or as a personal interest? The answer is, yes to all (simultaneously).<sup>13</sup>

## The Darwin Estate and Coproliting's Impact

On Charles Darwin's death in 1882, his widow, Emma, acquired *The Grove*.<sup>14</sup> Still largely extant, this Regency-style house and its outbuildings are located along Huntingdon Road's western approach into Cambridge, with its grounds today corresponding with

<sup>8</sup> The barrows have recent been reinvestigated with aim of their future conservation and display, see P. Boyles and J. Plouviez, *Roman Barrow Group and Villa, Rougham, Suffolk: Archaeological Evaluation Report*, Suffolk Archaeology Report No, 2018/035 (2018).

<sup>9</sup> Evans, "Delineating Objects," 275–83.

<sup>10</sup> Jenyns, *Memoir*, 222–8.

<sup>11</sup> See e. g., C. Evans, "Modelling Monuments and Excavations," in *Models: The Third Dimension of Science*, ed. S. de Chadarevian and N. Hopwood (Stanford: Stanford University Press, 2004), 109–37.

<sup>12</sup> Walters and Stow, *Darwin's Mentor*, 155–73; Martin, *Hitcham*.

<sup>13</sup> On "clerical antiquarianism" and its impact on the study of the past, see, for example, K. Hudson, *A Social History of Archaeology* (London: Macmillan, 1981), 18–21; and P. Levine, *The Amateur and the Professional: Antiquarians, Historians and Archaeologists in Victorian England, 1838–1886* (Cambridge: Cambridge University Press, 1986), 44 and 55–6. Certainly, Henslow's second-year account of Rougham's investigations presupposes the Christian context of its burials.

<sup>14</sup> Darwin's "archaeological fieldwork" was essentially pragmatic. Sites and monuments provided datums against which natural processes could be gauged, that variously involved the wind-determination of the infilling of barrow ditches and, at both Stonehenge and a series of Roman sites, the impact of earthworm-action, see C. Evans, "Small Agencies and Great Consequences: Darwin's Archaeology," *Antiquity* 83 (2009): 475–88.

those of Murray Edwards (*née* New Hall) and Fitzwilliam Colleges (*Fig. 3*). Two of her sons subsequently built their own houses at either end of plot: Horace (founder of the Cambridge Scientific Instruments Company), *The Orchard*, and Frank (University Reader in Botany), *Wychfield*. Extending over 6.5ha, this thereby amounted to considerable family estate.<sup>15</sup>

Through recent collegiate development, the University's Cambridge Archaeological Unit has conducted large-scale excavations within the former estate-grounds. Revealing significant later prehistoric and Roman-period remains, the latter involved a major settlement, two roads and a cemetery (see *Fig. 5*). The area's potential had, in fact, first been flagged by Horace Darwin, who donated Roman pottery found there to the Museum (*Fig. 2*). While there is no reason to dwell on what Darwin Family-contemporary material was recovered in the recent fieldwork – that, for example, the family evidently preferred Keiller's Marmalade (not the local Chivers brand) – there is nonetheless something wonderfully absurd about *Figure 4's* photograph. Little did they know that both Bronze Age and Roman-period ditch systems extended beneath their family home.

The link here to Henslow relates to the estate-ground's effective "islanding." The excavations' wider trenching to determine the extent of the settlements there (and within the neighbouring college lands), evinced later nineteenth century coprolite quarrying across the southern half of Murray Edwards/New Hall's grounds and the northern portion of St Edmund's; its deep destructive imprint stopping hard along the boundaries of the Darwin Estate.<sup>16</sup>

The remains of marine species, coprolites – the term coined by Buckland – are phosphatic nodules lying below the Chalk in Greensand.<sup>17</sup> Having identified them in deposits near Felixstowe, Henslow is held to have single-handedly fostered the region's coprolite industry. In 1845 he delivered a paper on the bed's identification to the British Association for the Advancement of Science, and subsequently contributed notices to newspapers and the *Gardener's Chronicle & Agricultural Gazette* highlighting their agricultural potential as a source of fertiliser.<sup>18</sup> The coprolite boom thereafter started in the 1850s.<sup>19</sup> Writing to Darwin in 1855 of a visit to the "crag" beds, Henslow was clearly surprised at the scale of its industry:

<sup>15</sup> T. M. Berra, *Darwin and His Children: His Other Legacy* (Oxford: Oxford University Press, 2013); C. Evans and G. Lucas, *Hinterlands and Inlands: The Archaeology of West Cambridge and Roman Cambridge Revised* (CAU Landscape Archives 3.) (Cambridge: McDonald Institute for Archaeological Research, 2020), 179–82.

<sup>16</sup> Evans and Lucas, *Hinterlands and Inlands*, fig. 2.23.

<sup>17</sup> S. G. Pemberton and R.W. Frey, "William Buckland and His 'Coprolite Vision,'" *Ichnos* 1 (1991): 317–25.

<sup>18</sup> J. S. Henslow, "On nodules, apparently coprolitic, from the Red Crag, London Clay and Greensand," *Report of the British Association for the Advancement of Science* (1846): 51–2.

<sup>19</sup> E. g. R. Grove, "Coprolite Mining in Cambridgeshire," *The Agricultural History Review* 24 (1976): 36–43; B. O'Connor, *The Dinosaurs on Coldham's Common: The Story of Cambridge's Coprolite Industry* (Cambridge: Privately Published, 1998).

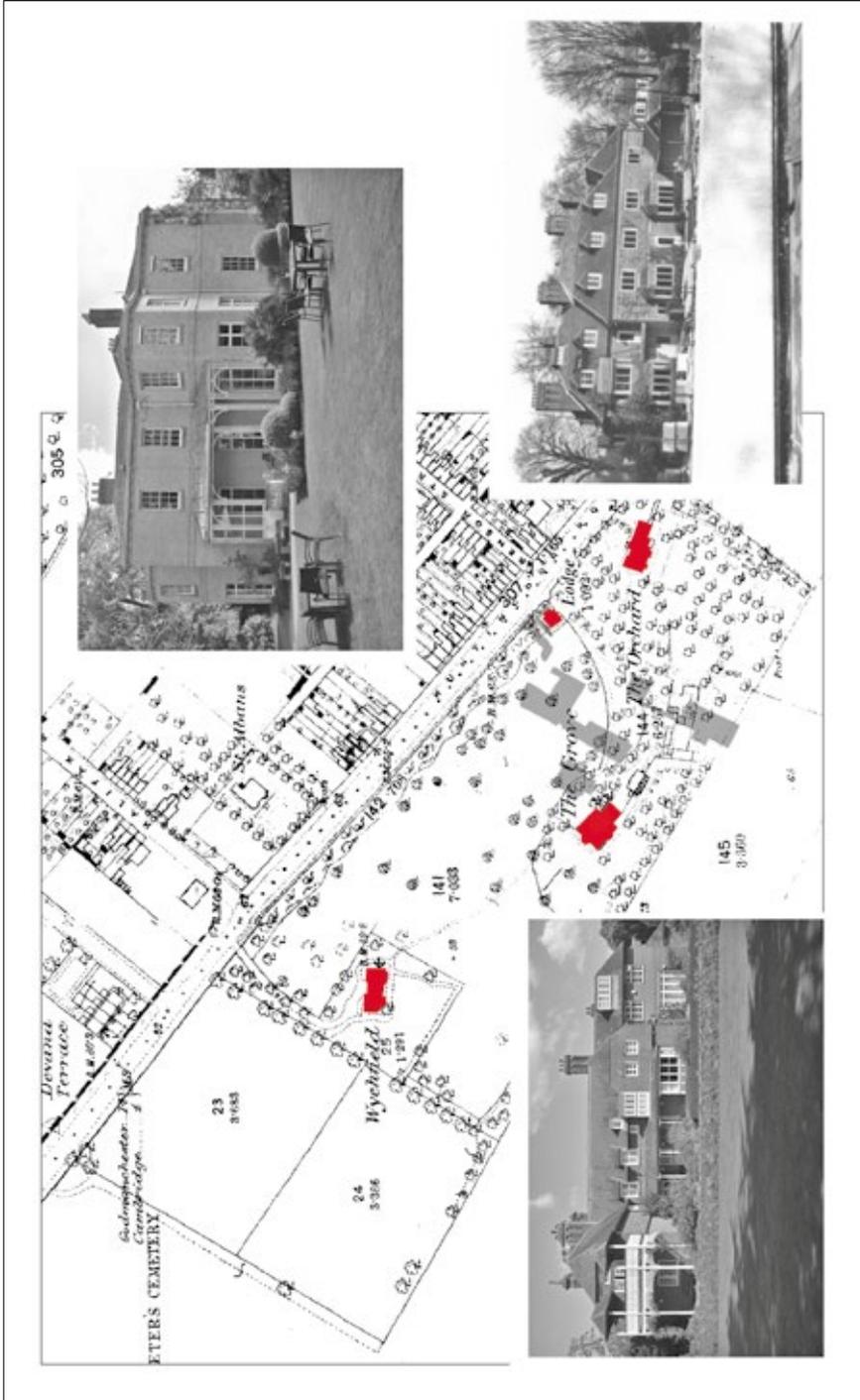


FIGURE 3. • The Darwin Family Cambridge Estate (1888 OS map), with the familial homes red-highlighted and with inset photographs of *Wychfield* (lower left) and, right, *The Grove* (top) and *The Orchard* (bottom); grey-tone indicates the excavation-areas shown on Figure 5).



FIGURE 4. • Fitzwilliam College, New Library: site photograph looking south with *The Grove* behind (top); below, its diverse pottery, with a Medieval strap-handle sherd (lower centre) and Middle Bronze Age wares (bottom right) amongst the otherwise nineteenth century material.

I have just got home from a 3 day tour among the Clay-pits – where I have been with Fisher (Tutor of Jesus) & George. I had no idea of the extent to which the workings had been carried – Many thousands of tons are now raised regularly per annum & some of the good folks have cleared many thousands of pounds.<sup>20</sup>

As opposed to pre-twentieth century gravel quarrying, whose shallower traces can still permit some degree of archaeological survival, involving hundreds of labourers and massive trench-workings, coprolite mining amounted to a “near-total destruction environment” (Fig. 5). A further example of its impact was recently encountered further west along Huntingdon Road, beyond Storey’s Way’s junction and up to what had been the Traveller’s Rest Pit (and its namesake pub today). In conjunction with the University’s North West Cambridge/Eddington development, while in the large-scale excavations just to the south extensive dense prehistoric and Roman settlements (with four separate cemeteries associated) were revealed, the aforementioned roadside swathe had been entirely reduced through coprolite quarrying. Clearly, the early settlement complexes had extended into that area, but all that was then recovered during the workings there were two rich Roman burials.<sup>21</sup> Reflecting the amateur part-time basis of the day’s antiquarian-archaeologists, these were reported upon by Babington, who – succeeding Henslow as Professor of Botany – also had active archaeological interests.<sup>22</sup>

Cambridgeshire alone saw more than 20 major coprolite quarries. Including at Wick-en, Trumpington and Coldham’s Common, some were huge and, for example, much of the land from Horningsea up to Bottisham Lode was thereby reduced.<sup>23</sup> Together involving many thousands of hectares, this now can only be counted as a devastating environmental and archaeological loss.<sup>24</sup> An unappreciated consequence of Henslow’s agricultural improvements and rural poor efforts – or, equally, the tensions arising from his simultaneously participating in the “deep time” debates as a clergyman, scientist and an antiquarian-archaeologist (see Note 3) – not all his many career-facets dovetailed neatly.

<sup>20</sup> Darwin Correspondence Project DCP-LETT-1706.

<sup>21</sup> The one burial was in a stone coffin (i.e. difficult to miss even in mass-quarrying), that still today resides under the front portico of Fitzwilliam Museum.

<sup>22</sup> See e. g. Levine, *The Amateur and the Professional*; C. C. Babington “On Roman interments by the side of the so-called Via Devana, near Cambridge,” *Communications of the Cambridge Antiquarian Society* II (1864): 289–94; C. C. Babington, *Ancient Cambridgeshire: Or an attempt to trace Roman and other ancient roads that passed through the county of Cambridge: With a record of the places where Roman coins and other remains have been found* (London: Deighton Bell & Co., 1883).

<sup>23</sup> Grove, “Coprolite Mining in Cambridgeshire,” fig. 1.

<sup>24</sup> E. g. N. T. Porter and E. Porter, “Report on objects of antiquarian interest found in the Coprolite Diggings during 1917 and 1918,” *Proceedings of the Cambridge Antiquarian Society* 22 (1921): 124–6.



FIGURE 5. • New Hall/Murray Edwards and Fitzwilliam College excavations' phase-plan (left); right, coprolite workings at Orwell, 1860-70s (top) and Abington Pigotts, 1883 (below); from O'Connor, *The Dinosaurs on Coldham's Common*, 37).

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## Acknowledgements

First getting to know Simon through 3-D scientific modelling interests, in the years since, imbued with his wisdom and humour, our friendship has been a constant source of wit, insight and inspiration. (It shouldn't come as a surprise to any that he also is very well-versed in archaeological matters.) This effort's production has greatly benefited from Edward Martin's comments and deep knowledge of Suffolk's archaeology. Simon Jackson of Colchester & Ipswich Museums kindly provided information concerning the latter's Henslow holdings and, at Coltwold Archaeology, Jo Caruth supplied the report of the recent fieldwork at Rougham's barrows. At the Cambridge Archaeological Unit, Andy Hall has rendered this contribution's figures, with Dave Webb responsible for Figure 4's photography.

# Meeting Simon Schaffer

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ALEX WRAGGE-MORLEY

The first time I met Simon Schaffer was during our first PhD supervision, in October 2007. Prior to that, my contact with him had been limited to one phone call and a handful of emails. Just one year before that meeting, I was only dimly aware that the history of science existed as a distinct field of inquiry, and had never even heard of Simon.

At that time, in September 2006, I had just started out on a master's degree in early modern history at King's College London. Given the brisk pace of academia in the United Kingdom, I was already preparing applications to do doctoral study. I wanted to work on the intellectual history of 17<sup>th</sup>-Century England, and had the Cambridge School of Intellectual History in my sights. I find it shameful to admit now – although it is true – that my main reason for turning to Cambridge was to get back at Oxford, the university that had rejected me some four years earlier.

While all this was going on, I discovered the history of science. Quickly jettisoning my earlier interests, I ended up writing an essay on 17<sup>th</sup>-century debates about the possibility of space travel – a theme that intrigued me simply because it seemed so outlandish. Looking back over the notes for that essay, still backed up almost 16 years later, I can date my first encounter with Simon's work precisely – December 2006. In that essay, which I in fact submitted as part of my application, I called him "Simon Shapin." It's a testimony to Simon's largeness of spirit that he was able to overlook that mistake.

It would be fair to say that my grasp of Simon's ideas was weak, and that my knowledge of his person was non-existent. I had visited Cambridge to meet potential supervisors, and felt deterred not only by the (seemingly unfriendly) characters I encountered, but also by the grandeur of their offices and the coldness of the corridors leading to them. But when I returned, both my mentors – Anne Goldgar and Ludmilla Jordanova – told me that Simon would be a perfect fit. Indeed, they told me that I would *love* working with him. So, I decided to pick Simon, even though I had not at that point really thought about changing my project.

I guess this little recollection tells you that I'm not a very good decision-maker. I seem to rely on impulse rather than calculation. But it also tells you that the stakes were pretty high when I went to the Department of History and Philosophy of Science for my first supervision with Simon. Would I find him less cold and forbidding than the supervisors I had crossed off my list? And would I actually enjoy working with him? As I went up to

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his office, the signs were good. Simon's office was on the end of an unpretentious corridor – a spirit far removed from that of the collegiate gothic surroundings I had encountered up that point.

And then I met Simon. Things moved quickly. I told him that I didn't want to work on intellectual history anymore. Instead, I wanted to work on the aesthetics of mountain scenery. I don't know if those were his actual words, but he seemed to say "Thank God" as I abandoned my old trajectory. I can't remember much of what happened in that meeting, except that Simon seemed to pour out ideas in a manner that I had never encountered before. I struggled to keep pace, but I felt inspired. On the way home, as I walked past the River Cam on Chesterton Road, I called my mother and said, "He's wonderful."

# Notes from a Comrade

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ANNA ALEXANDROVA

Look, Simon, there is no other way to put it, I will miss you terribly. But let me illustrate my sentiment with an episode.

In December 2021 I was working in my office. I was doing something mindless enough to put on music, I think I was writing supervision reports. I put on Adele's new album. You may not know it, but her voice is low, raspy, and deeply comforting. Just as Adele was getting going, you came in into your office next door and started a meeting with your student. Without even thinking about it, I switched off Adele and continued with my reports to the more familiar music of your supervision voice.

That was a thin description – a Rylean twitch – but this episode is a proper Rylean wink and so deserves a thick description. To understand why I switched off Adele so automatically and with no hesitation, you need to understand two things. It was late in the pandemic and I hadn't heard you supervising next door in a long time, plus you were retiring and I knew I didn't have many more such opportunities left. (In case I sound creepy I should mention it doesn't count as "eavesdropping" as I hardly hear what you say except for predictable excerpts: "it is therefore inevitable that ..." "recommend checking the Whipple," "a further fascinating episode" and so on.)

In switching off Adele to hear you next door I was in fact coming to terms with the ways in which I came to rely on you over the years and with the fact that from soon on I'll have to figure out another source of such support. You are a role model to me, but an unusual one. It's not that I want to be like you. Rather your presence next door and your example over the last decade had the effect of widening my vision of what I could be as a philosopher, a colleague, and a mentor. Seeing how you do things, how you apportion your time, how you react to things, made me realise how one's behaviour affirms one's values. I realise it sounds obvious, but in your behaviour, at least the portion of it visible to me, you affirm the values that I thought were necessarily in conflict. I thought if one were generous and committed to justice then one couldn't also be firm and protective of one's time. I thought that if one were funny and whimsical, one would likely lose rigour and seriousness. Somehow you managed to keep both and that gave me the courage to explore different ways of being.

In particular you modelled to me a way of being attentive and supportive to people without sinking a massive amount of time into them. You probably don't even notice these small acts, so here are a few reminders.

Once I was complaining about something, as I tend to, and you replied: "I hear you, comrade." I liked the double meaning of this. It was an acknowledgement of my Soviet heritage and it also affirmed that we are in this business together as equals.

On November 7<sup>th</sup> 2017 I brought chocolates into the office to mark the 100<sup>th</sup> anniversary of the Russian Revolution. I didn't feel too certain about this gesture in my own head but you sent around by email what we now would call a microaffirmation. You thanked me for the chocolates, adding a historical detail from Nadezhda Krupskaya's reminiscences about autumn 1916 in exile in Zurich with her husband Lenin: "On his way from the library, Lenin usually brought two bars of nut chocolate in blue wrappers, a 15 centimes a piece, and after lunch we took the chocolate and some books and went to the mountains. We had a favourite spot there in the very thick of the woods, where there was no crowd. He would lie there on the grass and read diligently." You made me feel like my decision to share these chocolates actually made sense.

And then there were countless episodes when I came to you for ideas. Where does Mill's defence of value-freedom of science come from? Are the Kew Gardens in the nineteenth century similar to clearing houses of knowledge like today's What Works Centres? Why was it important to philosophers to assert specialness of social sciences? Was the Stanford School's realism compatible with SSK? You had answers to all of these and hearing them is one of the greatest privileges of my life.

When I arrived to Cambridge, I didn't know much about you other than that you were the other author of *Leviathan and the Air-Pump*. In retrospect this is embarrassing, but I am grateful that I got to know you in my own time without worrying about making a fool out of myself. These years leave me with a rather uncertain gift, namely an inner "what would Simon say?" voice. When I think about my ideas in HPS, this inner voice makes me work hard to dig deeper and to be less intellectually predictable. As a colleague and a mentor, this voice gives me greater courage to retain my humanity even as I become "senior."

And this is why I will miss you, comrade.

# Of go-betweens and wise men

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JOSÉ RAMÓN MARCAIDA

One evening, on a 6th of January, in a Cambridge pub whose name I do not care to remember, Simon produced a cardboard box tied with string. It felt like watching a magician perform a trick. And what a trick! Inside the box was a *roscón de Reyes*. The *roscón* is a cake traditionally eaten around the day of the Epiphany (6 January). This festivity is a major event in countries like Spain, a day of family gatherings marked by the opening of presents brought by the Three Wise Men, or, as we call them in Spanish, *los Reyes Magos*. Simon said that he had not been able to find a *roscón* in Cambridge, so he had asked the Portuguese bakers in town to bake one for him instead. For all of us sitting at that table that evening, especially for those who, like me, had not been able to spend the *día de Reyes* with our families, this was a very special moment.

Anecdotes like this not only speak of Simon's well-known personal charm and generosity. They also shed light on his role as the most attentive and imaginative of go-betweens when it comes to bringing together individuals from diverse social and intellectual backgrounds. His many collaborations, as reflected in the range of contributions to this volume, testify to the reach and continuing significance of his work as mediator across disciplinary boundaries and academic cultures. In my case, it was thanks to Simon's support, and to the encouragement of another go-between and mentor, our mutual friend and colleague Juan Pimentel, that I was able to spend time at HPS, first as a Visiting Student in 2008, and then as a Visiting Scholar in 2012–2013. Simon understood right away what these opportunities meant for a young Spanish researcher trying to break into international academia. His unwavering support and bonhomie at these and other key stages in my career have been invaluable. *Muchas gracias*, Simon.

To return to my anecdote, there was something wonderfully paradoxical and subversive about the sight of that *roscón* sitting on a pub table in Cambridge. In fact, it has been largely through Simon that I have come to appreciate the power of such signs of estrangement and dislocation: Newton on the beach, the chess master hidden inside the Turk, Cortázar in Jaipur, Marcus Aurelius in Jesus Green, Lord Byron in Cádiz ... That evening, as I looked at that *roscón*, I could not help thinking about another intriguing juxtaposition. The shape of the cake and its candied fruit-based decoration are meant to symbolise the crowns worn by the *Reyes Magos*. So, there we were, eating and sharing the crown of our own local magus – a present more exciting than gold, incense or myrrh from our Cambridge wise man.

# A View from Outside

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SPIKE BUCKLOW

I think I probably first met Simon outside the school gates, as we waited to pick up daughters from the same class. School gates progressed to nativity plays and primary school progressed to secondary school and sleep-overs. At some point, Simon told me he'd read a book I'd written, "cover to cover." I was flattered because, by this time, I'd read enough of Simon's work to know that within that modest, witty, off-hand fellow-parent there dwelt a truly prodigious mind. Later though, as I started to appreciate the breadth and depth of his learning, I was less surprised that he might find room for the more arcane details of medieval artists' materials and methods.

I was a scientist in a non-school institution about ten miles from the sound of Great St Mary's and felt like an outsider but, thanks largely to Simon, I was drawn to the History and Philosophy of Science as a way of culturally grounding my work. Simon was open, accepting and always encouraging, from the nitty-gritty of navigating university politics and the publication world to the finer points of historical content, even when I nervously strayed into what I thought was his territory. Of course (being a slow learner) I later realized that Simon was not remotely territorial. And that is part of what makes him a great man; one who is happy to go anywhere and share anything with anyone who warms to his infectious curiosity. He has been an example to me and should, I feel, be an example to us all.

Our daughters are now living and working in London and, as Simon retires, I hope to be able to spend more time enjoying his company. Simon is the most intellectually generous person I have ever had the pleasure to know, I value his friendship and am deeply grateful for his support. Thank you, Simon, and very best wishes.



# MECHANICAL MONSTERS



William J. Ashworth, *Babbage's Brain*.

# Always There When You Need Him

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M. NORTON WISE

My most indelible memory of Simon Schaffer, extending over many years, is that he regularly showed up in my forays into the cultural history of physics just as I was beginning to explore territory that was new to me. And he showed up with an interpretive insight that turned out to be key to my own thinking. I will illustrate this endearing habit of appearing when needed with three examples from energy physics in the 19<sup>th</sup> century.

## Progress and Thermodynamics

The habit emerged way back in the 1980s when Crosbie Smith and I were writing *Energy and Empire*. Within a local cultural history, we were probing the significance in the late 1830s of the Glasgow astronomer and radical liberal John Pringle Nichol for William Thomson (later Lord Kelvin), his student and a family friend. A key question concerned the role of the controversial nebular hypothesis for the origin of the solar system, which Nichol was promoting in immensely popular lectures and publications. Based on the discovery by J. F. Encke that the comet that bears his name was losing motion, apparently from friction with the ether, Nichol and others concluded that the solar system too was losing motion and would ultimately collapse into the sun. Much more generally, Nichol concluded that the very concept of a natural law should be understood not simply as governing the spatial arrangement of the parts of a system but as governing the temporal development of the system. It was at this rather esoteric juncture that the unpublished manuscript of a paper by Simon Schaffer entered our purview, "The Nebular Hypothesis and the Science of Progress."

We learned from Schaffer that Nichol had developed this view in correspondence with John Stuart Mill and that they understood it as the cornerstone of a new "science of progress," governing not only non-human nature but the progression of man, and thus social progress as well, including political economy. This critical nugget of interpretation fed into what was already a churning mill of reflections on the role of progression in William Thomson's mathematical analysis of the steam engine and its production of work. It helped to bring political economy and the role of work as labor value into the history of thermodynamics, ultimately appearing in the series "Work and Waste: Political Economy and Natural Philosophy in Nineteenth Century Britain."

## Precision and Electromagnetism

I take this experience to be representative of the creative role that Simon Schaffer's signature essays have played in the work of so many other historians of science. Characteristic for these essays is the immediate connection they establish between what used to be called internal and external histories, a distinction that no longer even makes sense. Instead, we have sentences like the one that concluded Schaffer's "Accurate Measurement is an English Science:" "The label of precision attached to any measure hinged on cultures of communal trust and was a consequence of the strength of the social relations between these separate and complex institutions." The essay itself illustrates those social relations in nuanced detail for attempts to establish with precision whether the ratio of electrostatic to electromagnetic units of measurement matched the speed of light. That question lay at the heart of electromagnetic theory and telegraph construction alike. And the complex attempts to resolve it involved relations between numerous telegraph engineers, physical scientists, and technicians. These relations were built on constant travel, both metaphorical and actual, of instruments, materials, techniques, and people, between London, Cambridge, Göttingen, Baltimore, Glasgow, Zürich, and other local centers of measurement.

For me, as editor and commentator of *The Values of Precision*, reflections on findings like this made the question of how numbers travel the central theme of a volume that sought out the conditions for establishing precision measurement from the eighteenth to the twentieth century. Schaffer supplied a key lesson: "Precision is the result, rather than the cause, of consensus among scientific practitioners."

## Automata and Mechanics

Beyond their interpretive wealth, it is the rich detail of Schaffer's essays that makes them object lessons for historians. When I first read "Babbage's Intelligence: Calculating Engines and the Factory System" I had already long been interested in the question of what a cultural history of mechanics in the 19<sup>th</sup> century would look like. For mechanics, like thermodynamics and electromagnetism, was transformed as it became the basis of the physics of energy. And this transformation was closely tied up with the working machines of the industrial revolution and the factory system. That interrelation led to a fundamental distinction between dynamics, the study of the causes of motion or of work produced and expended, and kinematics or pure mechanism, the study of the geometry of motions producible by various linkages of gears, pulleys, shafts, etc. As Charles Babbage put it with respect to machines in a factory, there are "1<sup>st</sup>, Those which are employed to produce power; and 2<sup>dly</sup>, Those which are intended merely to transmit force and execute work." Thus the distinction is between *engines* that produce work and mere *mechanisms* that transmit that work throughout the factory.

What Schaffer so perceptively developed was Babbage's representation of this distinction as a matter of intelligence, both in his hierarchical "division of mental labor" and in his famous calculating engines. Manual workers at the lowest level in the factory, deprived of the tools and skills of their crafts, now mirrored the repetitive mechanisms they tended, as automata, while higher level engineers and managers became the sole engines of productive intelligence that powered the system. Similarly, Babbage's Difference Engine and Analytical Engine (if completed) would not only replace the menial labor of human computers, as automata, but would ultimately exercise such productive faculties as memory and foresight.

A specific anecdote in Schaffer's discussion captured my attention. At Saturday evening soirées at his London house Babbage exhibited a model of his Difference Engine alongside a cherished automaton, a Silver Lady, one foot high and elegantly dressed, who danced with an animated bird on her finger. "This piece of *Mechanism*," he observed, "formed a striking contrast with the . . . Difference *Engine*." It struck me that this juxtaposition was thoroughly gendered, and was typical of automata and their presentation. This realization led me to explore in "The Gender of Automata" how the distinction of mechanism and engine – or kinematics and dynamics in mechanics – permeated 19<sup>th</sup>-century British culture in a gendered form. Mechanisms producing repetition, rhythm, and imitation were coded female while engines of strength, intelligence, and logic were male. Unsurprising in themselves, it was nevertheless revealing to find that these stereotypes, with their grounding in formal mechanics, were to be found everywhere one looked, whether in popular literature (Dickens, Disraeli, Wells), evolutionary thinking (Chambers, Darwin), or physiology (Huxley, Carpenter).

In short, anyone exploring how deeply rooted in cultural history was the great transformation that was energy physics – whether in thermodynamics, electromagnetism, or mechanics – would do well to begin by reading Simon Schaffer's seminal essays. There they will see why the work accomplished in sites of scientific activity cannot be understood in the absence of the cultural settings and social relations in which it takes place. And they will find a great store of resources and inspiration for pursuing those relations in new ways.

# Erasmus Darwin's flights of fancy

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JENNY UGLOW

Simon has always written and spoken about Erasmus Darwin with a mix of amusement and respect, enjoying descriptions like those below on gunpowder, steam, and Franklin's lightning conductor. (And Darwin's comment from the advertisement to *The Botanic Garden* has, I think, a distinct Schaffer-like ring.)

## *The Economy of Vegetation, 1791*

### *From the advertisement*

The general design of the following sheets is to inlist Imagination under the banner of Science; and to lead her votaries from the looser analogies, which dress out the imagery of poetry, to the stricter ones, which form the ratiocination of philosophy.

### *From Canto V, 'The Discovery of Fire':*

#### *Gunpowder – addressed to the Rosicrucian Nymphs of Fire*

“You taught mysterious BACON to explore  
Metallic veins, and part the dross from ore;  
With sylvan coal in whirling mills combine  
The crystall'd nitre, and the sulphurous mine;  
Through wiry nets the black diffusion strain,  
And close an airy ocean in a grain.  
Pent in dark chambers of cylindric brass,  
Slumbers in grim repose the sooty mass;  
Lit by the brilliant spark, from grain to grain  
Runs the quick fire along the kindling train;  
On the pain'd ear-drum bursts the sudden crash,  
Starts the red flame, and Death pursues the flash.  
Fear's feeble hand directs the fiery darts,  
And Strength and Courage yield to chemic arts;  
Guilt with pale brow the mimic thunder owns,  
And tyrants tremble on their blood-stain'd thrones.”

*Canto VI, 'Steam-engine applied to Pumps, Bellows,  
Water-engines, Corn-mills, Coining, Barges, Waggons, Flying-chariots'*

NYMPHS! You erewhile on simmering cauldrons play'd,  
And call'd delighted SAVERY to your aid;  
Bade round the youth explosive STEAM aspire  
In gathering clouds, and wing'd the wave with fire;  
Bade with cold streams the quick expansion stop,  
And sunk the immense of vapour to a drop.--  
Press'd by the ponderous air the Piston falls  
Resistless, sliding through its iron walls;  
Quick moves the balanced beam, of giant-birth,  
Wields his large limbs, and nodding shakes the earth.

"The Giant-power from earth's remotest caves  
Lifts with strong arm her dark reluctant waves;  
Each cavern'd rock and hidden den explores,  
Drags her dark coals, and digs her shining ores.  
Next, in close cells of ribbed oak confined,  
Gale after gale, he crowds the struggling wind:  
The imprison'd storms through brazen nostrils roar,  
Fan the white flame, and fuse the sparkling ore.  
Here high in air the rising stream he pours  
To clay-built cisterns, or to lead-lined towers;  
Fresh through a thousand pipes the wave distils,  
And thirsty cities drink the exuberant rills.  
There the vast mill-stone with inebriate whirl  
On trembling floors his forceful fingers twirl,  
Whose flinty teeth the golden harvests grind,  
Feast without blood! and nourish human-kind."

"Now his hard hands on Mona's rifted crest,  
Bosom'd in rock, her azure ores arrest;  
With iron lips his rapid rollers seize  
The lengthening bars, in thin expansion squeeze;  
Descending screws with ponderous fly-wheels wound  
The tawny plates, the new medallions round;  
Hard dyes of steel the cupreous circles cramp,  
And with quick fall his massy hammers stamp.  
The Harp, the Lily and the Lion join,  
And GEORGE and BRITAIN guard the sterling coin.

Soon shall thy arm, UNCONQUER'D STEAM! afar  
 Drag the slow barge, or drive the rapid car;  
 Or on wide-waving wings expanded bear  
 The flying-chariot through the fields of air.  
 Fair crews triumphant, leaning from above,  
 Shall wave their fluttering kerchiefs as they move;  
 Or warrior-bands alarm the gaping crowd,  
 And armies shrink beneath the shadowy cloud.

*From Canto VII. Electricity and Lightning*

"YOU led your FRANKLIN to your glazed retreats,  
 Your air-built castles, and your silken seats;  
 Bade his bold arm invade the lowering sky,  
 And seize the tiptoe lightnings, ere they fly;  
 O'er the young Sage your mystic mantle spread,  
 And wreath'd the crown electric round his head.--  
 Thus when on wanton wing intrepid LOVE  
 Snatch'd the raised lightning from the arm of JOVE;  
 Quick o'er his knee the triple bolt He bent,  
 The cluster'd darts and forky arrows rent,  
 Snapp'd with illumin'd hands each flaming shaft,  
 His tingling fingers shook, and stamp'd, and laugh'd;  
 Bright o'er the floor the scatter'd fragments blaz'd,  
 And Gods retreating trembled as they gaz'd;  
 The immortal Sire, indulgent to his child,  
 Bow'd his ambrosial locks, and Heaven relenting smiled.

# The Machine inside the Man, The Man inside the Machine: My Robotic Mentor

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MICHAEL JOHN GORMAN

In the warm Irish Summer of 2005, the robots came to Dublin. From a working replica of Jacques de Vaucanson's defecating duck and an eighteenth-century clarinet-playing android, to an industrial robotic DJ and Dirk the robotic tramp, pushing his shopping trolley through city centre streets, the city was swarming with peculiar robots and automata. This was SAVE THE ROBOTS, a festival of robotic art I was curating with The Ark, the children's cultural centre. In the pond of St Stephen's Green, artist Natalie Jeremijenko was wading through the water trying to bring some robotic decoy ducks into conversation with real mallards as part of her interspecies artwork OOZ. Across the city, in an organic fruit market, a robot controlled by a Madagascar hissing cockroach harnessed to a ping-pong ball sized controller was causing much debate with shoppers about the ethical issues surrounding insect-controlled robots.

In the midst of this robotic mayhem arrived a slightly disheveled figure with a suitcase, Simon Schaffer, and suddenly there was a human (or at least apparently human) nucleation point for all the conversations about automata and robotics happening in the city between machine artists, engineers and robotic beasts. Suddenly everything, this gathering of machines and their human helpers, all made sense.

After a quick stroll through the Green to inspect Natalie Jeremijenko's robotic ducks, Simon was bundled off with us to the Irish Film Institute in Temple Bar for a special festival screening of Vikram Jayanti's film *Game Over: Kasparov vs Deep Blue*, documenting the moment when the world's greatest chess-player was beaten by an IBM computer. When the film ended, Simon delivered a pitch perfect lecture on the theme of humans inside machines.

From Deep Blue's notorious move in Game 2, which Kasparov insisted could only have been made by a hidden human controller, he unwound the story back to the stories of Wolfgang von Kempelen's Mechanical Turk that entertained the royal courts of Europe in the late eighteenth century.

And then, when it was over, the conversation-cloud surrounding Simon simply drifted across the street to the glass fronted Art House building, which was filled with an exhibition of historical automata and robots. On entering the building, we encountered a stern presence – the mechanical Turk himself seated at his chess board. John Gaughan, who had reconstructed the Turk, invited a Russian grandmaster chess player to take a

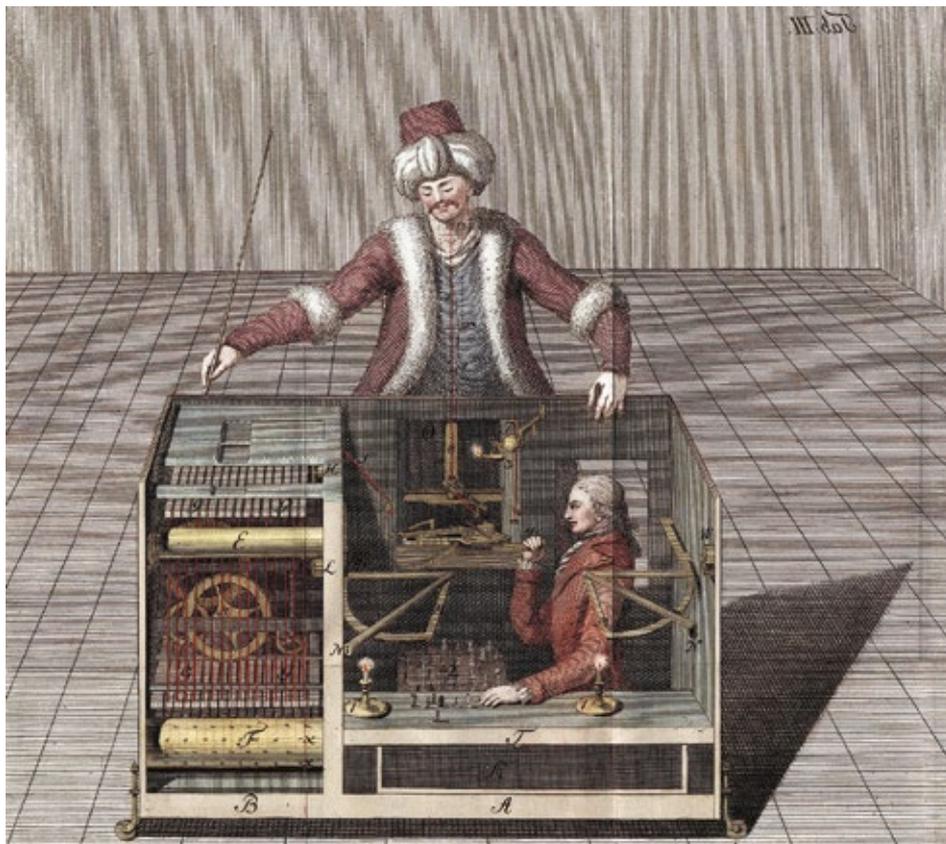


FIGURE 1. • Wolfgang von Kempelen's mechanical Turk, with the mechanism and the position of the hidden operator depicted incorrectly by Racknitz.

seat, and play against the mechanical Turk. After just a few moves, the grandmaster was roundly defeated to thunderous applause. After a few more chess games, all won by the Turk, and speculations about the inner workings of the automaton (where some team members mentioned their suspicions caused by John Gaughan's requirement for two airplane tickets to travel to Dublin from Los Angeles) it was time to relocate to the pub. But which pub? Of course Simon suggested the Turk's Head.

Who, or rather what is Simon Schaffer? Just as Garry Kasparov suspected Deep Blue of harbouring a hidden human operator, and just as many suspected the Mechanical Turk was inhabited by a chess-playing dwarf, many have long known that Simon Schaffer harbors a hidden mnemonic device, acoustically triggered, and allowing him to hold forth on any topic mentioned in conversation with total recall and assurance and generate new insights through combinatorial collisions of ideas.

I first got to know Simon back in the previous century when I was in living Florence, having just arrived to work on my PhD on Jesuit natural philosophy in the seventeenth

century at the European University Institute. I was feeling pretty lost at the time, having never studied history before, and having suddenly realized that all my source material was going to be in Latin, a language that I didn't remotely understand. When I was on the point of despair, French historian Pascal Briost told me that I needed to meet Simon Schaffer. A few months and a few Latin lessons later I went to see Simon in Cambridge. I arrived around 11 in the morning, and he suggested we go to the pub. The conversation we got into about the Jesuits and the vacuum debate was very intense. At one point, after a few pints had been had, I got up to go to the toilet, and moments later I realized he was there, standing at the neighbouring urinal, still talking about an experiment involving smoke in a Torricellian tube, without even a pause for breath.

Without blowing too much smoke, inside or outside a vacuum, it is fair to say that Simon inspired me to think anew about what a historian of science is and can be. Whereas my first months in Florence had plunged me into a state of self-doubt, and I was beginning to wonder if I had made a massive mistake in moving from Physics and Philosophy to dive into a PhD in history, meeting Simon opened my eyes to the idea that pursuing history of science was not something limiting but rather something opening up endless possibilities – creating installations with artists or reconstructions of Athanasius Kircher's magnetic machines, working on digital projects, or festivals or exhibitions, these were all perfectly compatible and indeed almost necessary parts of being a historian of science. In Florence, I was called, somewhat deprecatingly, a "Schafferiano" by some of my more conservative Italian colleagues, implying that I was one who had imbibed the Kool-Aid, but I wore the badge with pride.

It has sometimes been said that Niels Bohr's most important influence was not exerted through his own discoveries, but rather through the way he worked as a facilitator, mentor, questioner and catalyst to the discoveries of others. Einstein remarked that Bohr uttered opinions "like one who perpetually jousts about and never like one who believes he holds the whole defining truth." In conversation, Simon always appears not to be pushing his own ideas but rather to be fascinated by your ideas, and they seem always to flow out of the conversation alchemically transformed from the rather vague and loose concepts you began with into something that you feel really on fire about. This is an extraordinary skill, and left many people quite changed by the experience. While I have only had intermittent and alas far too little contact with Simon over the years, every encounter is seared into my memory.

Without Simon's robotic mentorship and his mischievous spirit I very much doubt I would ever have had the courage or the ability to jump out of academia to develop festivals, museums and idea-colliding spaces like Science Gallery and Biotopia. And even still, the worst FOMO of all is knowing that if Simon is not in the room, you are probably not in the place where the most interesting conversation is happening, whether he is talking with Werner Herzog about meteorites or demonstrating Newton's prism experiments in a Parisian salon.

Here's drinking to you, dear Simon, the conversation cloud that surrounds you and the mysterious combinatorial device within, long may its gears spin!



FIGURE 2. • On San Giorgio, Venice, Lenka Gorman, Simon Schaffer and Michael John Gorman, 2016 photograph by Pasquale Gagliardi.

# Prophecy backwards

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JIM SECORD

The Palace is gone, but the monsters endure. One of the best places to understand what it was like to confront the new world of extinct creatures conjured up by nineteenth-century geology is the Crystal Palace Park at Sydenham. Here is an island panorama of ancient life, extending from half-submerged amphibious forms to the majestic Iguanodon and Megalosaurus (*Fig. 1*). You can see them wonderfully explained by Simon in his 2018 “Mechanical Monsters” documentary for the BBC. They also feature in Adrian Desmond’s classic *Isis* article of 1979, “Designing the Dinosaur,” which for many years was a mainstay of Simon’s lectures on the sociology of knowledge.<sup>1</sup>

What do the monsters teach us? The projectors of the Crystal Palace believed that learning achieved through the eye had a clarity, immediacy and permanence that words could never match. This was the power of things. As the original Great Exhibition in Hyde Park had demonstrated, material objects had the potential to speed the march of progress. It also revealed that object lessons could make money. With industrial unrest and Chartism on the decline, popular education and commercial profit – mammoth and mammon – could go hand in hand. When Simon started teaching at Imperial College, his office was next to the Royal Commission for the Exhibition of 1851, which manages the great imperial display’s financial legacy.

The designer and sculptor of the monsters, Benjamin Waterhouse Hawkins, was fascinated by innovative technologies, and as Simon has shown, his beastly constructions were triumphs of Victorian engineering. Now Grade I listed structures, the largest monsters are tiny windowless brick-built country cottages raised on four legs, combining new ways of constructing public sculptures with those for building houses. The most radical innovation involved new techniques of reinforced concrete. Huge quantities of earth and stone had to be moved to make the islands, and the surrounding lake had a sophisticated

<sup>1</sup> Adrian Desmond, “Designing the Dinosaur: Richard Owen’s Response to Robert Edmond Grant,” *Isis* 70 (1979): 224–34. Other accounts with full references include Gowan Dawson, *Show Me the Bone: Reconstructing Prehistoric Monsters in Nineteenth-century Britain and America* (Chicago: University of Chicago Press, 2016), 168–208; Steve McCarthy, *The Crystal Palace Dinosaurs The Story of the World’s First Prehistoric Sculptures* (London: Crystal Palace Foundation, 1994); and James A. Secord, “Monsters at the Crystal Palace,” in *Models: The Third Dimension of Science*, ed. Soraya de Chadarevian and Nick Hopwood (Stanford: Stanford University Press, 2004), 138–169.



FIGURE 1. • Idealized view of the Crystal Palace at Sydenham. Lithograph by George Baxter, 1854.

plumbing system imitating the tides. That these mechanical wonders could be so thoroughly hidden from view, but then described in full detail for hundreds of thousands of readers in the illustrated press, was part of their attraction. When the engineer Robert Stephenson saw the Ichthyosaurus reconstruction, he asked Hawkins, “Where did you get that tail? That is an exact model of a screw propeller.”<sup>2</sup>

Beyond demonstrating the power of modern engineering and design, the monsters offered moral parables. Desmond focuses on Richard Owen, the comparative anatomist who could only be compared with Georges Cuvier. Although often credited with designing the monsters, Owen actually had only an indirect role in their creation, and his role was mainly to validate their interpretation. From his perspective, the scaly giants at the end of the sequence were the crowns of reptilian creation. Owen’s island story was not just about progress, however, for progress had been cut off. Modern reptiles, such as crocodiles, turtles and lizards, were puny degenerates. There was no sequence of development towards the present, no possibility of evolution. Hawkins agreed. Like Owen, he believed that all vertebrate creatures were built on an archetypal plan, just as his animal

<sup>2</sup> *Daily Review*, 2 November 1862, 2.

sculptures were an expression of an underlying aesthetic of cubic relations.<sup>3</sup> The creatures were perfectly designed and specially created by God.

Hawkins, however, went much further. As he saw it, the creatures had lived all at once or nearly so, and if they were extinct, this was something that had happened within historical times through human action. Those who visited the site were told this, as evidenced in early guidebooks and accounts of visits.<sup>4</sup> Dragons were not mythical – they were living creatures at least through the Middle Ages. St George had fought with pterodactyls just as surely as Edward III had fought the French at the battle of Crécy. The proof, as Hawkins saw it, was in the anatomical detail, especially the curious way that the outer toes supported the wings, which was accurately depicted in Chinese embroideries and medieval paintings. As he told an audience in Maidstone, “dragons formed part of natural history, and ... they must have been seen by man.” In fact, they were not monsters at all, a term Hawkins reserved for griffins, sphinxes and other perversely paradoxical creations of the human imagination.<sup>5</sup>

In his later career as an itinerant lecturer, Hawkins outlined his views in a set-piece talk on “The Age of Dragons,” illustrated with vivid images of medieval knights fighting with extinct animals (Fig. 2). These were not, as is often claimed, “fanciful” or “imaginary,” but rather as accurate as Hawkins could make them. He pointed to additional evidence that other extraordinary creatures had lived into human times, such as the Gorgon from the legend of Perseus and Andromeda; the colossal tortoises of India that could hold elephants on their backs; the ferocious British lion on the royal coat of arms; and the plesiosaurs illustrated by the ancient Romans at Pompeii. Some creatures had disappeared recently such as the giant mastodons and mammoths, or the giant moa known from its bones and the tales of the Māori. Others were on the brink, such as the great whales being slaughtered in the world’s oceans.<sup>6</sup>

And were the reptilian giants really all gone? Among many other pieces of evidence, Hawkins pointed to persistent reports of the existence of the Great Sea Serpent. The most authoritative witnessing had been by Captain Peter M’Quhae and the crew of H.M.S. *Daedalus* off the coast of Africa at about 5pm on 6 August 1848, only a few years before the Sydenham creatures began to take shape. The animal they had seen, with a serpentine body some sixty feet long, was convincingly depicted in the *Illustrated London News*. The creature made so many appearances in the following decades that many thought it must

<sup>3</sup> Benjamin Waterhouse Hawkins, *The Science of Drawing Simplified; Or, the Elements of Form Demonstrated by Models* (London: Smith, Elder and Co., 1843).

<sup>4</sup> See, for example, John Tallis, *History and Description of the Crystal Palace* (London: John Tallis and Co., [1854]), 3: 109.

<sup>5</sup> *Canterbury Journal*, 28 Mar. 1877, 7.

<sup>6</sup> For the lectures, see reports in *Bicester Advertiser*, 7 March 1879, 6; *Daily Review*, 2 November 1862, 2; *Edinburgh Evening Courant*, 12 November 1862, 2; *Renfrewshire Independent*, 15 Nov. 1862), 4; and also B. Waterhouse Hawkins, *The Age of Dragons: A Lecture, Delivered in the Town Hall, Pendleton, on Wednesday, October 29th, 1879. Manchester Science Lectures for the People, 11<sup>th</sup> series* (Manchester: John Heywood, 1879).



FIGURE 2. • St. George fighting a pterodactyl in Fingal's Cave. Pen and wash drawing by Benjamin Waterhouse Hawkins, 1874.

bridge put it, the fish symbol demonstrating Christ's presence through analogy in nature. Worsley told Owen that "the best way of overthrowing the Dragon-worshippers with their idols is to set before them the true ichthus."<sup>9</sup> Hawkins never was so explicit. Instead, his lectures featured virtuoso displays of drawing skill, in which one creature on his black-

be relatively common, at least in the tropics.<sup>7</sup>

Belief in the persistence of ancient creatures is often associated with the more extreme wing of Christian evangelicals, perhaps most famously with Philip Henry Gosse of the Plymouth Brethren. In his *Romance of Natural History* (1860), Gosse argued that sea serpents really did exist – they were probably surviving plesiosaurs – and that the world's antiquity was only apparent. Hawkins, however, appears to have approached the issue from the opposite end of the religious spectrum. Born a Catholic, he was rebaptised as an Anglican at the age of twelve, and appears to have held high church sympathies throughout his life.<sup>8</sup> Seen from this perspective, Owen's archetype could be depicted not only as a unified body plan for vertebrate animals, it was the type and sign of Christianity. It could even represent, as the Rev. Thomas Worsley at Cam-

<sup>7</sup> Sherrie Lynne Lyons, *Species, Serpents, Spirits, and Skulls: Science at the Margins in the Victorian Age* (Albany, New York: SUNY Press, 2009), 17–50.

<sup>8</sup> Valerie Bramwell and Robert M. Peck, *All in the Bones: A Biography of Benjamin Waterhouse Hawkins* (Philadelphia: The Academy of Natural Sciences, 2008), 6–7.

<sup>9</sup> Worsley is quoted in Nicolaas A. Rupke, *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994), 203.

board would morph into another to show that they all shared the same divinely-instituted body plan. Rather than overthrowing the dragons and their kin, Hawkins wanted to recruit them to the cause of true religion, against mechanistic theories of development.

These dangers were real. Soon after the celebrated dinner in the mould of the Iguanodon, held to publicize the impending opening in 1854, the *Illustrated Crystal Palace Gazette* used the display's sequential aspect to teach the evolutionary transmutation of the anonymous *Vestiges of the Natural History of Creation* (1844), by this time in its tenth edition. Readers were told they must "go to school at the Crystal Place, and learn something of what they call 'the development theory'."

But things were on the move, the vegetables grew out of the reach of these terrific munchers, and they themselves felt their tadpole propensities fading, and, with vague feelings for promotion, retired to the solitudes of the waters, to meditate ... upon the delights of the next brevet and the pleasures in store for the fishes they hoped to be.<sup>10</sup>

From this perspective, the men of science who envisioned past worlds were themselves the result of long ages of development: "animals with brains that enable them to prophesy backwards."<sup>11</sup> The mechanical view gained more authority after 1859; ironically, Hawkins (in need of work) illustrated Thomas Henry Huxley's *Evidence as to Man's Place in Nature* (1863) and other evolutionary writings. Hawkins loved his dragons like some people loved their lapdogs, as one reporter remarked; but they threatened the future when appropriated as a usable past for the modern world.<sup>12</sup>

Visiting Sydenham on a day trip in 1862, Fyodor Dostoyevsky famously condemned the Crystal Palace as a soulless machine, illustrating everything that was wrong about modern civilisation.<sup>13</sup> It was a monument to enslavement, a denial of human agency in the face of the universal reason of the multitude, an accomplished fact at which it was impossible even furtively to stick one's tongue out. In a world modelled on Sydenham, Dostoyevsky prophesied, "when everything has been calculated by tables," there will be nothing left to do. Life will be "terribly boring."<sup>14</sup> By taking us to such worlds, Simon has made life anything but boring.

<sup>10</sup> *Illustrated Palace Gazette*, February 1854, 52–53.

<sup>11</sup> *Illustrated Palace Gazette*, February 1854, 52–53.

<sup>12</sup> *Renfrewshire Independent*, 15 November 1862, 4.

<sup>13</sup> Roger Chapman, "Fyodor Dostoyevsky, Eastern Orthodoxy, and the Crystal Palace," in Iraj Omidvar and Anne R. Richards, eds, *Historic Engagements with Occidental Cultures, Religions, Powers* (New York: Palgrave Macmillan, 2014), 35–55.

<sup>14</sup> *Notes from the Underground* (1863), as translated by Sarah J. Young, <https://sarahjyoung.com/site/2010/04/22/the-crystal-palace-in-russian-literature-2/> (accessed 1 Mar. 2022).

# Learning to Explain

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SADIAH QURESHI

Dear Simon,

You've made such a difference to my own life, let alone the department, our field, or our discipline more broadly, that it's hard to know how to thank you. In trying to give a sense of the difference you've made to me, I hope to illuminate an aspect of your career that might easily go unnoticed otherwise.

You were on leave for much of my undergraduate studies in the department, with the late Bill Clark filling in, so you first taught me as a masters student. When considering doctoral research, I met with Jim Secord and he asked me about a possible second supervisor. In one of the best decisions I ever made, I immediately volunteered your name. I learned so much from you that shaped my intellectual and personal path, and continues to do so to this day. Here, I linger on the most important.

The most significant lesson was distinguishing between the thing that needs to be explained, and the explanation – the historical explanandum and explanans. I would frequently arrive for supervisions excited about my latest insights into “ethnological exhibitions,” only for you to insist I stop and consider why such shows had anything to do with race, ethnology or empire. Initially, I had no answer. Weren't the exhibitions self-evidently racialised and imperial? I left many supervisions knowing that I had much work to do, often only fully appreciating your insights much later, as I rifled through archived ephemera or wrote late into the night. As my archival treasures grew, I finally understood that I needed to explain how displayed peoples were *made* relevant to ethnology and empire for them to produce any kind of knowledge, whether scientific, imperial or racial. Realising the power of recovering the labour that created these connections and made them invisible changed my thesis, but also my historical practice. As I'm sure many other contributors will attest, this is just one example among countless others of your commitment to making labour visible and the profound influence this has had on our discipline through sociological approaches to knowledge-making.

Those early lessons in the sociology of knowledge continue to shape my own teaching. In recent years, I've noticed a shift in historical discussions of empire and race among students, scholars and the broader public. Early in my career, students would often come to me wanting to understand and uncover past forms of violence, but they were usually deeply reluctant to make their positionality or ethical commitments explicit. More re-

cently, students are much more confident. Yet, this confidence also often manifests itself as a moral imperative to demarcate between who was and was not an oppressor, as if this is sufficient historical explanation. I understand the impulse, especially as I remain frustrated by my sense that there has been relatively little change in achieving racial equity during my lifetime. Yet, as your student, I remain convinced that such proclamations usually reveal a new explanandum, rather than providing a definitive explanans.

The second lesson was much more intangible at the time, but profoundly shaped how I occupy space in the academy. I first encountered Sara Baartman's story when I was a teenager and chose to revisit it as an MPhil student. Like so many others, I simply could not fathom why she was exhibited across Europe and preserved as a scientific specimen rather than being buried. I was convinced her story was significant for broader discussions about being human. In later years, I realised that I was also trying to make sense of how people encountered my own perceived alterity within the confines of Cambridge. We first discussed her during my PhD, as I tried to draft my first article. In an act of enormous kindness and generosity, you read several drafts, and we had many conversations about how best to understand the significance of her life. One of the most important questions that came out of those conversations was *why* Sara stirred such curiosity. In much of the literature, historians took for granted that her presence was the *explanans* for public curiosity in her body and presence, yet few grappled with the fact that thousands of people of African descent lived in nineteenth-century London. I spent months reading histories of migration and the Black British presence, thinking about the ways in which Baartman was both like and unlike the resident population. Those stories of migration changed my path in ways that went far beyond my first published article.

In recent years, challenging historical erasure and discrimination within our discipline has underpinned my research, teaching and advocacy in new ways. Several years ago, I introduced a new undergraduate survey course on Black and Desi histories of Britain from the Tudors to Rhodes Must Fall. The course was my attempt to counteract historical erasure in the national curriculum right through to higher education. Teaching it, and supervising the countless dissertations that it inspires, is easily one of the most rewarding aspects of my teaching. My broader advocacy includes contributing to the Royal Historical Society's landmark report on racial inequalities within the discipline and working with heritage organisations on decolonising museums. These intertwined threads of research, teaching, and advocacy are rooted in my own ethics and experiences, but they are equally rooted in our early conversations about Black British history and global histories of science.

I'm currently trying to finish my second book on the intertwined histories of extinction and empire in the modern world. In particular, I want to explore how extinction is not merely a natural phenomenon, but an idea that is linked to broader histories of violence, dispossession and environmental catastrophe. As I mull over extinction and the earth's demise, I often reflect upon the paths leading to my present, and where I hope to be in the future. My heart never quite left those encounters with early histories of migration and I know I want to return to them imminently, potentially taking up my own

family's history. You helped light that spark. I only wish I had the words to thank you as I consider how best to tell the stories of ordinary migrants, like me, who so rarely figured in the histories I encountered until our conversations.

I hope that even these brief reminiscences give a sense of the profound impact you had on my life's path, as an exemplar of your impact on our discipline more broadly. As you embark on a new chapter, I wish you peace, health and joy.

With much love,

Sadiah

# MECHANICAL MONSTERS

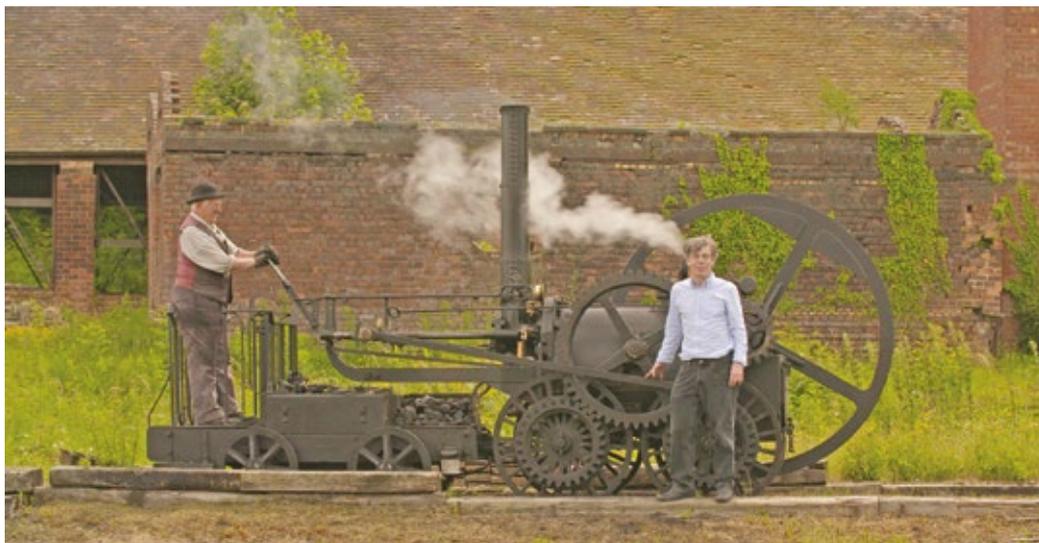
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ANDREW SMITH

In 2017/18, I had the great privilege of directing a Simon Schaffer documentary for the BBC, produced by Paul Sen's independent company, Furnace. *Mechanical Monsters* took us on a tour of some of the engineering triumphs of the 19<sup>th</sup> century, narrated from a uniquely Schafferian point of view; as we travelled, Simon told a twisting, turning, intellectually invigorating story of how these technological achievements had unexpected consequences for the philosophy, culture, theology and even the psychological well-being of the Victorian world.

Working on the production was a delight, taking us from the furnaces of Coalbrookdale to Babbage's calculating engine in the Science Museum to the Crystal Palace Dinosaur Park of 1854. We hopped over to central Ireland to scale "The Leviathan," a gigantic telescope built by Lord Rosse in the middle of the Bog of Allen; and down the Thames we went to tell the putrid story of Joseph Bazalgette's "Palace of Shit," the colossal Crossness Steam Pump designed to funnel much of the sewage out of central London. We





ended up, in a small studio somewhere in southern England, grappling with a magic lantern and a very early prototype of a projector, attempting to build a “Time Machine,” a slightly doomed effort to bring to life a bizarre scheme concocted by H. G. Wells and the pioneer of British cinema, Robert Paul, who had wanted to create an attraction which would give paying customers the sensation of time travel itself.

Reeled off like this, it must seem a wildly disparate and scattergun collection of Victorian constructions, follies and unrealised fancies; but what tied it all together was the spiderweb connectivity of Simon’s mind; with each “mechanical monster,” we learned about thermodynamics, evolution, spectroscopy, astronomy, the discovery of entropy, the global effects of the industrial revolution, the encroachment of Victorian pessimism and the communal loss of theological faith, the waning of the optimistic belief that technology would save us. And of course, it was all narrated with flair, eloquence and Simon’s rare ability to make the act of talking seem in and of itself dramatic; he injected a sense of scale and beauty to the stories he told, and from his precisely chosen words radiated the sense that it all mattered.

Early on, Simon and I agreed on three inviolable rules of filming. Nothing of any consequence was to be attempted before 9am. All filming was to be conducted as geographically close as possible to the hotel, or pub or restaurant planned for the evening. No filming would happen after 6pm. This wasn’t to downgrade how hard we worked, or how seriously we took the shoot; it was partly a reflection of how quickly we could film, given Simon’s ability to seamlessly riff his way through complex exposition, and get it done in the first take. But it was also because we all found Simon’s company so enjoyably edifying when the filming stopped.

Most of us make documentaries at least in part because it’s a great way to get a free education, and hang out with remarkable people, gaining insights into how they think



and how they conduct their lives. Most treasured, not just by me, but by all the crew, were the relaxed lunches, and the convivial post-work pint or two. Some TV presenters treat the set as if it's their seigneurial domain, with the crew playing the role of inconvenient mendicants, or at best servants of a sporadic usefulness; but Simon was non-hierarchical, collegiate, open and generous in spirit. Evenings felt like a free-roaming, democratic, subject-unlimited symposium. A typical night might cover Neolithic food preparation, the philosophy of museum curation, the toy theatres of Philip de Loutherbourg, the poetry of Matthew Arnold, encryption techniques used by the Napoleonic Grand Army, quantum computing, 1950s Polish documentaries, and the archaeology of industrial slagheaps. As Simon's brain whirred away, there were times when I could almost picture calorific waves of energy rippling out from his temples; my only regret is that I didn't record the conversations as some kind of Boswellian act of preservation.

Working with Simon could even change your life. One evening, we sat for hours in an Indian restaurant overlooking the River Severn at Ironbridge, as Simon unfurled tale after tale of Arabic science and history – I can specifically remember discussing pharaonic measuring rods, and one in particular, the cubit-rod of Tutankhamen's treasurer. As a direct result of that night, our assistant producer gave up her plans of working in TV and enrolled to study the history of Arabic science at Cambridge University.

Our scruffy and often erratic trade of documentary-making can feel a little vaudevillian, tatterdemalion, peripheral and ephemeral. In an hour of TV, you can only squeeze in about 6,000 words – what can you possibly convey which wouldn't be better communicated in some other medium? But Simon is one of those figures who fortify you with the belief that documentaries can matter. He approaches making a documentary not merely as a challenge, problem-solving your way through the relentless requirement to squeeze complex ideas into a narrow vessel; he sees documentary-making as a means

of thinking in itself, an opportunity not just to distil what you already think, but to reconsider what you think, to find new connections and new depths. I was left with the conviction that, for Simon, the necessity of having to explain something very complicated to a non-specialist audience in as few words as possible is itself an important component of thinking; a documentary can be not just a piece of science communication, but a way of conducting science itself.

# Teaching the history of science in a crazy world: On Georg Friedrich Nicolai's Biology of War

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MORITZ EPPLE

One thing I have taken from my conversations with Simon about academic work in the history of science is that we must be aware that there is a world outside the walls of academia. And rather than contributing to building these walls even higher we should look for ways to step over them, or to make them permeable.

There are several ways to transcend the walls of academia. One of them is to choose subjects for academic teaching that bring the outside world in and that connect to the non-academic lives of our students. So many such topics have arisen in our field over the last few decades, e.g. the links between science and colonialism (this was the topic Simon brought to Frankfurt when he gave his first talk here), the promises and problematic legacies of the varieties of science of the European enlightenment (from natural wonders to the mathematics of in/equality of wealth and to scientists' odd claims about human races) and, last but not least, the historical emergence and construction of scientific expertise itself. Simon's work has contributed greatly to increase awareness of such topics, and it has offered highly successful conceptual tools to employ in teaching and researching them.

Depending on where we live, certain political topics of the twentieth century continue to bother both us and our students. In Germany, for instance, to teach the history of science and *not* to address the role of science in Nazi Germany would definitely fail to address one of the most pressing issues regularly brought up by our students, all the more so at a time when new fascist tendencies are on the rise all over the globe.

The same is true, in this country and in many others, for the topic of science and war. Whether we took up in our Frankfurt courses the (usually broken) promises of early modern mathematical warfare, based on the materials of the Oxford History of Science Museum's exhibition *Geometry at War*, or the close ties between Napoleonic warfare, military education, and the building of the new French nation state, whether we looked into the complex story of Fritz Haber's Kaiser Wilhelm Institut during World War I or into any of the endless chapters of the history of science in World War II, our students were articulating their feeling of relevance and they came to the meetings with more than a basket of their own questions.<sup>1</sup> Should universities today conduct military research?

<sup>1</sup> For the *Geometry of War*, see <https://www.mhs.ox.ac.uk/geometry/content.htm>; see also Jim Bennett's thoughtful reflections in Jim Bennett, "Geometry in Context in the Sixteenth Century: The View from the Museum," *Early Science and Medicine* 7, no. 3 (2002): 214–30.

Should trained scientists, should *we* be prepared to do work for military purposes in our own life? Here students bring their own views, they learn, and they engage with the topic.

If we teach the history of science in such a way the outside world may even crash in where and when we do not expect it. In the winter term 2021–2022 I finally came round to offer a course I had planned for a long time, on a book that is rarely studied even if its existence is well-known to historians of medicine and of the European sciences during World War I: *Die Biologie des Krieges*, written by the electro-cardiologist and pacifist Georg Friedrich Nicolai.<sup>2</sup>

The origins of the book are fairly well-known. Shocked by the outbreak of the war, and perhaps even more by the infamous militaristic manifesto *An die Kulturwelt* signed by 93 renowned German scientists, Nicolai not only drafted a counter-declaration *An die Europäer*, signed by just three others, including Albert Einstein, but also began to lecture at Berlin's Charité hospital against the war. Several stages of professional discrimination followed, and Nicolai spent most of the war in a field hospital in West Prussian Graudenz (today's Grudziądz in Poland). There he expanded his lectures against the war into a book manuscript which was first printed, without his permission, in 1917 in Zürich, and then again in 1919 in authorized form. In Spring 1918, Nicolai fled Germany. But Nicolai could not return even after the end of World War I to normal professional life in Berlin, and he left Germany for good in 1922 for South America.<sup>3</sup>

The original idea of the course was not so much to re-tell Nicolai's story but to use his text as a probe into the thicket of European scientific culture before and in World War I, in order to throw light not only on Nicolai's argument condemning war as a dead end of human evolution – with a substantial number of acute analyses of individual and social behaviour in war as well as its long-term effects on both – but also to explore the debates of the period about evolution and society, the various patriotic justifications of war offered by Nicolai's academic colleagues (all of which Nicolai hoped to expose as fallacies if not conscious deceptions), and his general views of human progress.

Nicolai's basic argument against warfare has a simple structure which is outlined in the book's first sections and then expanded in subsequent chapters. It displays both strengths and inner problems that are closely tied to the historical situation in which he was writing. The fighting of groups of humans against each other, so the argument begins, may have had an evolutionary function in the very early phases of human evolution, when the growth of human population induced both migration and conflicts, since factions leaving their original groups would appropriate parts of the common goods of the original group, and since different factions meeting in new territories would tend to keep

<sup>2</sup>The edition we used is: Georg Friedrich Nicolai, *Die Biologie des Krieges*, 2 vols. (Zürich: Orell & Fuessli, 1919). Several reprints and translations of this edition are available, some including additional materials. In the following, no page references to this edition are given but readers are invited, of course, to take a look of their own.

<sup>3</sup>The standard biography remains Wolf Zuelzer's *The Nicolai Case: A Biography* (Detroit: Wayne State University Press, 1982).

these partial goods from other factions.<sup>4</sup> Nicolai marked this period as that of the emergence of the “capitalist triad” of private property, warfare, and slavery. However, even in this early phase of conflicts new societies formed in which conflicts were resolved by establishing some order integrating the different factions into new collectives – based on domination and unequal property for sure, but regulated and mixed nevertheless. Here, Nicolai linked his argument with a left-wing interpretation of the notion of the struggle for existence and of the social aspects of (both human and non-human) evolution as it was described at the time in an influential way in Peter Kropotkin’s series of essays re-published in monographic form in 1902 under the title *Mutual Aid: A Factor of Evolution*.<sup>5</sup> At all stages of human evolution, Nicolai argued with Kropotkin, cooperation was a crucial element of the struggle for existence, and more important than the transitory conflicts caused by initial migration. After this initial phase warfare lost its evolutionary function. From then on it remained a dysfunctional error in human evolution, brought about by partial interests of small groups of individuals in preserving (and at times masking) their role in social domination and in securing unequal wealth – a function which could not be justified in evolutionary terms.

This evolutionary perspective was coupled with a second thesis about human evolution which we might title just like one of the influential journals of our field: *Technology and Culture*. From its early stages, Nicolai argued, human cooperation brought about social products that would eventually contribute to the evolution of humankind in a positive way. On a material level, this cooperative product was technology (and the science supporting it), on an immaterial and moral level, it was culture. The material struggle for existence came down to securing and making productive use of ever higher amounts of energy for humankind; the core of cultural evolution was the formation of language and moral ideas, crowned by achievements such as Kant’s categorical imperative. The students in our group were quick in identifying and indeed criticizing one obvious feature of Nicolai’s thesis: its explicit adherence to a eurocentric account of civilizing progress as a form of prolonged evolution.

From this general perspective, Nicolai then proceeded to deconstruct (we would say) any and all justifications of warfare he encountered in his day. As we went through the book’s chapters, we were often struck by topics and motives that were surprisingly familiar from justifications of warfare as we know them from the later parts of the 20<sup>th</sup> century. Not only was any evolutionary utility of warfare denied, Nicolai also rejected any economic utility of modern wars by giving an account of the actual costs and economic damages induced by warfare; here he tried to include and even to quantify losses of workforce

<sup>4</sup>This part of the argument and the claim of a link between initial migration and the formation of private property was not new. Interestingly enough we do not find it in Engels but, for instance, in Etienne-Gabriel Morelly’s explanation of the emergence of private property in his *Code de la nature*, anonymously published in 1755. Closer to Nicolai, and one of the texts he referred to, is Peter Kropotkin’s *Mutual Aid*, referred to in the next note.

<sup>5</sup>Nicolai used a translation made by the German anarchist Gustav Landauer under the title *Gegenseitige Hilfe in der Entwicklung* (Leipzig: Theodor Thomas, 1904).

and infrastructure.<sup>6</sup> And as is to be expected from a physician who was working with war victims, Nicolai was acutely aware of the human losses, from physical impairment to psychological damages caused by war. He was equally clear-sighted about the deformations of culture brought about by war, beginning with the conscious abandonment of truth by all parties involved.<sup>7</sup>

Then he turned to a fascinating analysis of nationalism and patriotism invoked to justify warfare. Here, too, Nicolai adhered to his evolutionist perspective. He saw three evolutionary roots of what later was turned into patriotism, namely an attachment to the natural local milieu or habitat of a group, an attachment to those involved in immediate reproduction (family, in a loose sense), and a longing for social connection that he believed to be part of human nature. Neither of these three roots, however, were sufficient to justify the forms of militant patriotism he encountered among his contemporaries.

First, there was a patriotism tied to states. But all modern states, and in particular the larger and more powerful ones, included rather varied and different natural milieus (from wetlands to deserts, from mountain ranges to wide planes and so forth), they were populated by an abundance of different kinds of families, and so far social cohesion had been lacking in each of these states.

Then, there was an attempt to tie patriotism to races. Nicolai took great pains to show that to follow this route was the most deplorable error of modern science, be it from a historical, a linguistic, or a biological perspective. In all these dimensions, and due to long historical processes, modern societies were characterized as mixtures. To ask for homogeneity would belie social reality. There was, however, a catch to which I will return in a moment.

Finally, there was a patriotism claimed to be cultural. Were not the English as rightfully proud of Newton and modern science as the French could celebrate their Enlightenment and modern republicanism, while the Germans revelled in writers and thinkers such as Goethe and Kant? Was not this, at least, the basis for a worthy form of patriotism? In one of the book's strongest passages, Nicolai rejected even this idea: Modern individuals, he argued, combined their cultural background from all these cultural traditions. Just as modern societies were racial mixtures, modern individuals were endowed with and lived in mixed cultural horizons.

In sum, all existing forms of patriotism were mistaken and did not fulfil the evolutionary needs from which they had arisen. In light of the importance of the moral dimension of human evolution, the entire question of patriotism came down to this simple question: Should one place morality above the purported "fatherland" or vice versa? Would one rather accept a violation of the *Sittengesetz* if it served one's "fatherland" or would

<sup>6</sup> As far as I can tell, many of Nicolai's economic arguments were his own.

<sup>7</sup> For this reason, he was particularly furious about the repeated use of the words "Es ist nicht wahr, dass..." that were used in the manifesto *An die Kulturwelt* in order to reiterate incorrect claims of German propaganda, for instance that it was "not true" that German troops had violated Belgian neutrality in 1914 (which they had).

one rather condemn one's "fatherland" if it violated the *Sittengesetz* valid for all human beings? Of course, in this way of putting it, Nicolai believed the question to be rhetorical. Instead, humanity's task was to look for ways of fulfilling the needs and desires lying in the three evolutionary roots of patriotism in proper ways, both below and beyond the level of states, races, or nations. The task was to develop the proper social organism of humankind.<sup>8</sup>

Going through this argument (and its many branches and details glossed over here) as persons living in the early 21<sup>st</sup> century, the students were quick to point out a number of blind spots, inconsistencies, and errors that seemed obvious in retrospect.

First, technocentrism. Does technology indeed solve all problems of human organization? With hindsight, we understand that Nicolai's claim that all technological innovation results from civil life, and that it does not decide wars, was blatantly wrong. In particular, technological developments allowed later warfare to be partially delegated to machinery and weapons of mass destruction and thus to create the idea that a power can wage war without sending a substantial amount of its (usually male) population to the trenches as in World War I. Moreover, to persons living in a world of climate change and limited natural resources Nicolai's approach seemed obviously anthropocentric. Shouldn't our perspective today be that of living beyond the anthropocene? Some members of the group, however, pointed out that the last word about technological optimism has perhaps not yet been spoken: Couldn't there be a way in which technological evolution can tie into these new requirements of a humankind living in accord with the other species populating our globe?

Second, Eurocentrism. Throughout the book, Nicolai made a point of considering Europe as a cultural unit, and as the most advanced part in the development of humankind. He even went as far as saying that while all European states were racially mixed, he could identify with the idea that there existed a "European race." We found this to be an inconsistency given the overall structure of his argument and his insistence on the basic role of social and cultural mixture.

Third, and related to both previous issues, *Eugenesia*. Nicolai believed in the idea of a constant improvement of humankind, including by technological and cultural means. One of his later books, written in Spanish and published under the title *Eugenesia* in 1957 in Buenos Aires, even expanded this idea into a left-wing version of positive eugenics. It also led Nicolai to include, in his attacks on the idea that warfare would contribute to the survival of the fittest, passages looking down on impaired and disabled persons, believing that physical and intellectual strength was the goal of human development.<sup>9</sup>

<sup>8</sup> The shorter second part of his book contained a historical sketch of what he viewed as earlier attempts to articulate this idea.

<sup>9</sup> This has been noted by earlier commentators, e.g. by Peter Weindling and Hans-Jörg Schmuhl. It should be noted, however, that Nicolai did not justify these passages by reference to the tradition of racial hygiene, a tradition he explicitly rejected.

So, in the end, we did indeed learn a lot about scientific culture immediately before and in World War I, about the politically opposing varieties of social thought and Darwinism, about the debates around racial hygiene, and about scholars of a wide range of academic specialties trying to justify the war waged by their countries. We could certainly agree with Nicolai's central claim that humankind will only be able to leave wars behind if it finds a good form of social organisation that no longer depends on inequality and domination secured by armies and ideologies. We could also agree with his hope that the history of humankind provides clues in which direction this social organism might be found. But we also had to admit that despite all the force of his arguments against failed justifications of warfare, his views were hampered by inconsistencies and limitations that told us more about the period in which and against which he wrote than about our own. And isn't the critical conclusion of a historical course *always* that the material discussed is *dated*?

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After finishing the course, the events at the Ukrainian borders came thick and fast. On Tuesday 22 February 2022 I sent this message to the students of the course:

Dear participants,  
when planning this course I had no idea what degree of timeliness our topic would have at the end this term. As of now, Russian troops have entered Eastern Ukraine, and the further development of the situation is as threatening as it is unclear.

With the knowledge you have taken from the discussion of our text, observe with acuity what is happening, analyse the means and phrases used by the warmongers on both sides to take their steps, assess the damage or specific utility that threats and military action have or will have for people in the region and elsewhere. Obviously, at least a significant part of humankind has not advanced far beyond the state critically assessed by Nicolai.

Sobered greetings

ME

Two days later, the Russian military launched a full scale attack on Ukraine.

# RULES AND REPLICATIONS



# Strictly no social construction

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JACOB STEGENGA



Simon and I were together on the picket line during the UCU strike of 2018. He was there, fist raised yet smiling, to protect the pensions of us more junior professors. Someone (Simon?) had added "social" to the sign behind us, thereby demanding us to strictly forbid social construction.

# Simon Schaffer and the sociological turn

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HARRY COLLINS

I believe I first met Simon in 1980. We in Bath had been developing the relativistic sociology of scientific knowledge since the early 1970s, though somewhat in the shadow of the Edinburgh “strong programme,” of which people thought we were an offshoot – which we weren’t. I think it was Steve Shapin who suggested the idea of the 1980 conference to be held in Bath – it was called “New Perspectives in the History and Sociology of Science” and it was jointly sponsored by the British Society for the History of Science and the British Sociological Association Sociology of Science Study Group. Steve knew everyone and Steve was the driving force in so far as this involved bringing everyone together. I did the local organisation – the meeting was 27–29 March – but I didn’t know anyone in the history community at that time. Steve brought Simon into the magic circle of social analysts of science and Simon helped to engender another step change in the energy level.

Those were the best days of my academic career and I suspect they were the best days for many others who were discovering how to analyse science in new ways, leapfrogging the philosophers on whom we had depended for so long. I’ve described this elsewhere as “cracking the crystal of science” and it felt as though we were revolutionising the understanding of knowledge. That it involved a great deal of disrespect for the established academic powers was part of the fun and in those days, certainly in a UK still basking in the astonishing cultural upheaval of the ‘60s, this was what was expected from the grad students, post-docs and brand-new lecturers.

That conference eventually led to a publication – the special issue of *Social Studies of Science* entitled *Knowledge and Controversy: Studies in Modern Natural Science* (vol. 11 no. 1) but it contained only five studies of contemporary incidents and neither Simon nor Steve was included. Nevertheless, the thing took off because of the impetus from the conference.

Now, the meeting was not held at Bath University but at a local college on the outskirts of the town called Newton Park (now Bath Spa University). The College had excellent grounds and accommodation and was very helpful and enthusiastic when it came to arrangements. It was approached through a gate leading to a long winding drive through parkland. Simon put his mark on the meeting, and somehow told us what we had not quite worked out for ourselves, by hammering a home-made signpost into the ground for everyone to see as they drove in, at one of the sharper bends in the driveway. It read “The Sociological Turn.”

# Good as Gold

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MICHAEL BYCROFT

Science studies has a problem with epistemology. Simon Schaffer's œuvre, properly understood, contains a solution to this problem.

The problem with epistemology has taken several forms in Anglophone scholarship in the history, sociology and anthropology of science. One is the shift in research priorities noted by Arnold Thackray in 1981:

Epistemological questions about paradigms, research programs, and the truth content of science will continue to attract their followers, especially in the rich borderlands, where history of science dissolves into philosophy. However, the relativistic, agnostic mood that now characterises Western society and Western history seems likely to nourish a different range of concerns. We should rather expect to see new emphases on the politics of knowledge, on ideas as tools, and on the social dimension of scientific thought.<sup>1</sup>

Thackray predicted that historians of science would lose interest in such things as “the truth content of science.” This prediction turned out to be correct, to judge from an essay by Steven Shapin published in 2010. Shapin gave a list of statements that once seemed heretical but were now “just-what-it-is-to-do-history-of-science.” One of these statements was:

You could say that Truth (in any precise philosophical sense) is not a product of science, or that it is not a unique product.<sup>2</sup>

<sup>1</sup> Arnold Thackray, “Science, Technology, and Medicine,” *The Journal of Interdisciplinary History* 12, no. 2 (1981): 299–314, on 312–3.

<sup>2</sup> Steven Shapin, “Lowering the Tone in the History of Science: A Noble Calling,” in Steven Shapin, *Never Pure: Historical Studies of Science as if it was Produced by People with Bodies, Situated in Time, Space, Culture, and Society, and Struggling for Credibility and Authority* (Baltimore, MD: Johns Hopkins University Press, 2010), 1–14, on 5–6.

In other words, scientists are not in the business of generating true statements about the world, and they never have been. They may try to say true things, but they fail to say them. Perhaps they do not even try.

Such claims were sometimes accompanied by blanket dismissals of the academic discipline of epistemology. In the words of Bruno Latour and Steve Woolgar,

the particular branch of philosophy—epistemology—which holds that the only source of knowledge are ideas of reason intrinsic to the mind, is an area whose total extinction is overdue. The redundancy of epistemology is well established by flourishing sociological, historical and (other) philosophical analyses of knowledge, despite its constant assertion ... of the impossibility of these disciplines.<sup>3</sup>

Latour and Woolgar then made a prediction of their own:

Perhaps the best way to express our position is to propose a ten-year moratorium on cognitive explanations of science ... We hereby promise that if anything remains to be explained at the end of this period, we too will turn to the mind!<sup>4</sup>

This was written in 1986. It is now 2022. It is time to end the moratorium, because a great deal remains to be explained.

For example: why are so many scientists saying that the Earth is getting hotter very quickly? Latour's answer is that they have "managed to accumulate evidence" for this theory.<sup>5</sup> So far, so good. But how should we analyse this accumulation of evidence? Latour says that we should think of climate science as a set of robust networks, made up of institutions, instruments, costs, controversies, and so on.<sup>6</sup> The problem is that the network of climate-change skepticism is just as robust. It has institutions, instruments, costs, and controversies of its own. In fact, the skeptical network appears to be *more* robust than the rival network, given the glacial pace of international action on climate change. If the robustness of networks is any guide to truth, we ought to be skeptics about anthropogenic climate change. It's no use replying that the skeptical network is only more powerful, not more truthful. Because the distinction between truth and power is illusory, according to Latour: "We cannot distinguish between those moments when we have might and those when we have right."<sup>7</sup>

<sup>3</sup> Bruno Latour and Steve Woolgar, "Postscript to the Second Edition," in their *Laboratory Life: The Construction of Scientific Facts*, 2<sup>nd</sup> edn. (Princeton University Press, 1986), 273–86, on 280.

<sup>4</sup> Latour and Woolgar, "Postscript to the Second Edition," 280.

<sup>5</sup> Bruno Latour, *Down to Earth: Politics in the New Climatic Regime*, trans. Catherine Porter (Cambridge, UK: Polity Press, 2018), 17.

<sup>6</sup> Bruno Latour, *Facing Gaia: Eight Lectures on the New Climatic Regime* (Cambridge, UK: Polity Press, 2017), 31, 33, and 33 n. 63.

<sup>7</sup> Bruno Latour, *The Pasteurization of France*, trans. Alan Sheridan and John Law (Cambridge, MA: Harvard University Press, 1988), 183.

Another question: why does democracy need science? Harry Collins' answer, given in a recent book, is that science is a form of moral education.<sup>8</sup> Collins agrees that scientists aim for the truth, and that this is a good aim have. But there is a caveat: the quest for true beliefs is good because it cultivates democratic values, not because it is ever realised. The idea that scientists are getting closer to the truth is an example of "the touching naiveté of natural scientists," in Collins' words.<sup>9</sup> This is presented as a "moral defence" of science.<sup>10</sup> But if we take it seriously, it is more attack than defence. It suggests that scientists should receive far less state funding than they currently do, since science is an extremely inefficient form of moral education when compared to the alternatives, such as social work or team sport. Collins' account also suggests that we should not believe the scientists who say that the Earth is getting hotter very quickly. To believe them would presumably be another example of "touching naiveté." Instead, we should watch these scientists at work, noting how diligently they aim for the truth. We should then follow their example in our own lives. But why? Not because we will thereby acquire true beliefs. If scientists cannot acquire them, there is not much hope for the rest of us. Why, then? Because of the "self-evident goodness" of aiming for the truth, in Collins' words.<sup>11</sup> But what's the use of looking for the truth if we have no hope of finding it? Collins does not say.

Collins and Latour both face the same problem. They are trying to defend an epistemic enterprise (science) but they are wary of epistemology. The result is an unconvincing defence. This is not just a problem for anyone who thinks science is worth defending. It is also a problem for anyone interested in understanding human life, whether in the past or the present. There is an epistemic dimension to human life, just as there is a material dimension, a social dimension, an emotional dimension, and so on. People care about having true beliefs, which is not the same thing as having beneficial beliefs. People respond to arguments, and the force of an argument cannot be reduced to the amount of matter that is moved in its defence, nor to the number of well-connected people who endorse it.

"He who has the most, and the most powerful, allies wins."<sup>12</sup> Very well. But there is no reason to prefer that slogan to this one: "He who has the most, and the most powerful, arguments wins."

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What does this mean for historians?

Firstly, Arnold Thackray was only partly right. There was a shift away from epistemic questions among historians of science. But there is no reason to think this was a perma-

<sup>8</sup> Harry Collins and Robert Evans, *Why Democracies Need Science* (Cambridge, UK: Polity Press, 2017).

<sup>9</sup> Collins and Evans, *Why Democracies Need Science*, 37. Cf. 19, 30, 76, 81, 91, 96.

<sup>10</sup> Collins and Evans, *Why Democracies Need Science*, 22.

<sup>11</sup> Collins and Evans, *Why Democracies Need Science*, 23.

<sup>12</sup> Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 2011 [1985]), 342.

ment shift. Put differently, historians of science have as much reason to seek the company of logicians and epistemologists as they do to seek the company of sociologists, anthropologists, and geographers.

Secondly, there is much to gain by inverting the research strategy of science studies. This strategy was to take something that is usually studied as an epistemic enterprise (science) and to study it as a social, political, or material enterprise. This was, and is, very fruitful. The inverted strategy is to take things that are usually studied as social, political or material enterprises, and to study them as epistemic enterprises. The former strategy worked best when it was applied to things that seemed eminently epistemic, such as matters of fact. The inverted strategy works best when applied to things that do not seem epistemic at all, such as matters of value.

For guidance on how to do this, look no further than Simon Schaffer's papers on early modern metrology.<sup>13</sup> The point of "Golden Means," for example, was not just to show that Robert Boyle and Sir Isaac Newton were implicated in the trade in gold and slaves between England and the Gulf of Guinea in the seventeenth century. The point was also to show that the gold trade was an epistemic matter. Traders wanted to know how good their gold was, and this was not an easy thing to know. A great deal of time and effort was dedicated to solving this problem. The solutions are of interest to historians of race, globalisation, and the fiscal-military state, not just to historians of science. They would be interesting even if Boyle and Newton had had nothing to do with the Guinea trade. They would be interesting even if the hydrostatic balance, Boyle's solution to the problem of gold evaluation, played no role in the history of chemistry.

Schaffer, I suggest, is an epistemologist in disguise. He has not only been writing a social history of truth. Less visibly, but just as importantly, he has been writing an epistemic history of the good.

<sup>13</sup> Here are some examples. Simon Schaffer, "Measuring Virtue: Eudiometry, Enlightenment, and Pneumatic Medicine," in *The Medical Enlightenment of the Eighteenth Century*, ed. Andrew Cunningham and Roger French (Cambridge: Cambridge University Press, 1990), 281–318; Simon Schaffer, "Experimenters' Techniques, Dyers' Hands, and the Electric Planetarium," *Isis* 88, no. 3 (1997): 456–83; Simon Schaffer, "Golden Means: Assay Instruments and the Geography of Precision in the Guinea Trade," in *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*, ed. H. Otto Sibum, Marie-Noëlle Bourguet, and Christian Licoppe (London: Routledge, 2003), 20–50.

# The Equal Vanity Thesis

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DAVID BLOOR

Academic philosophers frequently identify relativism as a threat to truth, rationality, science, and morality: but what is “relativism?” The simplest answer is to define relativism as the rejection of any form of absolutism – and then to define “absolutism” as the belief in some form of ultimate perfection in thought and behavior. In Western culture such perfections are typically epitomised in the idea of God and the infinite character of His wisdom and power. Divinity is the cultural archetype and embodiment of absolutism in all its forms. Relativism (R) is thus the negation of absolutism (A).

$$R = \text{not-A.}$$

The rejection of absolutism is then both a necessary and a sufficient condition for relativism.

Most philosophers do not accept this definition. Given that an embrace of absolutism provides the obvious basis for rejecting relativism, it is worth asking why they do not take this route to avoid the alleged perils of relativism. Why not claim to know some absolute truths? A plausible explanation is that, in these secular days, it is difficult to mount a convincing, academic defence of absolutism. This explains why the most popular, academic position is to represent both relativism and absolutism as “extreme” positions. Philosophers can then say there is a spectrum stretching from A to R and they occupy the middle ground, symbolised by [not-A & not-R].

This result can be deftly engineered by insisting that the rejection of absolutism is a necessary, *but not a sufficient*, condition for relativism. These critics of relativism therefore add a further specification to the definition. A relativist, they insist, rejects absolutism (as they do) but also makes another claim – one from which they, as moderates, dissent. Relativists, according to much of the philosophical literature, allegedly embrace something known as the Equal Validity Thesis (EVT). If all propositions possess equal validity then, for the relativist, myth is as good as science, and Aristotle’s physics is as good as Einstein’s physics. Indeed, P is as valid as not-P, for all P. No wonder that relativism looks like a threat.

In the usual, anti-relativist polemic, one feature of the Equal Validity Thesis is always passed over – namely that, historically, it is a consistent feature of *absolutist* positions. The

neglect of this historical fact is surprising because it might be used to reinforce the image of absolutism and relativism as “extreme” positions. Consider the Book of Ecclesiastes in the Old Testament. Ecclesiastes asserted that all learning is vanity, indeed, the vanity of vanities. All learning, and all the trappings of power, amount to nothing compared with the infinite wisdom and power of God. Everything is subject to contingency, except the works of God. The Book of Ecclesiastes gives magnificent expression to what might be called The Equal Vanity Thesis. To re-express Ecclesiastes’ argument in quasi-formal terms, let  $m_A$  be the measure of Aristotle’s finite knowledge, and  $m_E$  the measure of Einstein’s finite knowledge. Then compared with God’s knowledge, represented by the usual symbol for infinity, we have:

$$\frac{m_A}{\infty} = \frac{m_E}{\infty} = 0$$

The ratio of any finite number to infinity is zero. Einstein is no improvement on Aristotle: “*there is no new thing under the sun*” (I.9). The Equal Validity Thesis is a special case of the Equal Vanity Thesis.

The philosophically favored, middle ground now lies between the “extremes”:

$$[A \& (EVT)] \text{ and } [\text{not-}A \& (EVT)].$$

But the equipoise and symmetry is more apparent than real. An imbalance emerges when formal considerations are placed in their historical context. The Equal Validity Thesis is typically *imputed* to relativists, while it is actually *implied* in paradigmatic cases of absolutism. Absolutists of all kinds can be found advocating their version of Equal Validity in their canonical texts. Versions of the thesis run throughout the Western religious and philosophical traditions. It can be found in the New Testament as well as the Old. The God of Ecclesiastes may be remote, but the countervailing desire of many theologians to bring God into human history also depends on a version of the EVT. Divine involvement in human affairs leads to the mystery of God’s incarnation in Christ. The Church Fathers decreed that Christ is *both* divine *and* human: where both attributions were fully valid. This doctrine has the form (P & not-P). The Mystery of Incarnation arises, in one form or another, for any version of absolutism. The absolutes of knowledge and morality must be brought down to earth and somehow lodged in the finite, human brain.

How do relativists avoid embracing the Equal Validity Thesis? The answer is: by seeking a naturalistic, causal analysis of assessments of validity in all their forms. The nerve of relativism lies in the thesis that normative judgements are only intelligible if they are natural, human accomplishments susceptible to scientific explanation – not mysterious intuitions or revelations. Relativists seek to construct a naturalistic understanding of cognitive norms using material from experimental psychology, sociology, and history. They pursue empirical investigations into how, individually and collectively, humans, like other animals, arrive at differentiated, rather than equal, degrees of belief. No behaviorist psychologist would construct a model of how a rat learns a laboratory maze by postulat-

ing a rat brain whose inductive instincts conform to the EVT. The beast would learn nothing. What holds for the rat holds for the human. Ecclesiastes had already reached this conclusion, but expressed it in the language of a lofty and sweeping absolutism: *For that which befalleth the sons of men befalleth beasts ... yea, they have all one breath; so that a man hath no preeminence above a beast: for all is vanity* (III. 19).

From a naturalistic standpoint the Equal Validity Thesis makes no sense: it is, at best, a way of expressing a point necessarily granted by all relativists: namely, that no proposition has absolute validity. All are equally devoid of absolute validity. The question is then: Where do the self-declared, “moderate,” middle-ground, philosophers stand with regard to the naturalistic project? Absolutism is a form of supernaturalism. If moderate philosophers truly reject absolutism then they should be profoundly suspicious of supernaturalism, and thus embrace the naturalistic project. But then how do they avoid embracing relativism – I mean the relativism that, on scientific grounds, runs directly counter to the Equal Validity Thesis? The answer is that if the philosophical critics embrace naturalism they cannot avoid being relativists as judged by the simple and intuitive definition with which I started out – that  $R = \text{not-}A$ .

Relativists, then, seek a scientific, and hence naturalistic, account of cognition and morality. Like any scientific enterprise, this will generate ongoing argument between different practitioners and their favoured hypotheses. Some disagreement, arising from within the naturalistic project, will be inevitable. Unfortunately, this provides cover for anti-naturalistic tendencies and philosophical trouble-making. But consistent, rear-guard action against reasonable, naturalistic hypotheses should raise the question: How genuine is the critic’s naturalistic commitment? Is the Doubting Thomas perhaps a super-naturalist, and absolutist, in disguise?

Of course, the so-called “moderates” can always retreat into dogmatism. They can insist on their arbitrary definition of “relativism” as the conjunction [ $\text{not-}A \ \& \ (\text{EVT})$ ]. They can ignore the fact that, in practice, their definition is a definition of the empty set. Their “relativists” are straw men. Then, when real-life, scientific relativists produce convincing, naturalistic accounts of judgements of unequal validity, these “moderate” philosophers believe they can declare that the relativists responsible for these accounts have ceased to be “true” relativists. This move will fool no-one. Historians of science can recognise opportunism, and an expedient philosophical blindness to history and cultural tradition, when they see it.

One feature of Simon’s work that I have always admired is the element of surprise that he can inject into a historical narrative. The reader or listener learns how to see old things in new and surprising ways. For example, his paper on the Country House helped me think about Lord Rayleigh’s personal laboratory with more understanding. The same applied to the paper about W. H. R. Rivers and the interweaving of Cambridge psychophysics and anthropology. It is this capacity to surprise that suggested to me that I should express my admiration for Simon’s scholarship by attempting a brief account of what, to me, was a surprising historical feature of the current debates about relativism. I am referring to the way in which Old Testament absolutism embraced what critics typically take

to be a defining feature of relativism. Does this mean that, given the Equal Vanity Thesis, we can talk of Old Testament relativism? Surely not: but, as Wellington said of the Battle of Waterloo, it was a damn close run thing. Of course, many of these surprising twists and turns in the history of the spirit-matter hierarchy will be familiar ground to Simon. He wrote about them in *Leviathan and the Air-Pump*. Going back to the Old Testament, however, I would not be at all surprised to find that Simon had written a paper, or given a talk, about the Book of Ecclesiastes, and done so years ago.

# Observing, cloudy nights and the history of amateur astronomy

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KLAUS STAUBERMANN



FIGURE 2. • Shared interests and collaboration continued during the years and Simon was happy to contribute to a workshop on the history of amateur astronomy at Stockholm Observatory organised by Klaus and colleagues in Sweden in 2013. Discussions continued late into the night and many dear traditions were followed up upon.



FIGURE 1. • Klaus Staubermann observing with a replicated Zöllner photometer as part of his PhD with Simon (1994-1998). Klaus writes that he spent many nights observing at the Old Observatory but most nights it was overcast, unfortunately, due to local Cambridge weather. Among his most memorable PhD memories are “liquid lunch” supervisions with Simon.

# Being Lord Rayleigh

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RICHARD NOAKES

I first encountered Simon one dark Monday afternoon in early October 1991, in a cold, musty-smelling lecture theatre in the Old Cavendish Laboratory. This was my first exposure to 1B History and Philosophy Science – a component of the second year of Cambridge University’s Natural Sciences Tripos that I’d only vaguely heard about, but which seemed like a blessing since my experimental and mathematical abilities were proving inadequate for a physics degree, let alone the professional career I’d planned in the subject. I was, of course, completely oblivious to the significance of the venue – the Rayleigh Lecture Theatre – to Simon’s research at the time. The theatre was part of an extension of the Cavendish built in 1907–8, largely financed by the Third Baron Rayleigh, the aristocratic physicist and University Chancellor whose regimes of electrical standards measurement at the Cavendish in the 1880s were central parts of Simon’s now widely-cited work on metrology.

On his way to the weekly lectures on early modern natural philosophy Simon walked through many of the same teaching and research spaces traversed by Rayleigh and his staff. Years later, when I was one of Simon’s PhD students and better able to appreciate his most recent work, I wondered whether, like Otto Sibus performing James Prescott Joule’s experiments on the mechanical equivalent of heat, Simon found “being” Lord Rayleigh every week helped him think about the “manufactory of Ohms.” He must have savoured any opportunities to do so when, in the mid-1990s, he did his stint as the head of Cambridge’s HPS department: whilst bemoaning his administrative burden to me on one of the countless walks from HPS to the Eagle pub, he sighed that he “wanted to work out what makes Lord Rayleigh tick, not how many toilet rolls to order.”

But as a 21 year old undergraduate what was crossing my mind before Simon entered the Rayleigh Lecture Theatre was apprehension about studying history of science for the first time, coupled with a sense of the privilege of embarking on the subject in a world-famous site of scientific heritage and a fear that my backside (unlike those of countless Cavendish research students) wouldn’t cope with the hard wooden seat. Simon’s performance soon alleviated any mental and bodily uneasiness and would prove to be the start of an intellectual journey that would change my life. In so many ways, Simon’s lectures were the virtuosic performances that I’d come to university to witness, and which were sadly lacking elsewhere in my undergraduate experiences: they combined an astonishing

scope and analytical depth, with some incisive historiographical positioning and generous helpings of spontaneity and wit. The latter qualities were never better exhibited than at the start of one lecture on Isaac Newton's theory of gravity. Simon had just announced that "This lecture is about" when one late-arriving and clumsy student tripped over a step up to the seats, prompting our quick-witted host to continue, "how bodies fall," and much laughter immediately followed.

Simon's lectures often evoked a very different emotion in me and fellow students – anger – but one directed at the same scientific mythmakers that he had in his sights. Only weeks before I started reading *Leviathan and the Air-Pump* (1985), Simon's incisive analysis of seventeenth century English experimental natural philosophy was an eye-opener because it highlighted the woeful extent to which histories of the sciences (and physics in particular) ignored the practical and rhetorical skills constitutive of natural knowledge making. This often passionately expressed historical revisionism struck a powerful personal chord with me because it seemed to make the kinds of messy and localised craft practices that I'd experienced via my father's antique restoration and clockmaking hobbies hugely significant to the apparently pure and universal laws and facts I'd been studying as a science student.

The combination of Simon's lectures and Myles Jackson's intellectually rigorous and typically entertaining supervisions gave me the strong motivation (and exam marks) to take Part II HPS and pursue history of science beyond that. Before starting Part II I found out that Simon was going to be on leave in the 1991–2 academic year, but this didn't prevent me from being "Simonised" as Kevin Knox, one of my Part II supervisors and later academic collaborators, humorously christened it: on the contrary, since I chose to focus my Part II dissertation on late Victorian physics, I had the privilege of having supervisions with both Simon and Andy Warwick during the summer vacation. The first supervisions with Simon were daunting and exhilarating experiences. They were daunting partly because of his office in HPS. I don't think I'd seen so many books in a room, and it didn't help that some shelves looked like they were about to collapse and that looking down on me from a high shelf was an oversize bust of another formidable mind (Beethoven). The exhilaration came from being told that there were far more exciting questions to put to my chosen topic than I had estimated, and that there was a wealth of relevant archival material waiting to be plundered. I was staggered by his ability to correctly anticipate the contents of letters that I believed were unknown to him. Intriguingly, these were from Lord Rayleigh, so once again the idea of Simon "being" the aristocratic physicist crossed my mind.

Although my dissertation ended up aligning more closely with Andy's work on coaching and mathematical physics than Simon's on metrology and experimental physics, I seemed to have done enough, after securing doctoral funding in late summer 1992, to persuade Simon that I could help him pursue his interests in the "pre-history" of the electron. I don't know whether he was disappointed that this led me more towards Victorian scientific investigations of spiritualism than a systematic study of the puzzling phenomena of gas discharge, but over the next five years he constantly encouraged me to explore

connections between these enterprises that, like the phenomena involved, were often hard to see. Underpinning much of this was what I'd not properly understood from my now well-thumbed copy of the *Air-Pump* – the virtues of approaching historical episodes from the perspective of a stranger who doesn't know what will turn out to be good or bad science, true or false knowledge etc. As in his undergraduate lectures, Simon sometimes captured such sophisticated interpretations with short and memorable phrases. Spiritualism, he exhorted, was not “dead on arrival,” and the experimental problems that some historians implied were limited to this and other “pseudo-sciences” – replication failures, unreliable instruments, capricious effects etc – were present in cable telegraphy, spectroscopy, gas discharge research and other enterprises that came to define nineteenth century physics.

To nurture this revisionism towards spiritualism, Simon encouraged me to read his own work (notably, a paper analysing the work required to make the faint, transient and problematic lines in laboratory-produced spectra count as the “same” as lines in the solar spectrum). But, of course, most nurturing took place in supervisions, which were usually held in the Eagle rather than his office because smoking and drinking (usually ale, but sometimes coffee) evidently sharpened his already awesome intellect. Simon's feedback on my writing samples was often a brilliant mini lecture that effectively reinterpreted the primary source material I'd tried to string together into an argument, and depressingly suggested that he still knew more about a subject which I believed I'd studied more thoroughly – a grumble I was amused to find in fellow “Schafferite” Iwan Morus's *Frankenstein's Children* (1998). I usually found it difficult to interrupt Simon because I was too busy transcribing the rapidly-arriving pearls of wisdom on whatever scraps of paper I could find. My notes were often so illegible that I had to type them up as soon as I got back home, and sometimes before the IPA rendered me intellectually inert. Reconstructing, interpreting and applying what Simon had said wasn't always easy but the gain was worth the pain and lasted years. There's advice that Simon gave on specific historical texts that I still mobilise in teaching contexts as models of sophisticated interpretation. As an example of close and critical reading I've often appealed to Simon's suggestion that when, in a *Philosophical Transactions* paper of 1875, the British chemist William Crookes announced that he had found no evidence for Karl von Reichenbach's controversial “od” force, he was not actually debunking the agent: Crookes was actually implying that “od” was a plausible but absent constituent of his physical laboratory.

So many of Simon's approaches to teaching define for me the very best in university-level pedagogy and the culture of higher education more generally, but the increased bureaucracy, regimentation and technologization of learning has limited my ability to adopt or even adapt his examples. But one of most heartening lessons I've learned as students return from Covid-19 lockdown modes of learning to new teaching “normals” is what they want more of is precisely the combination of intellectual brilliance, charisma, humour and humanity that Simon embodies more than anybody I know. No pressure then ...

# Photo State

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CHRISTOPHER PINNEY

One scorching afternoon in 2018, I set out for Nai Sarak in Old Delhi. As usual the journey there from Ramnagar, a few kilometers away, had taken about an hour, my autorickshaw stuttered to a halt in the congestion approaching Chandni Chowk. Dismounting by the Jain bird hospital where in the 1990s I had gotten myself photographed by one of the few remaining box-camera wallahs, I savored the bustle and energy. I wandered past the shop front of New Gramophone House, where I had purchased so many remarkable early 78rpm records over the years. I recalled auspicious finds on their top floor, including a recording of the nationalist politician Subhas Chandra Bose speaking to the Indian National Army from Singapore in 1942, and songs from films including *Awaara* and *Mother India*.

Next was Dariba Gali where photographic supply shops still sold hand-painted studio backdrops, and then I stopped to mourn at the entrance to the former first floor offices of the picture publishers Hem Chander Bhargava. In the 1990s I had spent many delightful afternoons up there chatting with Kishorlal Bhargava about the history of his family's firm. In those days there was a beautiful painted signboard above the entrance depicting the monkey god Hanuman transporting herbs to save the life of Lakshman, Ram's brother. It was a mythological emblem of transmission, perhaps intended as a subtle allegory of the power of the printed image and colportage.<sup>1</sup> Hem Chander was founded in 1900 and the signboard probably dated from 1910. Now it was gone, leaving bare brickwork and trailing cables.

I pressed on past the Gurudwara and turned left into the relative cool of Nai Sarak, heading for the southern section where dozens of calendar retailers were stocking up for the pre-Dipali frenzy. Then, on my right, in a tiny passageway that served as a shop front, I glimpsed a hand-painted sign that seemed to say "Photo State." The heavily serified and irregularly spaced lettering was a fine example of what Botnik and Raja eulogize as "subtle technology."<sup>2</sup> Beneath the sign was an ancient typewriter and a battered photocopier.

<sup>1</sup> I invoke the term in the spirit in which it used by Ernst Bloch, *Heritage of Our Times*, translated by Neville Plaice and Stephen Plaice (Cambridge: Polity Press, 1991), 341.

<sup>2</sup> Ken Botnik and Ira Raja, "Subtle Technology: The Design Innovation of Indian Artisanhip," *Design Issues* 27 (2011): 43–55.



Both looked decades past serviceability but were clearly still viable and in use. As Sudhir Mahadevan observed, “No technology dies a predictable death in India.” In his memorable phrase, there is an “obviation of obsolescence.”<sup>3</sup>

There was no one in the shop so I waited and gazed at this profound tableau, feeling “comflustrigated” by this deformation of a photocopying service into a name that so perfectly described my decades long fascination with the ways in which the camera has been embraced by Indians.<sup>4</sup> “State” conjured both the territory of India that has been my chief interest, and the “condition, or manner of existing” (*SOED*) that photography engenders. As I gazed further, I reflected on the serendipity of finding a typewriter to complete the Kittlerian *trimurti* of *Gramophone, Film, Typewriter*. Kittler opens his book with the proclamation “Media determine our situation” and later asserts that human essence “escapes into apparatus” and I have always relished this challenge to anthropological clichés

<sup>3</sup> Mahadevan Sudhir, *A Very Old Machine: The Many Origins of the Cinema in India* (Ranikhet: Permanent Black, 2018), 1 and 5.

<sup>4</sup> This indispensable word was unearthed by Maryam Sikander in her work on the linguistic deformations of the *Awadh Panch*, “Oudh Punch (1877–1915): Satire and Parody in the Colonial Contact Zone,” PhD Thesis (London: SOAS 2021).

that assert the contrary.<sup>5</sup> Kittler had always suggested to me a triangle with angles that I could never fully connect. On the one hand I completely grasped the parallels between what he calls the “data ratios” of both sound and image recording devices (gramophones and cameras) whose capaciousness allowed them to store what was akin to the unconscious as psychoanalysis came to understand it. On the other hand, I understood the historical entanglement of typewriters and gramophones (there is still a large c. 1900 sign near the east end of Chandni Chowk, advertising a building that was once the regional headquarters of the Gramophone and Typewriter Company Ltd). Both these observations allowed me to link the binaries of gramophone and camera, and also typewriter and gramophone as parallel pairs. But until this moment in Nai Sarak I had never, despite Kittler, been able to link cameras with the typewriter. The inadvertent deformation of “Photo State” helped me close the triangle.

But I was left with a sense that Kittler would never have ventured into this part of Delhi, and would never had the eyes or sensibility to enjoy such “comflustrigation.” I knew at once that a man who appreciated Leibniz as much for his biscuits as his physics was the ideal beholder of this tableau. The persistence of dead media, the dramaturgy of colliding epochs, and the humour of the assemblage, made me think of Simon Schaffer, of his writings, and also of Simon the friend. I hope he will relish the scene, prizing also the triumph of a subaltern ingenuity and optimism.

<sup>5</sup> Friedrich A. Kittler, *Gramophone, Film, Typewriter*, translated by Geoffrey Winthrop-Young and Michael Wutz (Stanford: Stanford University Press 1999), xxxix & 16.

# Simon's Travelling Knowledge

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MICHAEL BRAVO

Simon's work has travelled far and wide through the science studies and history of science communities, not only circulating, but teaching and inspiring. How such influence in the field is achieved has itself been the subject of one of Simon's thoughtful studies.<sup>1</sup> Colleagues who have spent time with Simon praise his unparalleled capacity for generosity in sharing his far-reaching knowledge. Indeed so frequent are such expressions of gratitude that his generosity must be much more than a demonstration of virtuosity or a personal quality witnessed by those of us lucky enough to have been taught by him. To understand how Simon's influence has travelled, I want to reflect on Simon's deep thinking about the geography of knowledge and what explanatory resources account for its mobility.

Perspective and grounding matters. Encountering Simon came about when I was a student at the Science Studies Unit in Edinburgh in 1985. Simon was essentially an honorary member of this remarkably quixotic, creative, and in print combative multidisciplinary group to whom I have a permanent indebtedness. Simon had been a regular visitor to Edinburgh collaborating with Steve Shapin on their ambitious study of Robert Boyle and the early Royal Society. One of the secrets behind the Science Studies Unit was an extraordinary level of trust between Bloor, Barnes, Shapin, and MacKenzie (as well as their Director, David Edge). Key but seldom recognized invisible technicians behind the functioning and success of this remarkable group were the Unit's Administrator Carole Tansley and the Librarian Moyra Forrest, who each deserve their own wiki-page in the history of science. It was around Carole's desk that we gathered to receive news of the first reviews of *Leviathan and the Air-Pump*.

The Unit enabled a space of learning and exchange where I believe SSU members tried to put into practice the values they espoused: at once disarming, modest, and open, while being highly focused and serious in dissecting their research problems. That was within the Unit – externally, they took positions in debates that were often highly combative. Within the trusted space of small-group seminars with no more than ten people in the room, these brilliant pathbreaking scholars would characteristically give work-in-

<sup>1</sup> Simon Schaffer, "The Eighteenth Brumaire of Bruno Latour," *Studies in History and Philosophy of Science* 22 (1991): 174–192, a review of *The Pasteurization of France*.

progress papers. Typically when they got stuck and reached an impasse in building an argument, the paper would end abruptly – with an apology along the lines of “now I am stuck!” Then it was up to everyone to pitch in and help, something I can’t fail to remember because I was the newest and least qualified research student to offer them ideas or advice. I have never quite seen anything like it since, a unique pedagogical environment whose efforts carved out a space for the social studies of science. That provided a context in which working with Simon in Cambridge, made sense.

Simon in his early years in Cambridge wore the badge of science studies, open and trusting to a fault within his research group, incredibly receptive to the experience of those who came to learn from him. True to the SSU, Simon could be highly combative when in performative disciplinary spaces. In those early days, when his polemical style was sometimes divisive and even earned him the reputation of being a precocious enfant terrible, he worked hard to use science studies to reshape the public sphere of the history of science. Simon’s history of science was never more alive than in the intellectual spaces that took root in the eighteenth century – the HPS coffee room, the Eagle, or the old smoke-choked tea room downstairs at the University Library.<sup>2</sup>

The Edinburgh “Strong Programme in the Sociology of Knowledge” was a crucial course in the staple diet of Simon’s historically-oriented teaching to the practice of sociology of science.<sup>3</sup> The principle of symmetry in analysing scientific controversies, that the same kind of explanatory resources should be used to account for true and false beliefs, was immensely important.<sup>4</sup> Perhaps still more significant, but less appreciated, was Simon’s regard for the principle of reflexivity. Famously the SSU conceded that their critiques of the social construction of science were just as applicable to their own sociological explanations – an early and specific condition of what today is more often broadly (and perhaps differently) framed as “positionality.” The question of how to incorporate the study of reflexivity or positionality in history of science should be numbered as one of Simon’s major contributions to the field, both in relation to theory and as an ethical norm within the science studies community of practice. Simon’s study of the standardization of astronomical observation at the Royal Greenwich Observatory and the problem of “personal equation” is a case in point, but there are many other characteristic examples throughout his corpus of works.

The question of how knowledge travels remained of central importance to Simon throughout his career precisely because it was a question about the social nature of material culture. His early account of the “multiplication of contexts” in getting air pumps to work in new settings focused our attention on the tight linkage between tacit knowledge

<sup>2</sup> The old HPS coffee room was a hive of chartist rebelliousness thanks to Iwan Morus, Gill Hudson, Rob Iliffe and Andy Warwick amongst others. One could essentially read for an HPS degree by soaking up the conversations there.

<sup>3</sup> David Bloor, “The Strong Programme in the Sociology of Knowledge,” in D. Bloor, *Knowledge and Social Imagery* (London: Routledge and Kegan Paul, 1976), 1–19.

<sup>4</sup> Bloor, “Strong Programme,” 7.

and the settings of the science, adjusting settings often by imposing strict and even violent conditions on labour and the social structures shaping it, to enable scientific experiments to be replicated in new locations.<sup>5</sup>

Cut back to the reflexive pedagogical basis for the multiplication of contexts, and one could identify the need for pedagogical practice not beholden to the shackles of late twentieth century academic disciplinarity, which often subsumed within its practice the norms it purported to study – hence Simon’s lukewarm relationship for many years with the History of Science Society. While Simon’s teaching could be seen as an attempt to re-orient and re-instill a different kind of disciplinarity, his community grew to incorporate a far wider diversity of approaches and practices, particularly through his research students and postdocs, enabling “a thousand flowers to blossom.” Simon delighted in seeing his students take science studies into the field to analyse the production of contemporary knowledge whether amongst physicists at CERN or amongst the Inuit of the High Arctic. He adopted a collaborative, supportive approach in performative practice: documentary filmmaking, museum-based explorations and exhibitions in the Whipple Museum or the Kettle’s Yard Art Gallery, art collaborations, theatre productions. These forms and settings have in their own way been as important forms of expression for Simon – and I would argue for our field – as his more formal analyses of travelling knowledge in works such as “Easily Cracked: Scientific Instruments in States of Disrepair.”<sup>6</sup>

A less frequently recognized source of inspiration for Simon’s capacity to share knowledge is his ethnographic sensibility. Although Simon received no formal training in anthropology, and hasn’t closely identified himself with the subfield of anthropology of science, the connection to anthropology is very significant for two reasons. The first is anthropology’s concern with the materiality of knowledge-making. I remember Simon’s fascination and the importance he attributed to Bruno Latour’s account of the role of paper and inscription, when a new tradition of ethnographies of laboratories emerged in the 1980s.<sup>7</sup> In the course of Simon’s career, his project with Bob Brain, Richard Staley, and Otto Sibum, developed into a powerful interrogation of museums, artifacts, and collections as key sites of knowledge-making in the culture of Victorian physics – where the focus of history of physics research practice moved into the Whipple Museum. I was never fully persuaded by Simon’s contention that the museum was the historian’s analog to the anthropologist doing fieldwork, but that was probably because I understood him too literally and needed to think through more completely what multi-sited ethnography means for the practice of anthropology of science. Simon’s engagement with museums

<sup>5</sup> Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life. Including a translation of Thomas Hobbes, Dialogus physicus de natura aeris, by Simon Schaffer* (Princeton: Princeton University Press, 1985), Chapter 6 “Replication and its Troubles: Air Pumps in the 1660s,” 225–82.

<sup>6</sup> Simon Schaffer, “Easily Cracked: Scientific Instruments of Disrepair,” *Isis* 102, no. 4 (2011): 706–17.

<sup>7</sup> Bruno Latour and Steve Woolgar, *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills: Sage Publications, 1979); and Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard, MA: Harvard University Press, 1987).

and exhibitions was visionary nonetheless – particularly his exhibition at Kettle's Yard Gallery on the cultural history of *No1se* with Adam Lowe and Bruno Latour. My own pedagogical experiments in teaching undergraduate geographers using floor-sized maps of indigenous Arctic trails in museum and gallery settings are indebted to this recognition of the importance of experimental spaces in science studies practice in Cambridge as well as the Arctic. Symmetrically, Inuit elders and filmmakers have been frequent visitors to work with collections of their own heritage in Cambridge and London, performing the reverse journey between our knowledge-making spaces and their audiences.

The reflexive turn led to anthropology in other ways, too, which characterize Simon's sensibility towards other cultures. Throughout the nearly four decades I have known him, he has had an enormous regard and respect for the importance of indigenous peoples' values, rights, and knowledge traditions – far more so than for most colleagues. Challenging the science/indigenous knowledge distinction was at the heart of David Bloor's teaching in the Edinburgh SSU, but what I saw was that most senior historians of science believed that what wasn't the culture of science shouldn't be studied as part of the history of science. Decolonising approaches to the history of sciences were not necessarily embraced by the wider discipline. Feminist historians were in general far more aware and conversant of intersectionality, such that the tight policing of disciplinary boundaries has only recently and gradually begun to soften. In terms of decolonizing the discipline in relation to indigeneity and other non-western traditions, historians of science can be seen to have dragged their heels.

Understanding how Simon embraced anthropology owes much to the important research of Anita Herle, Curator at the Cambridge Museum of Anthropology. Anita's fieldwork and collaborative museological practice with the Murray Islander in the Torres Straits has clearly shaped Simon's understanding of decoloniality.<sup>8</sup> Simon encouraged me to follow my desire to attend anthropology lectures alongside history of science, and gave me the strongest encouragement to carry out fieldwork amongst the High Arctic Inuit of Igloodik (Nunavut) at a time when the study of science and empire posed too great a threat to the discipline's boundaries and identity to be welcomed within the history of science. Decentring the history of science by granting agency and recognition to non-Europeans was then a step too far for HPS, but in other realms of scholarly enquiry, the recognition of indigenous agency, historical experience, collective memory and trauma was providing critical turning points in debates about land, justice, and colonial dispossession. In that context, Simon was far more attuned to indigenous political expression, particularly in British Columbia and the Torres Strait where he was sometimes able to visit as a family member, accompanying Anita on her field research visits. Simon in his historical sensibilities was drawn to the decolonial politics of scholars like Natalie Zemon-Davis, Marshall Sahlins, James Clifford, and Greg Dening.

<sup>8</sup> Anita Herle and Jude Philp, *Torres Strait Islanders: an Exhibition Marking the Centenary of the 1898 Cambridge Anthropological Expedition* (Cambridge: Cambridge Museum of Archaeology and Anthropology, 1998).

The implications of Simon's decolonizing spirit, where it came full circle, was in his reading of anthropology and history, particularly in relation to the exchange systems of world cultures. In seeking to understand how knowledge is created in the spaces of communication and exchange between and across cultures, working in the tradition of science studies, Simon recognized the enormous resources that anthropology could offer historians. Simon thought deeply about the concepts often used by historians like Morrell and Thackray to describe early modern and Victorian scientific networks and systems of patronage – hospitality, gifts, sharing, professing, listening, imbibing.<sup>9</sup> The complex ritual forms of exchange like the Trobrianders' *kula cycle* or the Northwest Coast *potlatch* have been subjected to intense critical examination by anthropologists. In returning to the roots of social constructivism of knowledge Simon was, like Bloor and Barnes, a careful reader of sociologists like Émile Durkheim and Karl Mannheim. However he took his anthropological analysis of science much further through reading a broad range of anthropologists: Mauss, Lévi-Strauss, Sahlins, Douglas, Nader, Suchman, Traweek, Clifford, Geertz and of course Latour (even as he distanced himself from the anthropological canon) – these loomed large in the reworking of his own personal equation. In bringing anthropological theory into history of science, far from exploring the edges of a discipline concerned with experiment, classification, calculation and analysis, it helped him to understand the discipline's soul.

<sup>9</sup>Jack Morrell and Arnold Thackray, *Gentlemen of Science: the Early Years of the British Association for the Advancement of Science* (Oxford: Oxford University Press, 1981).

# Seed Duplication

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HELEN ANNE CURRY

In the 1980s, the Nordic Gene Bank for Agricultural and Horticultural Plants established a storage facility for seeds in a coalmine on the Arctic island Svalbard. This was conceived as a safe site in which to house a duplicate copy of the Nordic Gene Bank's base collection – its collection of seed samples slated for long-term conservation – that was already maintained in Alnarp, Sweden. The Alnarp base collection, in turn, consisted in genetically identical duplicate samples from several active collections in regular use by crop breeders and other scientists from the Nordic region and around the world.

A proposal to create an additional Arctic seed storage facility, this one for international use, followed soon after. In gestation throughout the 1990s, the second facility, eventually named the Svalbard Global Seed Vault, took shape as an additional security measure for the conservation of diverse crop varieties held as samples in seed and gene banks worldwide. These institutions would be encouraged to create a copy of their collection for safekeeping in the vault.

Billed today as the “final back up,” the Svalbard Global Seed Vault represents the endpoint – for now, at least – of a technical recommendation of safety duplication pursued by the crop genetic conservation community since the 1970s. Many seed banks that have contributed to the Svalbard Global Seed Vault collection were, at the time of its opening in 2008, already duplicating their collections for security, typically by dividing individual accessions to the collection into genetically identical subsamples and arranging for separate storage of the two. For several of the most prominent national and international banks, this duplication process included producing a local copy (often called a base collection) and also a complete duplicate collection held at a physically distant seed storage facility to comply with requirements for safety duplication. In such cases, a copy sent to Svalbard would not just be a backup copy, but a *duplicate* backup (safety duplicate) of a backup (the base collection) meant to secure a collection in routine use (the active collection).

In a context where generating security by producing redundant copies – backup – is reflexive, and often considered virtuous, the justifications for the Svalbard Global Seed Vault seem unimpeachable. Seeds, just like the computer files we routinely launch into The Cloud, are vulnerable to loss but apparently cheap to copy. Why not copy, then?

For one, copies are not the easy solution so often imagined. Copies of business and government records stored in remote vaults after World War II, chiefly so that the world

could (it was thought) be reconstructed after a nuclear attack, often became out of date in storage, necessitating elaborate information management systems so that storage did not become its own form of annihilation. As information delivery and storage shifted from paper technologies to other formats, new concerns arose about future accessibility.

Meanwhile cold storage, once reserved mostly for biological preservation, proved an essential intervention for originals of photograph, films, and other media. Today, cold temperatures keep some fragile artefacts intact just long enough that they can be copied to a medium considered more stable. In other cases, the freezer is envisioned as their ultimate salvation. After the media outlet *Corbis* purchased the Bettman archive – a collection of millions of historic photographs, films, negatives, and other images – assessments indicated that many would be lost before they could be digitized. This led to construction of the Corbis Film Preservation Facility, an underground site where the collection would, according to one expert account, “literally be frozen in eternity in secure sub-zero humidity-controlled storage.”

Although pitched as a high-tech effort to salvage precious documents from their own intrinsic fragility, this project remains entangled with the very low-tech, last-ditch effort to save society from self-destruction in the Cold War. The preservation facility was not built from scratch, but rather incorporated into a secure document and data storage facility operated by the company Iron Mountain in an old limestone mine in Boyers, Pennsylvania. Iron Mountain's origins – it was originally the Iron Mountain Atomic Storage Corporation – lay in its selling safe, atomic-bomb-proof space (its first location was a depleted iron ore mine) to insurance companies, banks, and other urban businesses. There they could safely stash original records, duplicates, microfiche, and, in some cases, human executives in otherwise dangerous times.

In a recent re-invention of the Iron Mountain model, the Norwegian technology company Piql AS has teamed with the Norwegian State Mining Company – the same entity associated with the original Nordic Gene Bank facility on Svalbard – to create the Arctic World Archive. Located in an abandoned coal mine, the Arctic World Archive stores digital data in analogue form on photosensitive film. The Vatican Library has preserved digitized copies of “500 irreplaceable manuscripts.” The Felipe González Foundation has sent “important political memories ... transcripts of secret meetings, photographs, letters and handwritten notes by the sitting President.” Norwegian folk tales, the records of the chemical company SCG Thailand, and the 1949 Italian film *Ladri di biciclette* also feature as some of the “memories” now secured at the Arctic World Archive.

But secured against what? Chiefly, it seems, against the instability of the digital. As the website reminds its virtual visitors, “Much of our heritage is stored digitally and, despite best efforts to protect it for the future, it can be exposed to risks, either from the online environment or just from the limits of modern storage technology.” Now, however, it can be made analogue and kept in “the safest location on earth” – an abandoned Arctic mine.

Deposits to the Arctic World Archives are, in many cases, backups of backups. Consider the very early audio recordings offered for safekeeping in Svalbard by Utah Valley University. Originally recorded on Edison cylinders, physical objects that are carefully

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maintained at the university, the audio had been painstakingly restored, transcribed, and digitally preserved. A person could, in theory, place a (still playable!) Edison cylinder on a table next to a thumbdrive containing the digital audio, a paper copy of the recorded words, and the Piql-manufactured analogue version.

The Arctic World Archives and the Svalbard Global Seed Vault share more than a mountain: they share in a contemporary fixation with backup. This fixation has roots in the nuclear imaginary of the early Cold War but its branches have spread, almost to the point of smothering, as our collective repertoire of danger scenarios has expanded. But history suggests that making and safeguarding copies, whether of papers or seeds or sounds, produces only an elusive security. It has offered reassurance for a time, but this palliative effect inevitably dissipates as further threats, mundane or awe-striking, appear on the horizon.

What to do, then, when approached with the new failsafe duplicate that will secure the contents of the Svalbard Global Seed Vault and the Arctic World Archive from the melting permafrost or a Norwegian administration intent on re-opening the Svalbard mines? There may be only one reasonable option.

Reverse away slowly.

# Léon Foucault in Leningrad

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MICHAEL HAGNER

In 1928 Walter Benjamin felt a sense of shock upon entering Saint Basil's Cathedral in Moscow's Red Square: "The inside of the church has not only been emptied, but eviscerated like a felled deer, and turned into a 'museum' attraction for mass edification."<sup>1</sup> The transformation of Saint Basil's Cathedral was an early example of the Stalinist push to convert churches and monasteries into anti-religious or atheist museums. Occupying the most heavily symbolic as well as popular sites of the class enemy was an opportunity to spread the new teachings of socialism to a mass public. The exhibitions gradually mounted in profaned places of public worship combined selected episodes from religious history with scientific displays offering a firm foundation for materialism and atheism. This was the context for the installation of a Foucault pendulum in Saint Isaac's Cathedral in Leningrad, a monumental church built on the banks of the Neva that, under the Romanovs, had symbolized the link between ecclesiastical and political power.

It was no coincidence that the Bolsheviks chose Saint Isaac's Cathedral as the venue. The church had been modelled on the Panthéon in Paris, where Léon Foucault had first unveiled the pendulum to the public in a spectacular installation. In 1851, the year it was first installed, Foucault's pendulum had set out to fulfill the promise of the French Revolution to make Paris the capital of the sciences and to show the world the invincible power of knowledge. The Panthéon, converted by republican forces in 1790 into a secular temple to immortality, was the ideal setting for this mission.

Paris was the first but not the only place where the history of the Foucault pendulum was inseparably bound up with questions of politics and ideology. In the twentieth century, imposing presentations of the pendulum in the UN Headquarters in New York, in the Smithsonian Museum in Washington, and in Saint Isaac's Cathedral demonstrated its symbolic significance for the correlation between science and politics. In all these *lieux de mémoire*, place and pendulum were mutually reinforcing. Sites of memory intensified the effect of Foucault's experiment by acknowledging the significance of scientific knowledge for historical developments. For its part, the pendulum amplified these sites by making them the setting for a cosmic process.

<sup>1</sup>Walter Benjamin, *Moscow Diary*, trans. Richard Sieburth (Cambridge MA: Harvard University Press, 1986), 25.

The opening of the anti-religious museum in Leningrad was precisely orchestrated. It was held on April 11, 1931, a day before Easter, in the presence of 7000 spectators. The pendulum was suspended from the dome at the same spot where a dove had previously floated. The replacement of religion by science could hardly have been more simply or effectively conveyed: where once the Holy Ghost had presided, an icon of scientific knowledge now held sway.

A lithograph made shortly before the opening festivities gives an impression of the exhibition's design. The pendulum in its circular enclosure can be seen in the center of the picture. A statue on a plinth, barely recognizable here as a representation of Giordano Bruno, is visible on the left-hand side. An oversized slogan urges viewers to "take up arms for the scientific worldview." A chandelier is positioned slightly above the middle of the image, a relic of the cathedral's former classicistic interior that now illuminates a massive cogwheel installation connected to a Soviet star and tail, underlining the alliance between communist ideology and technology. These three focal points correspond to the three central components of the exhibition: the Foucault pendulum as proof of the scientific truth of Copernicanism; the Bruno statue as a memorial to a martyr in the struggle against religious orthodoxy; and the montage of cogwheel and Soviet star as a symbol for the Bolshevik-technological future.

Propagandists in Leningrad must have known that in Western nations – unlike in the Soviet Union – Copernicanism had long lost its novelty value. Only in the Moscow planetarium or in Saint Isaac's Cathedral could the pendulum's connection with the martyr Giordano Bruno, who regarded the rotating Earth from a quasi-privileged position, still cause a stir. Only there could the pendulum become the scientific emblem for a battle to eradicate the influence of religion while at the same time imparting essential elements of the new ideology to a still partly illiterate populace. Only there could the authorities act as if the Catholic church would fight tooth and nail to defend the geocentric worldview,

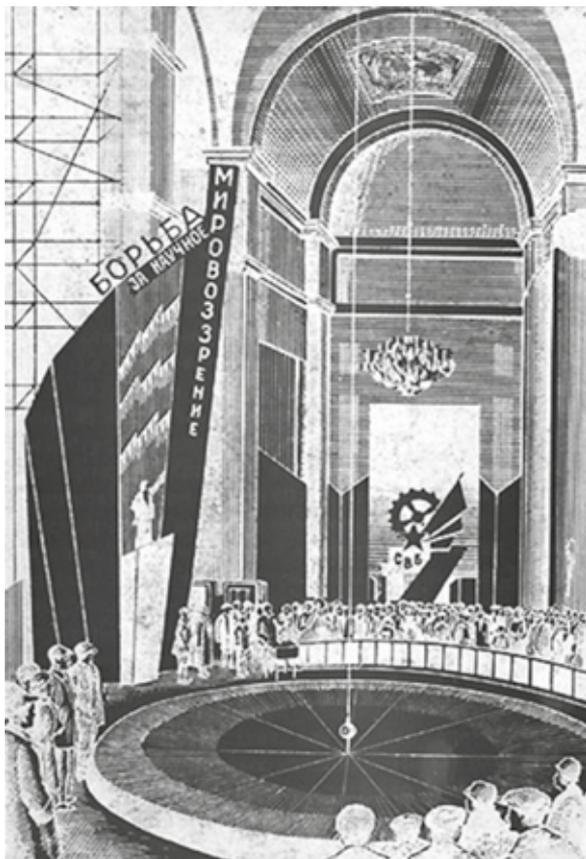


FIGURE 1. • A. Finn, A. Lebinsky, N. Troshin, A. Rostovstsev und N. Kamenshikov, *Iz ochaga mrakobesiya v ochag kul'tury*, Leningrad 1931.

notwithstanding the fact that Foucault's experiment represented the same bourgeois science that the Soviet regime had set out to supersede.

On closer inspection, the Leningrad exhibition can be seen as a gesture that responded to the political history of the pendulum in Paris even as it raised the stakes. Just as the French Revolution of 1789 had led directly to the desacralization of Sainte-Geneviève and indirectly, in 1851, to the first public demonstration of the pendulum by Foucault, so the Russian Revolution of 1917 was followed by the profanation of Saint Isaac's and the installation of the pendulum.

Yet the future turned out to be less revolutionary than the exhibition organizers had anticipated. Although the anti-religious museum stayed open, the constructivist montage had to be dismantled when Stalinist culture policy took a patriotic turn. In 1939 the museum published a postcard showing a rather different scene than the photographs taken earlier in the decade. The cathedral's internal walls are now only hinted at, while the movable walls with their pictures and slogans are gone. The statue of Giordano Bruno has likewise disappeared. All that remains are the pendulum and the public, shown engrossed in discussion, reflection, and contemplation in the area surrounding the rotunda.

If this image was representative for the museum's new exhibition policy, then the responsible cultural functionaries had acted quickly. Outside, the battle for atheism still raged, yet inside Saint Isaac's it had vanished, at least in its militant form. The pendulum no longer stood at the center of an ambitious, multi-layered scenography. On the contrary, it was now integrated into the grandiose interior of the church building, where it was to remain in the decades to come.

The pendulum survived the serious damage sustained by the cathedral under German bombardment in World War II and was reactivated following the building's restoration. With the détente between East and West in the 1970s, Leningrad's opening to Western tourists, and the revived memory of Russia's pre-revolutionary greatness, it was clear that Saint Isaac's Cathedral ranked high on the list of the nation's must-see attractions. Visitors were shown a painstakingly reconstructed nineteenth-century cathedral that no longer had anything to do with the anti-religious museum of the 1930s. That episode was more or less airbrushed from the building's history. The Soviet Union's belated reconciliation with Russian tradition was celebrated with a majestic iconography in which the monumental dimensions of the interior and its pompous decor took center stage.

The pendulum, while tolerated, had ceased playing a key role for the political iconography of the building. And yet it retained its popular appeal. Russian author Anastasia Edel recalls queuing with her parents for hours at the ticket office before being admitted into the cathedral to see the pendulum.<sup>2</sup> By the end, it had become a nuisance. In 1986 it was dismantled due to technical problems. As the Soviet Union entered its endgame with *perestroika* and religious services were once again permitted in the cathedral, an installation demonstrating the Earth's rotation had lost its legitimacy. With the cathedral's return

<sup>2</sup> Anastasia Edel, "The Pioneer's Palace Performs in Moscow," *The New York Review of Books*, 8 March 2019 (<https://www.nybooks.com/daily/2019/03/08/the-pioneers-palace-performs-in-moscow/>).

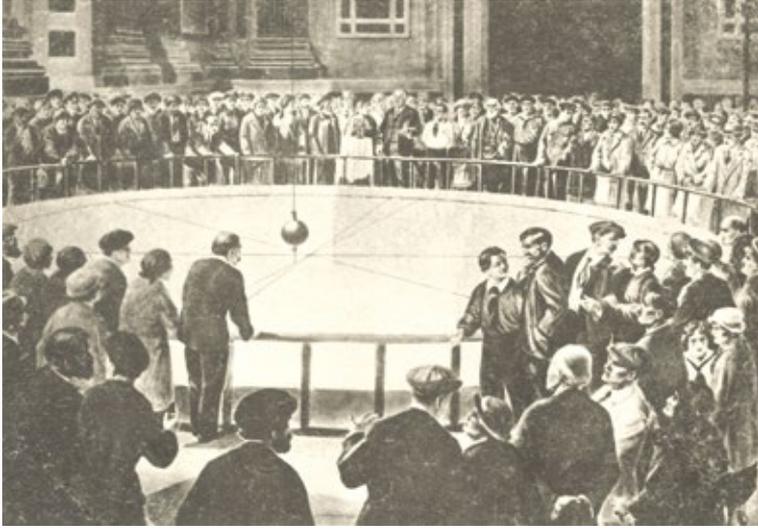


FIGURE 2. • Foucault's pendulum, Anti-religious Museum, Leningrad. Postcard 1939.

to the Russian Orthodox church, neatly coinciding with the hundredth anniversary of the October revolution, the case seemed to be closed. The dove was promptly restored to its pre-Bolshevik perch. Recent photographs circulating on the internet show the pendulum bob, with its long stylus, now displayed behind glass as a museum piece. This is well intended, because it acknowledges the pendulum's place in the history of the cathedral and registers a certain protest against the church's claims. Yet it is also reminiscent of a stuffed bear, the last of its kind to be felled in Saint Petersburg.

According to a much-quoted remark in Karl Marx's *The Eighteenth Brumaire of Louis Bonaparte*, originally made by Hegel, "all facts and personages of great importance in world history occur, as it were, twice."<sup>3</sup> This sometimes holds true for less important ones, too. In 1851 Louis-Napoléon Bonaparte had brought the pendulum into the Panthéon only to order it removed after the coup d'état. The Bolshevik exhibition organizers thematized this, at least implicitly, to position their own historical staging of the pendulum. They installed the pendulum in Saint Isaac's Cathedral and left it there even when anti-religious propaganda had been dropped from their educational mission. Post-communist rulers no longer had any use for the pendulum. It was hard to tell tragedy from farce here. Ingo Schulze put it best in his collection of Saint Petersburg stories, *33 Moments of Happiness*. "Where has the pendulum gone?" asks Wenjamin upon setting foot in Saint Isaac's. "They've gotten rid of the pendulum, the Earth has stopped moving!"<sup>4</sup>

<sup>3</sup> Karl Marx, *The Eighteenth Brumaire of Louis Bonaparte* (New York: International Press, 1963), 15.

<sup>4</sup> Ingo Schulze, *33 Augenblicke des Glücks. Aus den abenteuerlichen Aufzeichnungen der Deutschen in Piter* (Berlin: Berlin Verlag, 1995), 110.



SECOND INTERNATIONAL CONGRESS  
OF THE  
HISTORY OF SCIENCE AND TECHNOLOGY,  
LONDON, JUNE 29th, to JULY 3rd 1931.

Organized by  
LE COMITÉ INTERNATIONAL D'HISTOIRE DES SCIENCES, (President Secretary: ALDO MELLI)

With the Co-operation of  
THE NEWSWOMEN SOCIETY FOR  
THE STUDY OF THE HISTORY OF  
ENGINEERING AND TECHNOLOGY

THE HISTORY OF  
SCIENCE SOCIETY

Hon. Treasurer of the Congress:  
MR WILLIAM BRAGG, F.R.S.

President of the Congress:  
CHARLES SINGER

Hon. Sec. of the Congress:  
H. W. DECKENSON,  
Asst. Hon. Sec.: WALTER ADAMS,  
Ed. Sec.: EDWINGTON 438.

1931/31.

THE SCIENCE MUSEUM,  
SOUTH KENSINGTON, S.W. 7

Dear Professor Kojanovic,

I feel sure I must write to thank you for  
the great interest that you took in our Congress and  
for the important contribution that you made by sending  
a distinguished & delegation to represent your country.  
We are all here commended on the Congress (I include an  
article by Demol which shows the particular work) upon  
but the French delegates were a minority important  
collaboration ~~with~~ ~~the~~ ~~delegates~~ ~~and~~ ~~particular~~ ~~changes~~ ~~in~~  
character of the Congress. Coming as a ~~representative~~ ~~of~~ ~~the~~ ~~delegation~~  
delegation with a ~~strong~~ ~~nationalist~~ ~~ideology~~, they  
did effectively represent this view but the 1931 Congress  
left by most of the discussion was that of a ~~small~~ ~~group~~  
between two ~~groups~~ ~~of~~ ~~people~~ - but you have not  
one of all the others. For a delegation of our own was a

consequence of the language that it has in distinct a mark  
on the possibility of sufficient communication not only of  
the variety of the ideas but of the personal abilities  
and views.

The variety of the ideas was one that we first met  
for most of the members of the Congress that we had first  
effectively they had been of having the ~~approach~~ ~~of~~  
disturbed mathematics especially slowly without being  
shown by the previous programme and ~~unproductive~~.  
The degree of the ~~concern~~ ~~was~~ ~~left~~ ~~a~~ ~~number~~ ~~was~~ ~~one~~  
has to be challenge to the ~~an~~ ~~exception~~ ~~but~~ ~~was~~  
effect was ~~rather~~ ~~in~~ ~~the~~ ~~argument~~ ~~advance~~ ~~in~~  
the delegate's paper was the suggestion that ~~you~~ ~~was~~ ~~a~~  
dramatically ~~emphasized~~ ~~by~~ ~~the~~ ~~historical~~ ~~background~~ ~~is~~ ~~a~~ ~~real~~  
one that may then by ~~an~~ ~~undeveloped~~ ~~direction~~; but  
to note first of the ~~background~~ ~~is~~ ~~an~~ ~~unproductive~~  
unproductive ~~goal~~ ~~is~~ ~~achieved~~ ~~as~~ ~~an~~ ~~outcome~~; but to  
the ~~direction~~ ~~from~~ ~~you~~ ~~was~~ ~~an~~ ~~aspect~~ ~~which~~ ~~is~~ ~~an~~ ~~aspect~~ ~~of~~  
a real ~~direction~~ ~~to~~ ~~an~~ ~~unproductive~~ ~~direction~~ ~~for~~ ~~some~~  
~~purpose~~; one is ~~an~~ ~~unproductive~~ ~~direction~~ ~~for~~ ~~some~~  
all at one will ~~concern~~ ~~an~~ ~~unproductive~~ ~~direction~~ ~~of~~ ~~the~~

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THE SCIENCE MUSEUM,  
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negotiation could not of course, be ~~referred~~ ~~to~~ ~~the~~ ~~course~~ ~~with~~  
his presence in ~~an~~ ~~absence~~ ~~of~~ ~~the~~ ~~delegates~~ ~~and~~ ~~discussions~~ ~~which~~  
~~unproductive~~ ~~and~~ ~~was~~ ~~the~~ ~~reality~~ ~~you~~ ~~had~~ ~~to~~ ~~delegates~~ ~~was~~  
justified - ~~was~~

As I had not heard ~~beforehand~~ ~~that~~ ~~the~~ ~~delegates~~  
when it ~~emerged~~ ~~as~~ ~~my~~ ~~paper~~, the ~~was~~ ~~as~~ ~~the~~  
to ~~discuss~~ ~~the~~ ~~to~~ ~~the~~ ~~progress~~ ~~of~~ ~~the~~ ~~course~~  
to ~~get~~ ~~most~~ ~~of~~ ~~the~~ ~~papers~~ ~~into~~ ~~the~~ ~~main~~ ~~direction~~  
which, of course, by ~~the~~ ~~delegates~~ ~~on~~ ~~the~~ ~~last~~ ~~day~~  
first ~~idea~~ ~~of~~ ~~the~~ ~~papers~~, had ~~been~~ ~~about~~ ~~fully~~  
organized. It ~~was~~ ~~found~~ ~~that~~, however, to ~~arrange~~ ~~an~~ ~~other~~  
within ~~on~~ ~~the~~ ~~last~~ ~~day~~ ~~of~~ ~~the~~ ~~Congress~~, as ~~well~~ ~~as~~ ~~to~~ ~~have~~  
delegates ~~was~~ ~~all~~ ~~to~~ ~~read~~ ~~out~~ ~~of~~ ~~the~~ ~~papers~~. In ~~the~~  
morning, they ~~had~~ ~~by~~ ~~a~~ ~~majority~~ ~~of~~ ~~the~~ ~~delegates~~

particular, ~~which~~ ~~could~~ ~~be~~ ~~published~~, ~~on~~ ~~the~~  
particular ~~is~~ ~~the~~ ~~form~~ ~~of~~ ~~a~~ ~~book~~ "Return ~~us~~ ~~to~~  
two ~~books~~", ~~in~~ ~~the~~ ~~first~~ ~~nightly~~ ~~session~~ ~~of~~ ~~which~~ ~~was~~ ~~possible~~  
to ~~the~~ ~~Congress~~. This ~~was~~ ~~a~~ ~~confession~~ ~~of~~ ~~the~~ ~~fact~~  
because ~~was~~ ~~most~~ ~~of~~ ~~the~~ ~~Congress~~ ~~was~~ ~~my~~ ~~goal~~ ~~and~~ ~~I~~  
was ~~delegates~~ ~~was~~ ~~to~~ ~~delegates~~ ~~was~~ ~~to~~  
them ~~is~~ ~~finding~~ ~~the~~ ~~program~~ ~~about~~ ~~the~~ ~~after~~ ~~for~~ ~~the~~  
collaboration. This ~~is~~ ~~of~~ ~~course~~, ~~a~~ ~~great~~ ~~contrast~~ ~~between~~  
a ~~congress~~ ~~is~~ ~~higher~~ ~~in~~ ~~your~~ ~~country~~; ~~from~~ ~~long~~ ~~before~~  
and ~~later~~ ~~is~~ ~~to~~ ~~find~~ ~~direction~~ ~~as~~ ~~only~~ ~~an~~  
part of ~~the~~ ~~congress~~ ~~activities~~; ~~our~~ ~~traditional~~ ~~action~~ ~~of~~ ~~doing~~  
things ~~by~~ ~~unproductive~~ ~~communication~~ (it ~~is~~ ~~the~~ ~~basis~~ ~~of~~ ~~an~~ ~~unproductive~~  
action ~~of~~ ~~an~~ ~~unproductive~~ ~~system~~) ~~has~~ ~~in~~ ~~it~~ ~~regard~~ ~~to~~  
with ~~an~~ ~~unproductive~~ ~~action~~ ~~as~~ ~~did~~ ~~high~~ ~~on~~ ~~our~~ ~~own~~ ~~task~~  
finally, ~~as~~ ~~regards~~ ~~importance~~ ~~of~~ ~~an~~ ~~unproductive~~ ~~action~~, ~~the~~  
public ~~action~~ ~~then~~, ~~is~~ ~~well~~, ~~in~~ ~~progress~~ ~~was~~ ~~not~~  
finally ~~to~~ ~~your~~ ~~congress~~ ~~is~~ ~~to~~ ~~be~~ ~~productive~~, ~~regard~~ ~~to~~  
some ~~of~~ ~~the~~ ~~congress~~ ~~is~~ ~~to~~ ~~be~~ ~~productive~~, ~~regard~~ ~~to~~  
them, ~~but~~ ~~they~~ ~~was~~ ~~not~~ ~~descriptive~~ ~~of~~ ~~the~~ ~~unproductive~~  
The ~~unproductive~~ ~~is~~ ~~higher~~ ~~your~~ ~~own~~ ~~productivity~~ ~~of~~

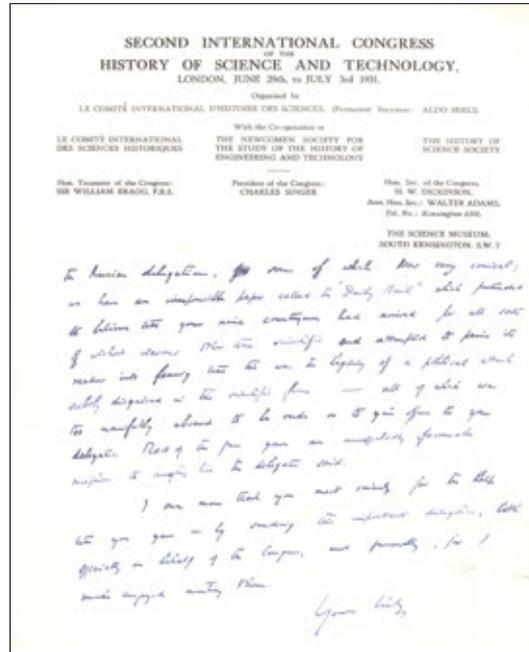


FIGURE 2. • From Walter Adams to F.V. Kiparisov, 19 July 1931 (draft),  
Papers of Walter Adams, ADAMS W/1/7, LSE Library.

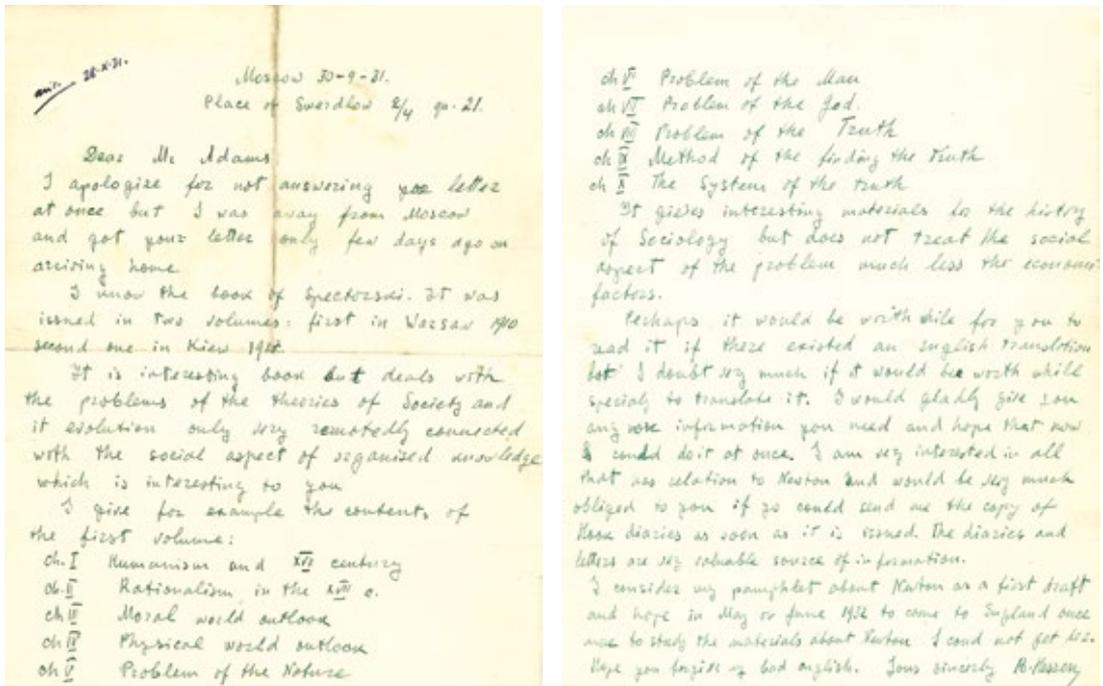


FIGURE 3. • From Boris Hessen to Walter Adams, 30 September 1931, Papers of Walter Adams,  
ADAMS W/1/7, LSE Library.

14. 12. 32  
 Moscow February 15<sup>th</sup>  
 Place of Swetlov 2/4 9a-21

Dear Professor Adams,  
 I hope to go this spring to London for  
 my Newton studies. Will you be so kind  
 as to let me know if the libraries of  
 science Museum and Rutherford-Museum will  
 be open during the period May-August  
 and if I could get a permission to work  
 there.

Will you be during this period in London?  
 I would have very much to meet you.  
 How your work at the Moon's libraries  
 is getting on.

I am yours faithfully  
 B. Hessen.

FIGURE 4. • From Boris Hessen to Walter Adams,  
15 Februar 1932, Papers of Walter Adams, ADAMS W/1/7, LSE Library.



# COAST: SEA AND THE CITY



# Nobody's perfect

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MARIO BIAGIOLI

Qualitative differences in thought styles increase in relation to the quality of the scholar. Simon's uniqueness is proof of that. But one can recognize two clusters within that varied population: those driven by a desire to master a problem and close a discussion – finding the answer and nailing the question shut – and those who instead want to open up conversations, showing how one question pops up as soon as another is answered, one rabbit hole after another. What makes Simon stand out – both in writing and conversation – is that he can do both. He can identify a very difficult question and answer it while at the same time seeding other questions with sufficient details and hints to start new discussions that can last for decades, and spawn more along the way. I know a few smart people, but none like Simon. I get bored easily, but never reading his work. I don't always agree with what Simon writes but always find in it more food for thought than I could handle.

But he is not perfect. With all his superior skills at analyzing practices, he has not managed to learn how to drive a car, not even the new push-button types. The ability to steer a few wheels from A to B could have facilitated his acceptance of a position at UCLA more than 30 years ago, where I was then starting my career, in the pre-GPS age. I regret the opportunity cost of that missing driving license, and the so many interesting discussions it made not happen.

# I Eat, Therefore I Am or Newton on the Rocks: A Footnote<sup>1</sup> To “Newton on The Beach”

---

PATRICIA FARA

Isaac Newton is sitting on the coast of Senegal, but this time he is not searching for an exceptionally smooth pebble. Instead, he is engaging in a philosophical conversation with an albino African, a merman and an oyster. Published five decades after Newton’s death, this image illustrated a playlet in *La philosophie de la nature*, a rambling collection by the Enlightenment radical, Jean Delisle de Sales. Still untranslated into English, Delisle’s forbidden text was published (and republished) abroad in small pocket-sized books ideal for clandestine circulation. Scattered through its ten volumes are several other pictures and literary diversions. For example, in another fantasy, a Parisian’s feebleness relative to a superhuman Caribbean is attributed to the degenerative influence of metropolitan civilization.

Newton features as an icon of rationality, a vegetarian at the top of an intelligence ladder who adjudicates on the moral dilemmas posed by eating any living being that thinks, loves and may have a soul. Although he has equipped himself with a pistol, Newton relies on logical arguments to conclude that while the African is inferior to a European, he is fundamentally different from the oyster and the merman because he understands the concept of God.

In real life, Newton never ventured abroad, but he did gather international data from observers involved in global trade. Delisle explained that Newton studied the tides in Senegal to place “the last seal on his great System of Nature” (although his notebooks reveal that he discarded this region’s inconvenient readings). Claiming that all animals can communicate – a conviction underpinning contemporary attempts to teach apes how to talk – Delisle placed his interlocutors in a poignant location for discussing the definition of humanity and the distinctions between different living creatures. Nearby lay La Gorée, the notorious island where captives were held before being dispatched across the Atlantic through the Door of No Return. If Africans were animals, as some argued, Europeans would have the right to own them and the duty to protect them.

An enigmatic figure writing under multiple names, Delisle was a social climber who wrote prolifically but derivatively. He first attracted attention by comparing Newton fa-

<sup>1</sup> A footnote to a footnote: Around twenty years ago, I discovered this French engraving of Newton on the coast in Senegal. Simon claimed to be mystified, but I suspect he was being tactful. This is what I’ve discovered since then: full footnotes available.

vourably with René Descartes; later, he wrote increasingly materialistic texts, but retained the concept of God and aligned himself with Voltaire. Following a spectacular trial in 1775–7, Delisle was imprisoned and his books were banned. Voltaire supported him throughout this ordeal, rallying public support in an attempt to protect more eminent radical writers who were preaching similar philosophies. The publicity dramatically promoted sales, and numerous editions of Delisle’s *Philosophie* were produced, although the secondary literature is sparse. His only biography runs to two volumes but has little to say about the *Philosophie*; I empathize with the reviewer who sniped that after 791 pages, it leaves readers with no desire to read Delisle himself.

Characteristically, his *Drame raisonnable* reflected rather than originated contemporary debates. Its questions are related to those of Denis Diderot’s *d’Alembert’s Dream*, notably the existence of God, transformation, and the relationships be-

tween physical nature and moral behaviour. There are also similarities in format: both sets of conversations involve four participants, with d’Alembert’s role as eavesdropper here being taken by Newton. Delisle could not have read the published version of *d’Alembert’s Dream*, which did not appear until 1830, but at least one copy of the manuscript was circulated among friends following prolonged collective discussion and deliberation.

The play’s themes revolve around what it means to be human. Delisle reported having seen for himself that unfamiliar humanoids existed: for example, he visited an exhibition in Lyon of a girl with the head and feet of a monkey. In his second-hand account



FIGURE 1. • “Which is the strongest right? The one that allows me to eat you.” Jean Delisle de Sales. *De la philosophie de la nature ou Traité de la morale pour le genre humain* (London, 1804), Vol. 4, 205.

of a voyage to the Falkland Islands, he relied on witness statements to claim certainty about other examples – Arctic pygmies, Sri Lankans with fat legs, Patagonian giants. According to Delisle, the brain fibres of a “savage” are the same as those of an Archimedes, but are paralyzed instead of being constantly in movement. Or as he wrote elsewhere, a “stupid black Angolan” was governed by the same natural laws as a witty French philosopher. Yet Delisle warned against assuming that human beings were identical. “After all,” he wrote authoritatively, “at the mouth of the Senegal live Albinos who bear very little resemblance to Europeans.” Albinos, he pronounced, are extremely stupid, placed right at the bottom of the human scale as far below “negroes” as Newton is above them. He described them as short degenerate people with tight-curved hair, rough white skin and red eyes like a partridge’s or an owl’s.

Not yet converted into the Starbucks logo, merpeople hovered on the edge of feasibility. As Delisle pointed out, the god Triton featured regularly in art works, and this one might be derived from Annibale Carracci’s fresco at the Farnese Palace. Merpeople appeared in other French texts, notably Benoit de Maillet’s influential *Telliamed* (1748), also written as a dialogue, which argued that life had originated long ago beneath the oceans: as the waters evaporated and the earth emerged, pre-existing seeds developed into life. Merpeople provided important evidence for transformism, and de Maillet reiterated several reportedly well-corroborated sightings. Publicized by the harsh criticisms of Voltaire and others, *Telliamed* sold well. Its French followers included Diderot, who envisaged different species emerging over long periods of time, and Jean-Baptiste Robinet, who gave marine humanoids additional certainty by drawing a voluptuous mermaid. Although sceptical of some accounts, Delisle suggested that mermen might have descended from humans with a foetal abnormality, and insisted that the next one to be captured should undergo scientific investigation.

The talking oyster was Delisle’s most fictitious actor. Traditionally symbolizing male gluttony and sexual desire, oysters functioned as exemplary creatures in debates about the natural world. In a passage inspired by *Telliamed*, Baron d’Holbach wrote that “from the benumbed oyster, to the thoughtful and active man, we see an uninterrupted progression, a perpetual chain of motion and combination, from which is produced beings, that only differ from each other by the variety of their elementary matter.” His blatantly materialist text appalled Voltaire: “I think that nothing has debased our century more than this enormous stupidity,” he told Delisle, who may have encountered Diderot’s remark that “In the eyes of Nature, however, the oyster that vegetates at the bottom of the seas is as dear and perfect as the proud biped who devours it.”

Delisle’s *Drame* introduces the thirteenth chapter of a section called “L’homme seul” (“Man apart”), a title signifying his deist convictions. After reviewing the senses, Delisle shifted his attention to the intellect, maintaining that reason is an innate faculty rather than a divine gift. The picture illustrates the first part of the play, which discusses the fight for survival and the arrogation of power by the strong. The plot hinges around the version of Newton as a vegetarian that prevailed towards the end of his life (despite contrary evidence supplied by his housekeeping accounts). Believing that animals possess reason,

Delisle seeks to identify a distinguishing criterion for humanity. As the imaginary conversation develops, it becomes clear that all four creatures can argue logically, and so do not comply with Cartesian models of living automata. After the albino begins lighting a fire to cook the merman, Newton interjects a question about God in order to determine at which link in the continuous chain of being an animal becomes a human. With his vision of God as a buzzing insect, the albino is the only one to pass the test. In an added commentary, Delisle summarises his conclusions: every feeling creature has a form of intelligence, but human rationality is infinitely superior because it can make generalisations, aspires towards God and knows the price of virtue.

The albino is terrified when Newton appears because white men behave like cannibals towards black Africans. Delisle opposed slavery, arguing against black inferiority and declaring that it was unthinkable for a free man to be sold for money. As Voltaire's protégé, he presumably accepted that Newton had acted corruptly to gain his position at the Mint through his niece's affair with the Earl of Halifax. Whether or not he felt disillusioned, Delisle left unspoken his awareness that Newton profited from superintending the Mint's exploitation of African resources; perhaps he also realized that Newton invested personally in companies trading enslaved peoples.

# Coastal Chemistry: Alkalis And Alum Production In North Yorkshire, 1600–1840

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JOHN R.R. CHRISTIE

Alum in its crystalline form has had various uses since ancient times. Its preeminent use in European history from late medieval until modern times was as a mordant, for the chemical binding of dye to cloth, so that dyes do not wash out, nor quickly fade. Good quality crystal had the additional capacity to brighten the colours to which it was applied. It was manufactured from mined or quarried mineral strata, rock or shale, occasionally clay, which was then calcined and lixiviated to produce an alumine sulphate salt solution. This solution then required chemical cleansing to remove or reduce harmful impurities, followed by evaporation until the concentrated solution strength reached the point at which crystallization was achievable by the action of either volatile alkali (ammonia, forming the double crystalline salt ammonia alumine sulphate): or vegetable alkali (potash, forming the double crystalline salt potassium alumine sulphate).

From 1460, the discovery of alum bearing mineral at Tolfa in the papal territories near Rome, together with practical knowledge of crystal production from Byzantium, created a monopolizing industry providing a significant income stream for the papacy. Over the next three centuries the monopoly was broken by increasing numbers of alum producing sites in Germany, France, the Low Countries, Sweden and England. Tolfa alum nonetheless retained its position of market primacy as the highest quality and most expensive alum. The basis of this reputation was its geochemical composition. The mineral already contained vegetable alkali, reducing dependence on bought-in alkalis. Crucially, its iron content was exceptionally small, iron becoming known to be especially detrimental to the qualities of the crystal. These features only became recognized in analytical and precisely quantified chemical terms in the late eighteenth and early nineteenth century, through the work of Klaproth in Germany, and Thenard and Roard in France. Other European sites lacked these advantages, requiring the availability of vegetable and/or volatile alkali, and having residues which, in the case of English alum, meant that its market value was at times only half that of Tolfa alum.

It is possible to discern some differences in technical means of early modern alum production. Liège alum was extensively weathered before calcination, whereas weathering was not practiced in England. English alum mineral came with embedded pyrites (ferrous sulphate) which provided sulphur. Some Swedish sites added layers of pyrites to provide the sulphur for the calcination process. Design of and materials for evapora-

tion vessels, and latterly evaporation heating technology undergo alteration. These differences and changes are significant, but they should not obscure the fundamental stability of the production process: quarrying, calcining to produce the alum salt, steeping to produce the salt solution, chemically cleansing it, evaporating to crystallization point, adding alkali to crystallize, washing then recrystallizing. From 1460 to around 1800 this remained remarkably stable as the pan-European process for alum crystal. The precisely quantified work of Thenard and Roard, a massive, commerce-driven experimental onslaught on Tolfa primacy, was a refinement of rather than fundamental change in this basic process. As a means of production, in a considerable variety of geological, geographical, economic, political and social settings, it was a notable *longue durée*. The last Yorkshire alum site did not close until 1863.

English alum production was unique in its predominantly coastal setting. Although the first efforts, late in the sixteenth-century, to identify alum rock and produce crystal were in southern England, these were largely unsuccessful, and probably included misidentified mineral deposits of copperas. Accessible, workable alum shale strata were only found in Yorkshire, the majority of them on the north Yorkshire coast, running from south of Whitby northward toward Redcar. The accessibility of the strata, some fifty-five to sixty-five million years old, was owed to the long processes of coastal erosion on a coastline which today is still subject at times to dramatic episodes of erosive collapse. Numerous and severe problems attended efforts to initiate and maintain viable alum works. Royal privileges had to be obtained, the Excise required compensation for any loss of revenue levied on imported alum diminished by competing native production. Essential practical knowledge was lacking in the labour market, and available alchemical advice and instruction largely inept. Given these expensive legal requirements, the substantial risks of capitalization and the lack of expertise, it is not surprising that early English efforts to produce viable amounts of alum were halting, and were attended by episodes of workers paid in kind not money, crippling debt, financial ruin, imprisonment and suicide.

Circumstances changed during the interregnum, as commercially sustainable works of longevity sufficient to maintain and expand a practically experienced work force began to supply a regular alum market in London. Low in quality but therefore cheap to buy, much of the consumption was British, although European sales, competing with Liège alum, were not unknown, some Yorkshire alum travelling as far as Marseille. These degrees of success encouraged the opening of further coastal sites, eventually totaling a string of nine coastal alum works across the seventeenth and eighteenth centuries.

The coastal character of English alum production brought with it both advantages and difficulties. Sea transport for shipping alum crystal to London, and for receiving the alkalis necessary for production, was immediately on hand. Casks of crystal were lowered down the cliffs by ratcheted pulleys to cargo boats. Barrels of alkali were hauled up. Once at sea however, crystal was vulnerable. As a valuable product it was on occasion subject to attempted piracy. This remained a persistent concern, works managers carefully noting unidentified foreign ships lying off the coast, and taking heed of any reports

and rumours. The seasonal cycle of coastal temperature and weather change could also require response. The quarried alum rock was constructed into what was called a “mine-heap” for calcination. The rock was fired by a base level of fuel (coal, local wood and furze). The base fuel would be fired and more layers of rock were added. Layers of rock were separated by wet vegetable matter to help moderate the slow rising burn of the rock, and especially to control and isolate over-burning, fatal for production of the calcined salt. The largest mineheaps could reach heights of thirty metres, and had wooden scaffold erected around and above them to aid construction and tending of the calcining mass of rock. As it was constructed, the surface was sealed with alum rock paste, which afforded some protection against wind (which could stimulate over-burning), and rain (which might reduce or quell the burn), but equally in warm summer weather the heap might require watering to moderate the rate and temperature of the burn. The sealing also functioned to contain the sulphur gases released by calcination. The well-managed heap would have a slow even burn rising through the layers of rock, and maintained at 5–600C, the temperature necessary to release the trioxide of sulphur gas essential to the formation of the sulphate salt of alum.

These larger heaps, again unique to Yorkshire alum, took ten to twelve months to fully calcine. The salt product would be steeped in pits with circulating water for up to a fortnight, to produce a solution of sufficient strength. This was boiled, then placed in settling vats for cleansing, carried out chemically by adding human urine, first collected locally, later transported by sea from London, and effective particularly for settling out



FIGURE 1. • Henry Barlow Carter, *Coastal quarry and mineheap, Peak Alum Works, 1843*.

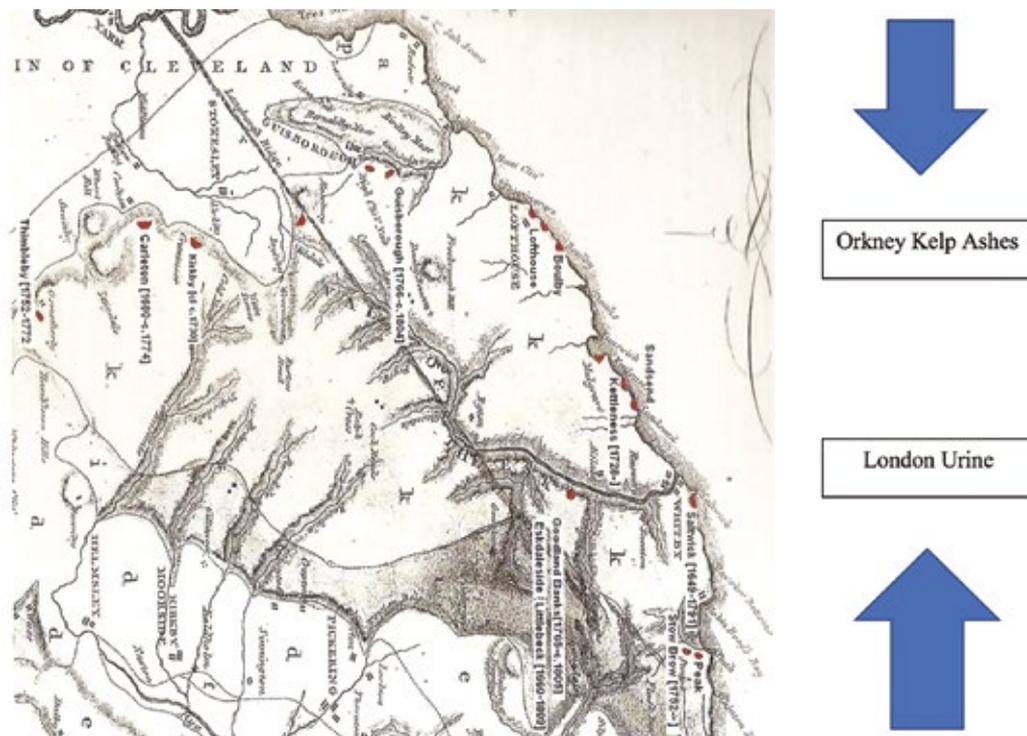


FIGURE 2. • North Yorkshire Alum Coast, reoriented to North-South axis.

the ferrous material derived from the pyrites contained in the original alum mineral, and particularly harmful for effective alum. Some potash was also used to settle out nitre and prevent the alum salt from hardening. The best urine came from the poor, who drank significantly less alcohol than the rich. The following stage of evaporation was the most precisely quantified of the productive operations. The concentration of the salt solution was measured by its specific gravity and would be carried out in the small assay laboratories which most alum works maintained. Weighted wooden sticks, then superseded by more sophisticated devices, were used to measure the concentration until it reached the range, 1.15–1.3 SG, for crystallization to be induced. The vegetable alkali used for crystallization was initially supplied by limited local Yorkshire materials available on the seashore. As demand grew, it was shipped south from the Orkney islands north of mainland Scotland, and had the form of alkaline ash, produced by the Orkney kelpers, who gathered kelp from kelp beds on the coast and burned it to produce the ash. This coastal chemical manufacture was thus essential for providing the key alkaline component for Yorkshire's coastal alum production.

The presence of both potash and urine at production sites has caused persistent confusion in understandings of their alkaline practical chemistry, because urine contains the ammoniacal component of volatile alkali, occasioning the assumption that either or both

were used for crystallization purposes. At least on the Yorkshire coast, this assumption is unwarranted. Why import both if either is sufficient? As is evident even from an early, published account of alum production in England, the urine was not primarily used for crystallization, but for the preliminary “settling” or purification of the salt solution.<sup>1</sup> The presence of volatile and vegetable alkali does not necessarily sustain the case that both were used for crystallization. They were not used as alternatives for the same purpose, but for separate and different operations of a coastal alkaline chemistry whose reach extended from London to the Orkneys, the length of the British Isles.

<sup>1</sup>Daniel Colwall, “An Account of the English Alum-Works,” *Philosophical Transactions of the Royal Society of London* 12 (1677–78): 1052–6.

# Simon Schaffer and How to Really be an Engineer when you Grow up

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SUJIT SIVASUNDARAM

I first encountered Simon Schaffer in 1995. I was a 1B student in History and Philosophy of Science who had decided that he would not be an engineer. Engineering had been in my sights for quite some years when I was growing up in Sri Lanka. As I now think of it, this was the legacy of postcolonial developmentalism: if you could build bridges, you could make a relatively new state in the South a better place. But if you could not build bridges, or indeed if you worried that the bridges you built would fall down, what then? Roll up, roll up to hear Simon Schaffer lecturing to second-year undergraduates. In his introductory lectures, Simon provided compelling expositions of early modern natural philosophy; the experimental techniques and material practices of the sciences; and how facts and knowledge were verified and constituted by audiences. Critically, he explained how science and technology were inextricable from modes of extraction, exploitation and social hierarchy. There was that loud voice that boomed through the lecture theatre: it was almost as if the experiment was being deconstructed by the manner of this exposition which itself was such a persuasive and bravura performance. It was much better than the latter-day scientists and definitely far superior to the engineer-lecturers.

So it surely followed that one did not need to be an engineer, in the narrow sense of a bridge-builder. One could instead follow in the trajectory – the slipstream – of Simon Schaffer. This engineering is more creative and inter-disciplinary in kind, stretching across anthropology, museology and sociology as well as history and philosophy. It is a remaking of history, through careful attention to how stuff is made and remade as a result of structural forces that are much bigger than those that bridge-building engineers focus on. And so, it was perhaps because of Simon's influence that, more recently, I started to work on a set of images in Cambridge University's Library. I had been running classes for undergraduates with photographic albums from Sri Lanka for some years. Simon himself taught a class on this course on the subject of the "ship as island." One Sri Lankan album was too interesting. It showed a gigantic piece of kit. The piece of kit is a breakwater, or perhaps it may be called a bridge, where sea meets land in Colombo. The British built breakwaters in Colombo across the late nineteenth and early-twentieth centuries.

One conversation I had with Simon at the time, which he probably won't remember and which I believe occurred at the Eagle, encouraged me to focus in on the breakwaters. He said the social history of colonial engineering is worth considering as a subject. For



FIGURE 1. • Colombo Harbour Completed 1885. Copyright: Cambridge University Library.

context, Colombo was a multiply-colonised and repeatedly engineered city which was built in a wetland, including by the Portuguese, Dutch and British and it is currently the home of a interventionist programme of debt-generating engineering undertaken by the Chinese. There is no significant natural harbour in Colombo, though it became a key transit point in the middle of the Indian Ocean, including for enslaved and indentured peoples and now for internation-

al trade. These images of the breakwater which caught my attention are not the type of photographic sequence that historians of Asia normally consider. There are few people in the images, so this isn't necessarily about the ethnographic eye, a key theme in visual studies of South Asia. Indeed, it is the breakwater which is the subject in the images.

I've now been working beneath and beyond the breakwater in various ways, for some years, including in the archives in Sri Lanka over the pandemic. When I began researching the images, I had no idea that they would lead into the whole history of the city. For the breakwater-making of the British follows in the track of the lake-making of the Portuguese and the canal-making of the Dutch and British. These images are also visually compatible with the contemporary Chinese programme of dumping sand in the sea off today's Colombo to create new land. In other words, engineering has happened time and time again for purposes of empire and curiously it has followed the same pattern. It is not supplementary to the history of the city; it is foundational. Yet, this iconic engineering has never made a city in the global South fully stable or finished. Indeed, this engineering has met with severe natural obstacles; it has been susceptible to breakage or leakage in a fashion resonant with what Simon always points to in relation to ships.

Even though the images here point to the calm sea, this is a fiction. The making of the breakwater arose from how it could and often did not tame huge Indian ocean waves, especially in the monsoon. It was supposed at first that nine feet was the greatest height of waves at Colombo, but subsequent measurements determined that where the breakwater was being built waves rose to twelve feet and fifteen feet. This meant that bits of breakwater were washed away by the waves. It also meant that the labour of making the

breakwater, often under-water, was gruelling. It was no wonder then that, in the history of Sri Lanka, the idea of the strike arose at the harbour-side. This big piece of kit generated tussles between communities as a result of colonial management. Engineering was tied to the segregation of the colonial city. As evidence, British harbour-development saw local fishermen sent out of their traditional fishing grounds; the beach they were allocated was crowded and generated petitions against the state as well as what was termed a “riot” which turned on the governors. In the midst of this arose discourses of anti-Tamil sentiment, against supposed migrant fishermen from India.

All of this is to say that following a bridge of sorts proves so fruitful if unexpected as a departure point. It allows a consideration not only of how material changes are tied to patterns of imperialism in a strategic site at the centre of the Indian Ocean which is environmentally unstable and low-lying. It also brings into view how engineering when placed within colonialism and in the global South relies on all of this labour and can indeed be the space from which strikes, resistance and new politics emerge. I have started to think of the breakwater as the site which births the city next to the sea. The labour which lies beneath it leads into the broadest canvas of modern politics.

One thing I really appreciate about Simon is his openness to South Asia. We co-convened a wonderful conference in Delhi which will always be an intellectual highlight in my memory. The openness extends to South Asia as a place and also to people of South Asian heritage. Simon has always been attentive to what I said about Sri Lanka – not something that I have regularly experienced in the Fenland. This is a story of how breakwaters at the centre of the Indian ocean are world-making objects. Appreciating that is to undo the imperial power of engineering, but also to be an engineer of a different kind and to start from the global South to remake the history of scientific techniques. It was Simon Schaffer then who taught me how to be this other engineer.



FIGURE 2. • Colombo Harbour Completed 1885. Copyright: Cambridge University Library.

# WESTERN PUMPING STATION, 1873–2022

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CAITLÍN DOHERTY

Of course we all know about the cathedral. Different shit, different day. But what about this secular profanity, the Pimlico People's Palace? A marker at the tideway, there and back, from the river to the sea. Four times a day it changes its mind, the city's old pets bobbing by the windows of Ebury. And yes, it is guarded by blue bronze fish cast by a man named George, and yes, we are drawn to the unorthodox, to maritime gothic, and obviously the good pub nearby got turned into flats, but you know, I know, what I'm talking about. You know where to look, in and out of the railway apertures, depending on the angle of exit and entry to Battersea, or, how the Thames' plug drains through the Grosvenor estate as if your departure depleted the tank. Close the lock on your way out— the geese these geese, oh how they nag! Names long scratched in the flume, telling the lie of air: it takes dirt to circulate. Here I'd ask about the links between the first great drills, the diving bells, ovoid and stethoscoped tracks, original congestion charges, the body politic and its urban arteries. To consider: Big Joe's pressurised jets and the living photos of wax men in sewers. Their monikers in the chimney too, well those images show absence just as graffiti in soot has to be scratched out—what's the word for a boneless catacomb? (Balloon!) Who minds it now? I like to think of his backroom kitchenette. Always five minutes left on the maintenance clock, always dying for a pint meaning he's not dead yet, just one hundred and forty nine and very very thirsty. [*cig break*]. From here the first

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branch of electrification spindled over enclosed basins, rivers: mole, ember, rythe. Look to Brighton, meaning time and the southern hemisphere. The queen morphs: station, pavilion, state. But here we are on the rim of a bowl of monster soup and these classic crested louvred roundells are calling over the egg and fleur de lis. Three diesels grumble on ad astra and then some, immobile extractions rooted, points of duration not depth. How to gauge for import on uncalibrated land? All measurement is dative; just depends on where you stand.

# Remembering Sydney Cove

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KATE FULLAGAR

*For Simon Schaffer, upon his retirement—a small memento from Australia, like the print discussed here, to remind him of friends far away who always think of him fondly.*

More than seventy years after the death of Arthur Phillip, a “wardrobe dealer” called Mrs Lye was asked to clear out the remaining effects of the late Admiral from his final home in Bath. Phillip had served as inaugural governor of New South Wales from 1788 to 1793. His impressive collection of silver, jewels, and furniture had been despatched soon after he died in 1814. The fifth-floor attic of 19 Bennett Street, however, was left untouched at the point of sale to a local family. Only in 1890 did the new proprietor arrange to have it emptied. Mrs Lye recovered “dozens” of old books and one landscape print. Uninterested in the history of the prior occupant, she promptly had the books destroyed. The print, though, caught her business-woman’s attention. She sold it to a nearby auctioneer, G. W. Hawkins.<sup>1</sup>

What Hawkins did with the print is unclear. Fortunately, its title was recorded, and fortunately again, there are several existent copies. *A View of Sydney Cove* is an aquatint engraved by Francis Jukes in 1804, measuring 24 inches wide by 17 inches high. We don’t know whether Phillip’s was also hand-watercoloured like the one presently in the National Library of Australia or left uncoloured like the one now in the British Museum. We do know that Jukes created it from a drawing by Edward Dayes, with whom he often collaborated. Neither Jukes nor Dayes ever visited New South Wales. Dayes copied the image from a work probably brought to Britain in 1801 by the second governor John Hunter. In turn, Hunter had probably commissioned it a few years earlier from his friend the emancipated convict Thomas Watling.<sup>2</sup>

The print pointed to many of the changes that Hunter had overseen in Sydney. There were more houses, more garden crops, and, finally, some working cattle. Most of all, it showed evidence of a fledgling maritime construction industry, centering the half-framed hull of a new brig in dry dock. At the same time, the *View* also included some elements

<sup>1</sup> See George Mackaness, *Admiral Arthur Phillip: Founder of New South Wales 1738–1814* (Sydney: Angus & Robertson, 1937), 460.

<sup>2</sup> Watling had been granted an absolute pardon by his fellow Scot Hunter in 1797. This was also the year that work started on the brig depicted here. Both Watling and Hunter had left the colony by 1800. On the brig, see <https://silentworldfoundation.org.au/object/view-of-sydney-cove-new-south-wales/>, accessed March 2022.

from Phillip's time. Government House in the far-left distance stood as before. Both Pitt's Row stretching to the horizon and the tall ship sailing in the harbour would have been familiar sights. Moreover, the Indigenous presence lingered as it had throughout the last decade. The family in the foreground represented the persistence of the Eora people in the place they called Warrane, despite the unrelenting advances of the British intruders.

A smattering of scholars has already discussed this print in terms of early Australian art.<sup>3</sup> I am more interested in the significance of its preservation in Phillip's attic. Did its survival indicate a special fondness on the part of the former governor? Did it serve as a sentimental or nostalgic reminder to him of his five years establishing a settlement in Europe's Antipodes? Such a conclusion would fit well with dominant understandings of Phillip's role in history. Because his efforts in New South Wales led eventually to the emergence of modern Australia, Phillip is now remembered as a kind of national founding father. Nationalist historiography would like to assume that the man who helped forge the Sydney colony somehow sensed its role in creating, one day, a proudly separate polity. It wants Phillip to have thought about Australia as much as Australia now thinks about him.

Of course, he didn't. That Phillip stored the print in a fifth-floor room signifies neglect rather than attachment. On a lower floor, he kept a large library of books, paintings, and over 400 drawings. His will had specified their immediate disposal to either named relatives or the auctioneer.<sup>4</sup> *A View of Sydney Cove* escaped everyone's attention because it had been earlier abandoned to the peculiar purgatory of attic storage.

This is not to suggest that Phillip felt the opposite of affection for the print. If there was any frustration involved, it would have been for the man who likely gave it to him, John Hunter. Phillip's successor had, it seems, commissioned the original image, and, still smarting from his brusque dismissal from office in 1800, was known to bend any handy ear about his under-appreciated accomplishments. Watling's depiction of maritime prosperity was designed to communicate Hunter's mark on New South Wales. Phillip may have become weary of the spiel.

Most probably, Phillip felt nothing much at all for Jukes' aquatint. When Hunter visited him, he'd just retired, begrudgingly, from his dual role as Inspector of Naval Impressment and Supervisor of the Sea Fencibles. He'd only undertaken these roles after being discharged from active service in 1798. In total, Phillip devoted nine years to the British campaign against Revolutionary France. This was nearly double the time he'd spent as a colonial governor. Before New South Wales, too, Phillip had worked close to four years in Brazil, either on secondment or as an allied agent to the pro-British Portuguese navy. He'd operated as a spy or state provocateur for at least three years through Britain's war

<sup>3</sup> Ian McLean, "Sense of Place: Edward Dayes's and Thomas Watling's Pictures of Sydney Cove," *Australian and New Zealand Journal of Art* 2, no. 1 (2001): 11–26; Olivia Barr, "A View of Sydney Cove," in *Pride of Place: Exploring the Grimwade Collection*, ed. Alisa Bunbury (Melbourne: Melbourne University Press, 2020), 82–3.

<sup>4</sup> See Louise Anemaat, *Natural Curiosity: Unseen Art of the First Fleet* (Sydney: NewSouth, 2014), 79.



FIGURE 1. • Francis Jukes and Edward Dayes (after), *A View of Sydney Cove*, aquatint, 43.8 \* 62 cm, 1804. Canberra: National Library of Australia, PIC Drawer 16 #S45.

against American revolutionaries and had earlier served in the British navy for nearly five years through the Seven Year's War.<sup>5</sup> When scanning Phillip's whole career, his governorship is not necessarily what stands out. If anything defined Phillip's loyalties and passions, it was the promotion of Britain's power abroad. Phillip's life was defined by and only makes sense through the lens of the aggression and expansion of the eighteenth-century British empire. It was not focused on just one spot.

Moreover, and in consequence, when Phillip looked at images of Sydney Cove, he saw an effect of imperialism, not the start of a new polity. When he viewed Sydney's many buildings, he saw housing for convicts and officials, not homes for free settlers. When he registered a growth in agriculture and livestock, he saw sustenance and a potential for exports, not the promise of independent prosperity. When he clocked ships in the harbour or in dry dock, he saw an increase in connections between outposts of the British empire, not the dawn of a fresh mercantile enterprise. Reimagining Sydney Cove in the late eighteenth century through Phillip's eyes reminds viewers that New South Wales existed as an extension and handmaiden to empire. To see it instead as a distinct place burgeoning into its own future – one remembered tenderly by its earliest mak-

<sup>5</sup> See Kate Fullagar, *Phillip and Bennelong: A History Unravelling* (Sydney: Simon and Schuster, forthcoming 2023).

ers – is to diminish the critically reactionary and global contexts of its foundation. Phillip's forgotten print prompts us to recognise that Australian beginnings owed chiefly to the world-wide assertion of British power against imperial rivals, colonized peoples, and revolutionary ideals.

Revising the role of New South Wales in Phillip's life, and with it the role of the colony in Australia's past, also recasts one other related subject. This is the role of Indigenous people in the history of the colony. In *A View of Sydney Cove*, the role is represented by the Eora family in the foreground. Most scholarship on the early portrayal of Indigenous peoples in colonial art argues that its idealization and traditionalization evokes the erasure that settlers would soon enact.<sup>6</sup> This is a convincing proposition, given later behaviours in New South Wales. It's doubtful, however, that Phillip would have been taken in by these tactics. To the originator of the imperial outpost, Indigenous people never looked like they might just fade away. Phillip had dedicated at least half of his energies while governor to establishing some understanding with the Eora, however imperfectly executed. He had done so because he knew that every other British colony before his had forged at some point a treaty with First Nations. Phillip ultimately failed to formalise an agreement – the Home Office refused to meet with his chosen go-between, Bennelong, in 1793, and soon afterwards he lost the authority to rectify the situation. But the importance of noting the critical counterpart to empire – the undeniable existence of Indigenous people – was always in his mind. To see Phillip and early New South Wales as signs of the neglected power of imperialism in shaping Australia is also to see – perhaps paradoxically – the central role played by the Indigenous people who faced invasion.

Phillip was no champion of Indigenous rights in New South Wales: his mission had been to establish a colony for the empire and he pursued it with dogged, unflagging resolve. Nevertheless, his efforts in engaging Indigenous leaders spoke at least to the way he always understood that they were the constant and unmissable foil of his masters' plans. In forgetting the imperial dimensions of Australian foundation, modern commentators too often also forget the towering significance of empire's biggest existential challenge – prior Aboriginal occupation.

Mrs Lye's discovery of *A View of Sydney Cove* in Arthur Phillip's former attic could help underscore the popular view of Australia as a country birthed in 1788 by a devoted paterfamilias. It could, however, better prompt a recognition that Australia rather emerged from a colony forged by the twinned forces of relentless British expansion and unyielding Indigenous persistence.

<sup>6</sup> See McLean, "Sense of Place," 21, and Rod Macneil, "Time after Time: Temporal Frontiers and Boundaries in Colonial Images of Australian Landscape," in *Colonial Frontiers*, ed. Lynette Russell (Manchester: Manchester University Press, 2001), 47–67.

# Curiosity, Creativity, and Character

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ALEXI BAKER

I was lucky enough to work with Professor Simon Schaffer on the AHRC-funded project “The Board of Longitude, 1714–1828: Science, Innovation, and Empire in the Georgian World,” which ran from 2010–2015. My experiences with Simon during and since those years have continuously reinforced how he has a wide-ranging and impressive intellect,

as is well-known. However, they have also continuously reinforced how he combines this with a generous, collaborative, unpretentious, and open-minded spirit – a much rarer attribute.

Simon has explored an impressive array of interesting subjects in his scholarly and popular work. The choice of subjects seems to have been guided both by his own perpetual curiosity and sometimes by the types of work which would benefit scholarship or society at a given time. His work has often reflected how the history of science and technology involved a variety of actors, networks, and influences – including not just intellectual thought and experimentation but also a host of other mathematical, technological, and socio-economic activities and motivations. Although it has become increasingly common over the decades to take such factors and dynamics into consideration, they are still all too often ignored or underestimated in favor of presenting narrower conceptualizations of early “science.” Simon has also connected



FIGURE 1. • Simon raises a glass during a narrow boat trip to celebrate the conclusion of the Board of Longitude project in 2015.



FIGURE 2. • Simon takes to the water in Ely with members of the Board of Longitude project.



FIGURE 3. • Dr. Anita McConnell (1936–2016), whom Simon involved in activities at Cambridge, visiting the Galápagos Islands in 2014.



FIGURE 4. • Simon speaking at Alexi Baker's conference *Objects in motion: material culture in transition* at the Centre for Research in the Arts, Social Sciences and Humanities [CRASSH] in 2015.

publications and projects to more global histories and the impacts of colonialism and imperialism, while supporting the work of scholars beyond Europe and North America.

Simon's scholarly and popular work and his outlook at large are furthermore impressive for being so grounded in accessibility and in the wider world. He often collaborates across disciplines and sectors, producing more insightful and evocative projects than likely would have emerged from a more siloed approach. He seeks to communicate his ideas to and to learn from all types of people and audiences as well, rather than constraining discussion to "the ivory tower" of Oxbridge academia.

In a similar vein, Simon has enriched his projects but also countless lives by working with all different types of students, scholars, and other collaborators. Despite increased discussion of related issues in academia, some individuals and institutions continue to have narrow perceptions of what types of people can have scholarly potential or possess worthwhile knowledge and ideas. These prejudices impact for example people from different racial and socioeconomic and geographical backgrounds, women including older women who have had to fight throughout their careers, and researchers without institutional affiliations or based outside of universities. Simon has continuously exhibited that he recognizes and values expertise and creativity across the board. He also openly acknowledges and tries to assist with the greater challenges which face many students and scholars.

Simon Schaffer is rightfully well-regarded for his academic publications, projects, and teaching – as well as for his engaging appearances on television and radio. However, what seems most remarkable to me is that he remains unfailingly humble as well as incredibly thoughtful and generous despite being perpetually busy himself. Simon's extraordinary ideas and eloquent manner of communication inspire many people within and far beyond academia – but he has also touched many lives by merit of being a wonderful person.

# La Tour du Monde with Simon

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NEIL SAFIER

“Depuis quelques mois je suis au Bengale,” wrote the French botanist Jean-Baptiste Leschenault de la Tour to his colleague Antoine-Laurent de Jussieu in Paris in November of 1819. It was in Calcutta, “où Flore étale ses richesses avec une grande profusion,” that Leschenault de la Tour had taken up residence, finding his way to the East India Company’s botanical garden on the banks of the Ganges, and marveling at the work of the garden’s director, Nathaniel Wallich, who “receives all means to enrich [the garden] and applies himself with the utmost effort.” Wallich, of Danish extraction, had himself come to Bengal in 1807, but due to fallout from the Napoleonic wars in 1808 ended up as a prisoner of war of the British. Buttressed by his scholarly credentials, Wallich was permitted to go to work for the Company, first as William Roxburgh’s assistant and later as Superintendent of the Garden, a post that he took over in 1815 and in which he remained – barring a couple of brief absences – until 1846. In Wallich’s case, his Danish nationality was not a barrier to his advancement within an increasingly meritocratic and nationality-blind scientific world; even the political complexities of a post-Napoleonic era were not sufficient to exclude him from serving in what might have been construed in some circles as his enemy’s imperial garden.

For Leschenault, writing back to the French capital, cosmopolitan Calcutta was only one stop on an extraordinary world tour that had begun nearly twenty years before. Through an invitation to join an expedition led by Nicholas Baudin that would chart the western coast of New Holland (Australia) in 1800, Leschenault came to epitomize the traveling botanist, hitching rides on ambitious expeditions of scientific curiosity – and frequent botanical looting – as he traveled throughout the South Pacific, Australia, and Southeast Asia. Sponsored by Napoleon, who had famously recognized the value of military officers and scientists traveling together, Baudin had been ordered to survey the western coast of Australia with an especial attention to geography and natural history, a marriage of military and scientific purposes that came to exemplify Napoleon’s ethos of exploration in the late-eighteenth century. Previously, Baudin had traveled to China, India, and around the tip of Africa, and had been forced due to bad weather all the way to La Trinité (Martinique), where he deposited his not insignificant collection of live plants, seashells, minerals, insects, fish, and other bounty from his earlier travels. On his Australian voyage several years later, Leschenault accompanied Baudin and his

entourage as chief botanist. Leaving Paris, Leschenault de la Tour's extraordinary life took him from Paris to Australia, Indonesia, India, and finally to Suriname and French Guyana, only several years following the letter that he composed to Jussieu in Calcutta. Moving across broad spaces and crossing the globe with apparent ease was, in the early nineteenth century, the after-effect of circumnavigations that had made the globe seem to be a far smaller place than even a century before.

\* \* \*

Leschenault de la Tour was one of a broad array of late-eighteenth-century scientific go-betweens I had the privilege to follow while working on *The Brokered World* project alongside Simon and other cherished friends. Like these scientific actors, we live in an age where connecting with colleagues and sharing our archival, botanical, linguistic, and culinary experiences are essential and eminently enjoyable aspects of what we do – pandemic travel bans and war induced no-fly zones excepted. From Halifax to Madrid, passing through Oxford, Haarlem, Cambridge, and at least one Canadian coastal city in between, it was always a special privilege having Simon around: as a mentor, as a colleague, and as a friend. In all of our interactions, these intertwined elements grew consistently and in concert. For Simon, discussing ideas and being a generous and engaged interlocutor always went hand-in-hand, even while on the move. During the course of our many conversations, I would often lean in closely when he uttered the words “And as you know far better than I ...,” convinced that he was poised to articulate my own ideas – which he extracted from a presentation I had given only minutes before – with far fewer words and far greater eloquence and argumentative power than I was capable. If I could have grabbed a pen or a recording device without embarrassing myself, I would have done so at every turn (of phrase). He never failed to remember with acuity what I had written – sometimes even down to the footnotes – very often better than I.

Simon's mastery of the language and conceptual tools of several overlapping and interconnected fields – anthropology, art history, the socio-political histories of measurement, the cultural history of knowledge construction, to name only a few – was not, however, what most characterized these amiable conversations that inevitably doubled as high-octane mentoring sessions. Rather, it was his consistent – *insistent* really – tone of positive reinforcement, always seeking to make me and others feel like we were on the verge of extraordinary discoveries, even when we ourselves felt as if we were only getting started and still had so very far to go. This may seem like a banal observation were it not for the palpable dearth of this sort of generosity within our academic guild, due at least in part to a hyper-critical, often overly destructive stance many scholars (unfortunately) feel is essential to furthering their own careers. Simon's approach always felt different to me, as if he were the tireless champion of those who were working toward – but not yet fully arrived at – paradigm-shifting conclusions within their respective fields. And the results of this kind of mentorship were always, for me, extraordinary to behold.

I cannot say for certain why Leschenault de la Tour was the anecdotal figure that came to mind when conjuring the contours of my friendship with Simon over these nearly two

decades. The geography, of course, is evocative and overlaps with many of Simon's own intellectual forays – Paris, Australia, and India, *entre autres*. But so is the conceptual trilogy that is represented by Leschenault's story: science and circulation, imperial institutions and their rivalries, connections between geographically distant and distinct locales. Simon's *œuvre* does not habitually gravitate toward botanizing as an imperial scientific pursuit – nor does he frequently travel with military officers, at least that I'm aware of – but the elements of espionage, political intrigue, cultural inversion, and ironic juxtapositions – what we might happily call a paradigmatically Schafferian “science from below” – are part of how Simon has brilliantly illuminated not only his own scholarly terrain but so many other ancillary pathways through the history and philosophy of science – and well beyond.

When I first discussed the La Tour project with Simon, it was still very much in its infancy (as it regrettably remains). Simon not only delighted in the title – La Tour du Monde – but reflected on several ironies that inhered within it. I giggled along with him, keen as I always was to be in on the joke but never sure in the end whether we were, in fact, understanding or laughing at the same thing. Simon immediately picked up on the multiple meanings – a world tour, of course, and an allusion to the \*other\* Latour, bien sûr – but I suspected other “entendres” which he had seen but I may not myself have grasped. With Simon, I frequently felt that I was at least two (and often three or four) steps behind, always running to catch up. But what was true then and remains so today – and I suspect this is the case for all who have had the joy and exhilaration of working with him – is that we were simply delighted to be part of the contest: out of breath, to be sure, uncertain of the next set of probing questions, without a doubt, but reveling in the exercise and thrilled to be part of the Schafferian collective.

“Did you see what I did there?”

Thank you, Simon. As you take your well-deserved leave from more formal duties, I look forward to sharing the next chapter with you and with all of the others – too many to reference and myself proudly among them – who love you dearly.



FIGURE 1. • Simon and Neil on a film set replicating the 1964 New York World's Fair (reconstructed on the campus of the University of British Columbia, Vancouver, for the filming of Brad Bird's *Tomorrowland*, August, 2013).

# Following threads of 19th-century Edinburgh science

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REBEKAH HIGGITT

Starting work at National Museums Scotland in 2020, while access to collections and archives was limited, prompted me to see what I could learn of 19th-century Edinburgh's scientific circles from the life of a "genial and kindly" Scottish participant in the 1874 transit of Venus expeditions. I first encountered him in the humorous drawings by a fellow member of the Sandwich Islands Station, Lieutenant E. J. W. Noble, who evidently found this astronomer's Scottishness amusing: his accent was noted, he was shown dancing a Highland fling at a soiree in Honolulu (which he did) and adopting "the Highland Costume" to confound or delight mosquitos (which he surely did not). Imagining the homecomings of the expedition team, Noble depicted John Walter Nichol "Away down to Edinburgh," being greeted at the door of the Playfair Observatory on Calton Hill, where he had been assistant, by a bonneted, kilted figure, supposed to be the Astronomer Royal for Scotland (then Charles Piazzi Smyth, this kilt is even more unlikely).<sup>1</sup>

That return to Edinburgh never took place. Nichol chose instead further exploration of Hawai'i and Maui, a period at the Royal Observatory in Greenwich reducing the expedition's positional observations, and travel to Leipzig to study under Karl Bruhns, director of the new observatory there. He also published some observations on volcanoes in the *Proceedings of the Royal Society of Edinburgh* and an investigation of a comet's orbit in *Astronomische Nachrichten*. This looked like a man aiming for a serious scientific career but, returning to Britain in 1878, he died of a pulmonary infection in Teignmouth. Having been made a Fellow of the Royal Astronomical Society shortly before the transit expedition, less than five years later the RAS's *Monthly Notices* published his obituary.<sup>2</sup>

Looking forward from Nichol's expeditionary experiences, then, gave limited insight. However, his obituary helped me begin to track his path to Hawai'i and the opportuni-

<sup>1</sup> E. J. W. Noble, "Life & Adventures of Station B," Albums 1 and 2, available at Cambridge Digital Library courtesy of Charlotte Tupman: <https://cudl.lib.cam.ac.uk/view/MS-TRANSIT-00001/1> and <https://cudl.lib.cam.ac.uk/view/MS-TRANSIT-00002/1>. Rebekah Higgitt, "Framing the Transit: Expeditionary Culture and Identities in Lieutenant E.J.W. Noble's Caricatures of the 1874 Transit of Venus Expedition to Honolulu," *Annals of Science* 74, no. 3 (2017): 214–39, <https://doi.org/10.1080/00033790.2017.1328074>.

<sup>2</sup> Obituary of John Walter Nichol, *Monthly Notices of the Royal Astronomical Society* (February 1879): 237.



FIGURE 1. • J. W. Nichol observing the 1874 transit of Venus from Honolulu, exclaiming “gude gracious!,” E. J. W. Noble, “Life & Adventures of Station B,” Album 1 <https://cudl.lib.cam.ac.uk/view/MS-TRANSIT-00001/49> (detail). Reproduced courtesy of Cambridge University Library and with permission of Charlotte Tupman.

ties offered by mid-19th-century Edinburgh. The tartan threads of the unlikely kilts in Noble’s caricatures led to a tightly woven fabric of lives and places in the city. While I had assumed that Edinburgh’s observatory would play the major role – Nichol’s being an assistant there is the only detail mentioned in accounts of the transit expedition – it was in fact, and perhaps unsurprisingly, Edinburgh’s educational institutions, though the observatory, societies, offices and manufactories also played their part.



FIGURE 2. • Nichol, plagued by mosquitoes, "proposes trying the Highland Costume," Noble, "Life & Adventures," Album 1 <https://cudl.lib.cam.ac.uk/view/MS-TRANSIT-00001/29> (detail).  
Reproduced courtesy of Cambridge University Library and with permission of Charlotte Tupman.

Nichol had an ideal start in life for a future astronomer. His father, Walter, was a successful mathematics teacher who had helped launch the subject at two famous Edinburgh schools. Starting as a teacher of writing and arithmetic at George Heriot's Hospital in 1810, a history of the school states that

It was the success which attended Mr. Nichol's voluntary labours with his pupils, which induced the governors to nominate a teacher solely for the scientific department. He had a geometry class consisting of 40 pupils. Before quitting the Hospital in 1813, he proved that a boy of twelve, possessed of fair talents, may be advantageously initiated in the study of the elements of geometry.<sup>3</sup>

<sup>3</sup> William Steven, *Memoir of George Heriot; With a History of the Hospital, Founded by Him in Edinburgh; and an Account of the Heriot Foundation Schools* (Edinburgh: Bell & Bradfute and London: Smith, Elder & Co., 1845), 193.

Later, he was the “eminent teacher” to which the Royal High School turned when they decided that they, too, should have a dedicated mathematics master. Otherwise, he taught privately, developing a significant reputation, receiving an honorary degree, becoming a Fellow of the Society of Antiquaries of Scotland, being called on to provide testimonials for applicants to school and University positions, and remembered as “an admirable teacher, and greatly beloved by his numerous pupils.”<sup>4</sup>

In 1841, two years before John Walter Nichol was born, the family – Walter, his wife Elizabeth, son William, daughter Mary and a servant – was living at 86 South Bridge, handily close to the University’s College buildings. In 1855, Walter was still teaching there but was living at a grander address, 2 Queen Street. He sent his sons to the nearby Edinburgh Institution for Languages and Mathematics, where his cousin, George Murray, took charge of “Mathematics in all their Departments.”<sup>5</sup>

The modern and mathematical education enjoyed by William and John Walter was, it seems, to their taste. Although William won prizes for the traditional subjects of Latin and Greek, he was said to have “evinced a desire for scientific knowledge” and, with his father’s encouragement, explored sciences from conchology to mechanics. He used his modern languages to read scientific literature and, as a medical student at the University, developed a particular interest in botany. He joined the Botanical Society of Edinburgh and “added many species of mosses to the flora of Scotland.”

The professor of botany, John Hutton Balfour, noted William’s “zeal and enthusiasm” and recommended him for a botanical expedition being planned by William Hooker, director of Kew Gardens. He was too late for this post but, on Hooker’s advice, became a naval surgeon and went to Portsmouth. He was again delayed, this time by ill health, but set off for India in 1859 only to die of typhoid in Alexandria.<sup>6</sup>

William had, according to his obituary by Balfour, also been affected by the recent and unexpected deaths of his father and younger sister. In 1861, the surviving family members, John Walter and Elizabeth, were living at Haddington Place on Leith Walk, just beneath Calton Hill. Having lost his father and brother by the age of 16, John Walter Nichol had gone straight from school into employment. He became a General Merchant’s Clerk in Leith and mother and son lived comfortably together with a servant. By 1871 they had moved to a modest villa on Murray Street (now Sciennes Gardens), and Elizabeth was living on the interest of a “Railway Share.”

The RAS Fellow who wrote Nichol’s obituary was, as we might expect, approving of the “accurate, business-like habits” that he was supposed to have gained by working for a mercantile firm. What it certainly gave him was sufficient wealth that, a decade on, he

<sup>4</sup>William Steven, *The History of the High School of Edinburgh* (Edinburgh: Maclachlan & Stewart, 1849), 227–8; Charles Cowan, *Reminiscences* (Printed for private circulation, 1878), 28.

<sup>5</sup>Entry for the Edinburgh Institution for Languages, Mathematics &c. in *Oliver & Boyd’s New Edinburgh Almanac* (Edinburgh: Oliver & Boyd, 1840), 480.

<sup>6</sup>John Hutton Balfour, “Biography of Dr William Nichol,” *Transactions of the Botanical Society of Edinburgh* 6 (1860): 290–92.

could begin to “gratify [his] taste” for scientific subjects and attend lectures at the University. In 1869, at the ripe age of 26, his name was included on the prize list for the First Class of Mathematics.

In December 1870 he arrived at the Royal Observatory, Edinburgh, as second assistant. Initially a temporary appointment, by 1871, having “acquitted himself so admirably” and passed two Civil Service examinations, Nichol gained a permanent post.<sup>7</sup> He worked chiefly on reducing observations for publication in the *Edinburgh Star-Place Catalogue and Ephemeris* (1877), though he must also have gained significant observing experience.

He brought more than his financial and university mathematics. Piazzi Smyth reported that Nichol had arrived “strongly recommended from the Natural Philosophy Laboratory” by Professor Peter Guthrie Tait. There, according to Tait’s reports to the Royal Society of Edinburgh, he undertook experiments, including on “Radiation at various pressures of the surrounding gas.” At the Observatory he pursued some similar work: in 1871 Nichol and first assistant Alexander Wallace participated in experiments on the spectrum of light passing through high pressure steam. These were inspired by Tait and his predecessor, James David Forbes, but also benefitted from Calton Hill’s proximity to industrial sites and engineering skills, drawing on the assistance of Alexander Slight, who had an engine works on Leith Walk, and Thomas Wheatley, the locomotive superintendent of the North British Railway.

(At this point, pulling on tangential threads, I was led back to NMS. Alexander Slight was, among other things, an inspector for the Northern Lighthouse Board, the collection of which has long been displayed at Chambers Street. His father, James, also an engineer, worked under Robert Stevenson on Bell Rock Lighthouse and was curator, and often maker, of the Highland and Agricultural Society of Scotland’s models collection. Once displayed at their premises on George IV Bridge, by the 1870s these were also at the Museum. Just down the road, in the north basement of the College, Tait set up his “Big Gun” pressure apparatus to calibrate results from the HMS *Challenger* expedition by testing deep-sea thermometers, now likewise at the Museum. But I, like histories and collections, digress.)

After less than three years, Nichol resigned his Observatory position and volunteered for the transit of Venus effort. It’s possible that he felt an obligation to take up scientific work and travel in its pursuit, fulfilling the ambitions of his brother and father, but it was also an important opportunity, leading to his election as a Fellow of the RAS and experience of observing regimes at Greenwich and elsewhere.

By the end of the decade, however, Elizabeth Nichol had lost her third and last child. In the 1890s she bequeathed £2000 to the University in his memory to fund an assistantship to the Chair of Natural Philosophy. This was the role Nichol held under Tait, kickstarting his second career. The Nichol Foundation Scholarship still exists – given to

<sup>7</sup> Charles Piazzi Smyth, *Astronomical Observations Made at the Royal Observatory, Edinburgh*, vol. 13 (Edinburgh: Neill and Company, 1871), vi, 102.



FIGURE 3. • Nichol's imagined return to Edinburgh, Noble, "Life & Adventures," Album 2 <https://cudl.lib.cam.ac.uk/view/MS-TRANSIT-00002/22> (detail).  
 Reproduced courtesy of Cambridge University Library and with permission of Charlotte Tupman.

the Physics student achieving highest marks, it has been the first of many prizes in some scientific careers. For me, pursuing the threads of Nichol's story has offered a new route into Edinburgh's scientific histories, connecting observatory to engine house, laboratory to counting house and both mathematician and botanist to imperial expeditions.

# The Go-Between

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ALISON BASHFORD

The history of science attracts intellectual go-betweens. Or it creates us: this century and that, one continent then another, natural sciences then physical sciences, the heavens and the earth, here and the beyond. Few of us broker in contexts that even remotely approach the excitement and danger of the imperial world, 1770–1820. Still, we recreate and relive vicariously through our historical actors, and – perhaps a little timidly – through the pieces of paper and (if we’re brave) the objects and landscapes that hold and tell their past. For them, the risk and the opportunity for braveness lay in every brokered exchange. For us, the opportunity only really lies in the boldness of possible intellectual connections; the occasionally risky brokering of this and that way of knowing.

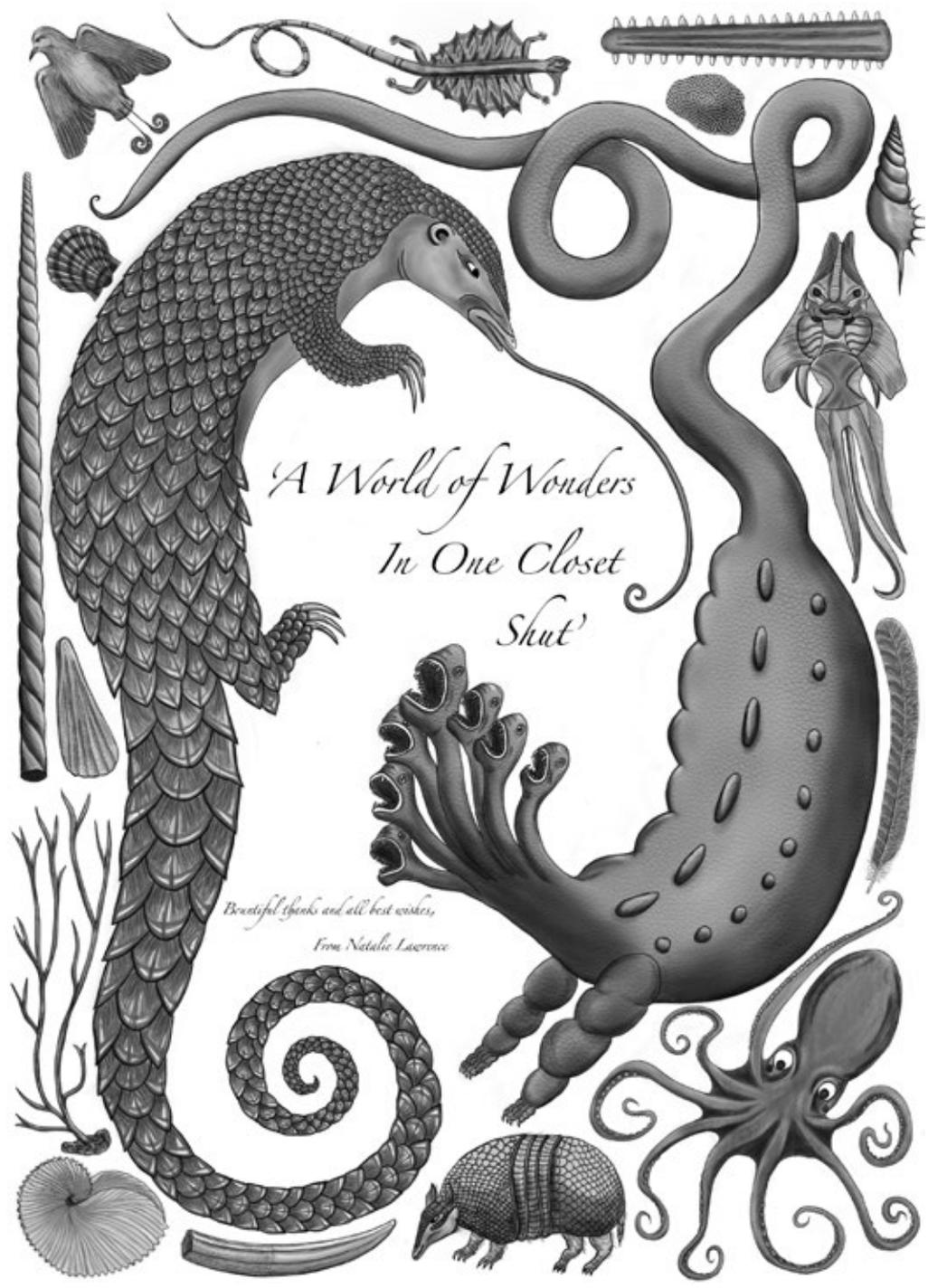
It’s a small enough part of the Schaffer opus, but the collaborative *Brokered World: Go-Betweens and Global Intelligence* (2009) focused the attention of many of us seeking to bring world history and the history of science together. It was powerful not just in its geographical and epistemological sweep, but also temporally: 1770–1820 was itself in-between. The thing is, thereafter, I couldn’t help, and can never stop, perceiving Simon himself as the Master Go-Between. He is so especially across early and late modernity. That exchange is hard. And for those of us more familiar with reduced late-modern mindsets and worldviews, Schaffer’s go-between work has enjoined us, via his early moderns, to consider the heavens and the earth, elements and the cosmos together.

Because he is the Master Go-Between, Simon Schaffer reliably turns up to talks on matters seemingly distant and disconnected. Many of us giving Cambridge talks here and there, on this and that, can easily recall the Schaffer focus. He is always readily discerned in the audience: watching and listening hard, intellectually poised like a cat ready to pounce, but never to devour us – never. Quite the opposite, for suddenly there is the vigorous Schaffer nod. Yes! He’s made the delicious go-between connection.

Is Simon Schaffer also a broker of global intelligence? Well, he’s certainly not a *broccour*, an Old French “small trader.” But if he is a knowledge broker, then the commissions on his many intellectual deals have been distributed amongst us all, fairly shared.



EVERYTHING AND NOTHING:  
A MUSEUM OF MEETINGS



*'A World of Wonders  
In One Closet  
Shut'*

*Beautiful things and all best wishes,  
From Natalie Lawrence*

# My PhD was on science in eighteenth-century Russia

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SIMON WERRETT

My PhD was on science in eighteenth-century Russia. According to my diary, Wednesday 25 November 1998, the topics discussed in a PhD supervision with Simon were as follows: Gustav Metzger, the Ordnance Office, Fish and Ships, George III, absolutism, lightning rods, Stanisław Lem, Conan the Barbarian, the Science Wars, Alfred Jarry, SSK, the loss of skilled labour, Lotus and Ferrari, and the Steampunk Trilogy. This is why we loved him, and still do.

# Interventions in HPS: The case of the elephant leg

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EOIN CARTER

When sitting down to write this short piece on Simon, it's occurred to me that just about every contributor must be grappling with the same dual problems of knowledge and social order. Knowledge, because the one claim in HPS that commands universal assent is that Simon Schaffer knows everything. Social order, because anyone who knows that also knows (one is tempted to say, "*a fortiori* ...") that there's no way to express such a claim without immediate dissension and uproar from the man himself. The last forty-odd years of our discipline unravel into a series of fortuitous conversations on squash courts, anti-parables about the lucky schlemiel, and a web of chance and circumstance so gossamer-thin it'd take the skills of a Simon Schaffer to trace it.

This leaves us with, as he might put it, a second-order problem: is there a form of compliment to be had out there that is a) adequate to the task of describing Simon – not just the unfathomable depths of his knowledge, but more importantly his boundless generosity, unflagging patience and support, his wit and warmth – but that b) Simon himself would be willing to accept? I'll leave the high scholarship to others, and instead offer just the one anecdote. A few years back, shortly before the world became mediated by screens, one of the schlemiel's PhD students was feeling, as PhD students are wont to, a little lost and struggling and frankly badly in need of some fresh air and conversation. Simon Schaffer, FBA (for it was he), defining scholar of his generation, took the student for a kebab. They sat eating it, in a children's play park just off King Street, till well past dark and the student had quite forgotten what his problems were. If Simon were to be asked, I'm sure he'd say it was just what the situation demanded; it was nothing. To the student, it was everything.

Thank you Simon.

# Welcome to fenland

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CLAIRE OLIVER

It all began somewhat cryptically with an unexpected email informing me that “Simon would like to talk to you.” The message was equal parts surreal and marvelous, particularly for a master’s student of modest academic credentials.

I was living in Vancouver at the time and I remember having to jog around the block just to work out my nerves before the phone appointment.

What I didn’t expect was for all nervousness to disappear within the first ten seconds of our conversation. The deep, expressive voice on the other end was captivating, kind, and disarmingly friendly, with a habit of continuously dispensing brilliant ideas at breakneck speed. It was, to quote Douglas Adams, an “extraordinary eruption of information.” Simon went on to reiterate my PhD research proposal back to me in terms far more exciting and multidimensional than the draft I had sent him – something I would later come to know as a core aspect of his intellectual largesse. We briefly discussed our mutual admiration of Harold Innis before saying goodbye. Tempering my expectations, I quietly reminded myself that even if I wasn’t accepted to Cambridge, at least I’d had the chance to talk to Simon Schaffer.

Simon sent me another message a few months later when I arrived in Cambridge. It began simply with “hello there, welcome to fenland.” The greeting stuck with me and has drifted back to mind every so often in the years since – an early glimpse into a person whose brilliance is somehow matched by his unassumingly generous capacity to lift up the conceptual work of others. The more time I spend in academia, the more I have come to appreciate what a rare and wonderful thing it is to study with someone like Simon. He is a bright light within an often indifferent and lonesome line of work.

These early conversations from a distance remain memorable because it often seems that Simon is communicating from afar – not from lack of warmth or clarity, but rather due to his uncanny ability to see beyond everyone else’s perspectival limits (one is reminded of Vonnegut’s Tralfamadoreans, or perhaps the kaleidoscopic vision of the mantis shrimp). For me, this intellectual distance has only shrunk thanks to four years of Simon’s excellent mentorship. I’m certain I will never be able to take notes fast enough; figuratively speaking, I doubt that any of us will. But that’s not the point, and besides,

he would hate for us to linger on such a flattering and unpragmatic line of inquiry. The phenomenological reality of working with Simon is that I have never lost the feeling of excitement from that first phone call, yet somehow I find myself looking forward to every meeting and every conversation more than the last. The word magic comes to mind. I'm sure the feeling will carry on forever.

# Simon Things

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KATY BARRETT AND SOPHIE WARING

## Intro

As PhD students on the Longitude project, working in HPS 2010–2014, we were lucky to have Simon’s support on an additional range of projects focused on material and digital culture.

The “Things” seminars at CRASSH focused on a series of types of object as a way into an area of history, leading to conferences in Cambridge and Los Angeles considering the material culture of enlightenment arts and sciences.<sup>1</sup> The “Papers of the Board of Longitude” made key archives at the Cambridge University Library accessible through short summaries and essays introducing digitised materials.<sup>2</sup>

Both since moving into curatorial careers, we felt a series of “Things” that we associate with Simon would be appropriate additions to this volume, here rendered through short museum-style labels.

## The Comfy Chair

“Do have the comfy chair,” Simon would say on you entering the office for a supervision. We students rapidly discovered that this chair was anything but. Springs sticking out, lumpy padding, an oddly tight seat for what looked a wide and welcoming back, the chair in fact contributed to keeping you alert for discussion. The least uncomfortable spot to perch kept you, literally and metaphorically, on the edge. Only with confidence did we each ask Simon the reason behind this untruth: to see how long we would take to challenge him.

<sup>1</sup> Adriana Craciun and Simon Schaffer, eds., *The Material Cultures of Enlightenment Arts and Sciences* (London: Palgrave Macmillan, 2016).

<sup>2</sup> “The Papers of the Board of Longitude,” accessed 1 March 2022, <http://cudl.lib.cam.ac.uk/collections/rgo14/1>.

## The World on Fire

A legend within the history of science department: the day Simon set his waste bin on fire. Latterly known to frequent the courtyard garden for a regular smoke – and the opportunity to catch colleagues and students in passing – previous smoking in the office led to a smouldering butt, conflagration, the building evacuated, and the ever-to-be-feared telling-off from Tamara.

## Technologies of Print

Simon's ability to absorb and retain information is famous. Often describing himself as a "peasant with a photographic memory," as students we watched in awe as he absorbed an essay page by page directly as it came off the printer. Words agonised over late into the night, were picked up and lightly tweaked to a better turn of phrase, a more complete line of thought. I often couldn't throw away the pages printed and discussed in this way, even if carrying no additional notes, as if the material presence of this exchange might be imprinted in the paper and transfer itself to me through proximity.

## The Perfect Bun

Supervisions over coffee in Fitzbillies. The cinamony smell of the legendary Chelsea Bun leading to crisp but doughy pastry, gooey currants, warm sugar. As students we negotiated temptation tempered by practical considerations and the distraction of sticky fingers while attempting to make notes. Inevitable mess ensued on the slaved-over chapter or sample writing. The smell of Fitzbillies always brings back the sense of a world being unlocked so patiently, so generously, by one of the greatest minds you'll meet. We learnt to go through and interpret our notes immediately after discussion before understanding faded and links drawn clearly by Simon quickly became obscure. Sensory memories persist in the bun marks on old notes.

## Wisdom in a half pint

Even more challenging was the attempt to navigate supervisions in the pub. At what time of day is it reasonable to have a pint rather than coffee? Realisation dawned on supervision two or three that the attempt to keep up with Simon's thoughts – the patient spelling of authors, opening up of new avenues of thought – was rendered impossible by the addition of even half a pint to your galloping brain.

Later we would watch Simon's handling of a half pint: the quick turn of the wrist to pour the half into the partially drunk previous pint, the evolution of one pint to more over an evening of rich discussion, through half pints added. Let alone, the almost impossibility of ever managing to buy Simon a drink!

### The Eternal Phrases

We all know Simon's enviable generosity with learning. Two memorable phrases repeated in meetings, supervisions, seminars, folding you into an assumption of shared knowledge. "As you know better than I" showing deference to the speaker's expertise, followed by a piercingly accurate new way of thinking. The occasional kind, offhand spelling of a name or concept to follow.

"Teaching you to suck eggs:" the phrase that always conjured memories of painting eggs for Easter with my grandmother (although hard-boiled rather than sucked). The complete confusion of our American post-doc as to what this phrase meant, hardly relieved by explaining the normal addition of "your grandmother."

### The Air Pump

Only known to us as a discipline-defining author before applying to study for the PhD, it is hard to think about Simon without (Leviathan and) the air pump. Always conceived through Boyle's famous printed image, the pump's glass vessel resembles a bubble: an image that would haunt my ongoing research into longitude, projecting, bubbles of ideas, knowledge and investment. These are always further connected in my mind to Simon's treasured pack of replica "Bubble Cards" produced in response to the South Sea Crisis of 1720, filled with visual and linguistic puns. The regular amazement at discovering that every new avenue of thought you might excitedly discover, Simon had been there before and could help to guide.

# The Aeolipile at the Aquila (aka, The Eagle)

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LIBA TAUB

Simon Schaffer is renowned for his work exploring methods of knowledge production and societal factors related to different knowledge systems. He has also produced path-

breaking work on scientific instruments. At home in Cambridge, he is especially well known for his lively conversations – often held at The Eagle – and his provocative questions. Over many years, Simon has played crucial roles in the Whipple Museum of the History of Science, curating and collaborating on exhibitions, advising on acquisitions and other museum matters, supervising student and post-doctoral research and providing crucial support for the work of the Whipple, through chairing the Museum Committee and being a vocal advocate for the cause.

One particular instrument in the collection of the Whipple Museum of the History of Science, an aeolipile, probably dated to the late eighteenth century and acquired in 2007 (Wh. 6127), encapsulates and highlights many of Simon's ac-

ademic interests and activities: knowledge production, social interactions and scientific instruments, including those used for demonstration.

The name “aeolipile” is a hybrid, formed from the name for the Greek responsible for the winds – Aiolos – and Latin word for “ball,” *pila*, especially associated with games. Thus, an aeolipile (sometimes spelled aolipile) means “the ball of Aiolos,” and carries the



FIGURE 1. • Aeolipile, brass, probably late 18th century. Length 177mm; width 135mm; height 187mm. Wh. 6127. Image © Whipple Museum of the History of Science; reproduced with kind permission.

suggestion of the possibility of excitement and maybe even entertainment.<sup>1</sup> The Whipple's aeolipile is in three separate parts: a hollow, spherical receptacle (a ball) with a long, curved neck coming from its top, through which it would be filled with water; a carriage with three wheels, forming the support in which the ball-shaped receptacle sits; a fuel container which sits in the carriage so that the source of heat is directly below the receptacle. The aeolipile is intended to show the effects of steam under pressure. When the fuel heats the water in the receptacle to boiling, steam is expelled from the hole in the receptacle, causing the carriage to move.

The Roman architectural author Vitruvius (1st century BCE; Book 1, chapter 6, section 2) described the aeolipile:

Eolipiles [*aeoli pilae* or *aeolipilae*] are hollow bronze balls, with a very small opening through which water is poured into them. Set before a fire, not a breath issues from them before they get warm; but as soon as they begin to boil, out comes a strong blast due to the fire.<sup>2</sup>

What were aeolipilae for? Vitruvius describes the aeolipile within his discussion of city planning, and the need to arrange the walls, streets and alleys to shut out noxious winds. He explains that wind “is a wave of air flowing with uncertain currents of motion,” and “rises when heat strikes moisture and the onrush of the force presses out the power of the breath of the blast.” The aeolipile offers a demonstration of how the heating of air produces wind, for when seeing an aeolipile in action, “thus we may know and judge, from this small and very brief spectacle, about the great and immense causes of the nature of the sky and of the winds.” Notably, it is the “craftsman’s invention of things which express the divine truth, about the causes which lurk in the heavens.” In other words, the aeolipile is a device used to demonstrate a particular understanding of a physical phenomenon; it allows us to know and judge explanations of wind. By some definitions, this would

<sup>1</sup> In the *Odyssey* (10.19ff.) the god Zeus made Aiolos, a mortal, responsible for all of the winds, secured in a sack. Aiolos only released the West wind to enable ships to be blown safely on journeys. When some of Odysseus’ men, hoping that Aiolos’ wind-bag actually held treasures, untied the string closure, they let loose the gusts, causing a terrible storm that swept them away. Control of weather has great symbolic value.

<sup>2</sup> [Vitruvius] *Vitruvius: The Ten Books on Architecture*, trans. Morris Hicky Morgan (Cambridge MA: Harvard University Press; London: Humphrey Milford, Oxford University Press, 1914), accessed 13 February 2022 via Perseus Project <http://data.perseus.org/citations/urn:cts:latinLit:phi1056.phi001.perseus-eng1:1.6.2>. Heron of Alexandria (fl. 62 CE), in the *Pneumatica*, provided instructions to make a ball which used two jets of steam to rotate ([Heron] *Heronis Alexandrini opera quae supersunt omnia, vol. 1, Pneumatica et automata*, ed. Wilhelm Schmidt (Stuttgart: Teubner, 1899), 228–33; *The Pneumatics of Hero of Alexandria*, trans. Bennet Woodcroft (London: Charles Whittingham, 1851), 72. Hermann Diels, *Antike Technik* (Osnabrück: Otto Zeller, 1965), 58–62, esp. 58 n. 4 and F.M. Feldhaus, *Die Technik der Vorzeit, der geschichtlichen Zeit und der Naturvölker* (Leipzig: Wilhelm Engelmann, 1914), 26–27, s.v. “Aeolipil” and “Aeolsball,” both distinguish between the object described by Vitruvius and that in the *Pneumatica*. Some, including Marie Boas, “Heron’s Pneumatica: A Study of Its Transmission and Influence,” *Isis* 40, no. 1 (1949): 38–48, regarded Heron’s device as “the basis of the earliest attempts at steam-engine design,” but for a different view see Paul Keyser, “A New Look at Heron’s ‘Steam Engine,’” *Archive for History of Exact Sciences* 44, no. 2 (1992), 107–24.



FIGURE 2. • Aeolipile depicted in Jean Antoine Nollet, *Leçons de Physique Expérimentale* (Paris: Chez Les Freres Guerin, 1749-1764), vol. 6, Leçon XII, Pl. 2, fig. 6. Image © Whipple Library; reproduced with kind permission.

qualify as a scientific instrument, and Morgan's slightly more free translation conveys this understanding: "this is the fact we may learn from bronze eolipiles, and thus by means of a scientific invention discover a divine truth lurking in the laws of the heavens."<sup>3</sup>

As knowledge of Vitruvius' work proliferated via numerous translations into European languages as well as different Latin editions, various early modern natural philosophers – including René Descartes (1596–1650), Marin Mersenne (1588–1648), and Robert Boyle (1627–1691) – used the aeolipile in different ways, including as a model of wind and as a device involved in the determination of the weight of air.<sup>4</sup> Similar devices were built in the late eighteenth century and aeolipiles featured in cabinets of curiosities. The Whipple's aeolipile is the type depicted by Jean-Antoine Nollet in his *Leçons de Physique Expérimentale*.<sup>5</sup> The frontispiece amply displays the social appeal of a well-stocked physics cabinet, and Nollet was also involved in equipping Voltaire's at Château de Cirey in the 1730s. Within the salon setting occupied by the Marquise du Châtelet along with various guests and philosophes, Nollet's instruments epitomised the dual role of these objects, as both ornamental and epistemic.<sup>6</sup> We can easily understand the wish to have

<sup>3</sup>[Vitruvius], *Vitruvius On Architecture*, trans. Frank Granger (Cambridge MA: Harvard University Press, 1931), 54–55, slightly amended. Morgan translation, *Vitruvius*.

<sup>4</sup>Craig Martin, "The Aeolipile as Experimental Model in Early Modern Natural Philosophy," *Perspectives on Science* 24, no. 3 (2016): 264–84.

<sup>5</sup>Jean Antoine Nollet, *Leçons de Physique Expérimentale* (Paris: Chez Les Freres Guerin, 1764), vol. IV, Leçon XXI, Pl. 2, fig. 6.

<sup>6</sup>Jean-Francois Gauvin, "Functionless: science museums and the display of 'pure objects,'" *Science Museums and Research* Spring 2016 ,10.15180/ 160506, accessed 13 February 2022, <http://journal.sciencemuseum.ac.uk/browse/issue-05/functionless/>; Jean-Francois Gauvin, "Le cabinet de physique du château de Cirey et la philosophie naturelle de Mme Du Châtelet et de Voltaire," in *Emilie Du Châtelet: Rewriting Enlightenment Philosophy and Science*, ed. J. P. Zinsser and J. C. Hayes (Oxford: Voltaire Foundation, 2006), 165–202.

at least one aeolipile in an eighteenth-century physics cabinet, as wind and weather physics continued to be a concern.<sup>7</sup> An aeolipile currently in the collection of the Musée des Arts et Métiers (CNAM Inv. 01619), was part of the cabinet of the physicist Jacques Alexandre César Charles (1746–1823), well known for his interests in gases.<sup>8</sup>

In antiquity, the aeolipile may have been made and used for entertainment at symposia, those renowned ancient drinking parties. Heron of Alexandria and others described devices constructed for such purposes, and there is also some archaeological evidence (for the water-organ, trick drinking cups and other entertaining things). But symposia were not only held purely for entertainment; or, at least some of the entertainment was intellectual, the sort one might encounter at the Eagle.

Plutarch, in his *Quaestiones Convivales*, asks what are appropriate topics for discussion at drinking (and dinner) parties. He and a number of other ancient authors have given us accounts of the settings and circumstances in which scientific ideas were discussed. In particular, Plutarch and Athenaeus (the latter in *The Deipnosophistae*, i.e., *The Dinner Sophists*) provide fictionalised accounts of such conversations – the “table talk” of symposia. While Plutarch’s question is somewhat joking, the sympotic conversations he recounts were intellectually challenging,



FIGURE 3. • Frontispiece, Jean Antoine Nollet, *Leçons de Physique Expérimentale* (Paris: Chez Les Freres Guerin, 1749), vol. 1. Bamberg, Staatsbibliothek, Bip.Phys.o.9(1).

<sup>7</sup> Martin, “The Aeolipile as Experimental Model.”

<sup>8</sup> CNAM Inv. 01619: <https://artsandculture.google.com/asset/aeolipile-on-a-chariot/OQGeWWfSF6R-9g>. Another aeolipile, similar to that in the Whipple, is in the collection of the Physics Museum of the University of Coimbra, from Colégio dos Nobres, catalogue no. 257, <http://museu.fis.uc.pt/80ing.htm>. Accessed 14 February 2022. Oliver Goldsmith (1730–1774), in *An History of the Earth and Animated Nature*, 8 vols, new edition (London: F. Wingrave, 1791), 314, was apparently not wildly impressed by the aeolipile: “This is nothing more than a hollow copper ball, with a long pipe; a tea-kettle might be readily made into one, if it were entirely closed at the lid, and the spout left open.” He did explain its use, as a model of wind: “through this spout it is to be filled with water, and then set upon the fire, by which means it produces a violent blast, like wind, which continues while there is any water remaining in the instrument. In this manner water is converted into a rushing air.” Accessed 13 February 2022, <https://wellcomecollection.org/works/gbdwa3wj/items?canvas=340>.

as well as entertaining, rather like being at Simon's table. The physical settings of such symposia were not always indoors; they sometimes took place in gardens, again reminiscent of well-known sites of Simon's symposia. And, whilst it may be argued that some of these ancient conversations reported to us had an educational or intellectual ambition, the settings and circumstances were certainly intended to foster social interactions as well.

The accounts of ancient sympotic conversations are in some cases linked to other written texts, some of which incorporated mathematical problem-poems and riddles. Throughout, we notice that the scientific discussions are suffused with inquiry and puzzling things out. There is evidence that special objects were constructed for demonstration at symposia. For example, some described by Heron of Alexandria and Philon of Byzantium (fl. 200 BCE) may have been designed for use, literally, as conversation pieces, that were not only puzzling but entertaining. These objects were meant to foster and promote enquiry, discussion and debate.

We have descriptions of objects designed to serve suitable proportions of wine and water described in Heron's *Pneumatics* and also a seemingly inexhaustible *kratēr*. In some of these objects the flow of liquid would appear to be "contrary to nature" (*para physin*), and symposiasts' expectations of how liquids act would have been challenged. Like the arithmetical problem-poems and riddles, these objects would have been part of the performance culture of the symposium, perplexing yet amusing. Such thought-provoking objects would have provided special opportunities for piquing curiosity, raising questions and engaging in further conversation.

The aeolipile may have been such a curiosity, designed to spark conversation, especially as it moved across the symposium table spouting steam. However, according to Vitruvius' account, it seems to have had a more serious purpose: the aeolipile would have contributed to shared knowledge production. The aeolipile was used to "ascertain and determine the causes and effects of the great operations of the heavens and the winds." The "brazen aeolipylæ . . . clearly shew that an attentive examination of human inventions often leads to a knowledge of the general laws of nature."<sup>9</sup> Simon has shown us that while active powers might be understood as coming from machines themselves, "demonstration devices were designed to teach truths about nature."<sup>10</sup> The Whipple's aeolipile may be an eighteenth-century "reconstruction" of the device described by Vitruvius, a device that would likely have been used to demonstrate truths about nature to a group of people engaged in erudite and entertaining conversation, whilst sharing other sorts of refreshment. Perhaps this should not surprise us, as Simon has always reminded us that knowledge production, is, fundamentally, a social activity.

<sup>9</sup> [Vitruvius] *The Architecture of Marcus Vitruvius Pollio*, trans. Joseph Gwilt (London: Priestley and Weale, 1826), accessed 14 February 2022, [https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Vitruvius/1\\*.html](https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Vitruvius/1*.html). In the case of Vitruvius, the aeolipile was used to demonstrate weather phenomena (wind).

<sup>10</sup> Simon Schaffer, "Natural Philosophy and Public Spectacle in the Eighteenth Century," *History of Science* 21, no. 1 (1983): 1–43; Simon Schaffer, "Machine Philosophy: Demonstration Devices in Georgian Mechanics," *Osiris*, 2nd series, 9 (1994): 157–82, on 159.

# Chapeau!

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LUDMILLA JORDANOVA

Dear Simon,

You're retiring! Or should I say "retiring?" It's a chance for those who love, admire and respect you to wish you well, and to express their hope that the next phase of life is long and rewarding. I can't remember when we first met. It must have been at some point in the 1970s, during what I think of as the heady days in HPS, full of earnest, impassioned discussions, fierce ideological conflicts and idealistic aspirations for what the history of science could achieve. No one has done more to fulfil those aspirations than you, and you have done this on many stages in the academic world and beyond. Chapeau! It has always been such a pleasure to talk with you, no matter what the subject, to be in meetings with you, no matter how tricky, and to read your work – always exhilarating. Your work for the Science Museum Group has touched me most immediately in recent years. It was a special honour for me to follow you as a trustee since you demonstrated so brilliantly the value of having historians of science as critical friends. There are still challenges ahead that we could not have anticipated half a century or so ago, challenges that make the history of science, undertaken in the fashion you exemplify, more important than ever. Thank you for everything.

Much love, Ludi (who is indeed "retired")

# Binding the history of science and museology

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ROBERT BUD

Not least among Simon Schaffer's many contributions to the history of science has been the work he has done to bind the discipline closer to museology. There is, of course, a long and honourable association between science museums displaying the material culture of science and its past, on the one hand, and, on the other, the study of the history of science and technology. Collections such as the Whipple Museum in Cambridge and the Museum of the History of Science in Oxford have been curated by distinguished scholars. The National Museum of American History, formerly the Museum of History and Technology, has been staffed by such luminaries as Robert Multhauf, and other national, university, and private museums worldwide can claim a similar distinction. The Artefacts consortium, now running for a quarter of a century, has met annually and produced many important volumes.<sup>1</sup>

All too often, however, the practice of curatorship has still been divided between connoisseurship of the object on the one hand and, on the other, academic study divorced from the museum, its artefacts and visitors. For their part, many academic historians have neglected the specific potential of the museum. Simon has broken with this past neglect by building closer bonds with numerous institutions. He has been an enthusiastic contributor to pioneering museum exhibits: at the Whipple in such displays as *1900 the New Age, No Ise*, in Cambridge, *Ships, Clocks and Stars* at the National Maritime Museum or several at the ZKM in Karlsruhe, such as *Making Things Public*. I should also like to emphasise the value of his support for research at the Science Museum, where he has served as a trustee, member of the Journal's editorial committee, a valued member of the museum's advisory committee and advisor on several exhibitions.

The linkage between scholar and exhibit has been more than bureaucratic and curatorial. Simon's interests have been so varied and the contributions so numerous that it is necessary rather than invidious to point just to one. His work with Steven Shapin on *Leviathan and the Air-Pump* has seemed most significant for this museum curator. That early work pointed to the ways in which the materiality of Boyle's experiments mattered to the historian and, also, to the importance of the gentleman witnesses. Subsequently,

<sup>1</sup> See the website [www.artefactsconsortium.org](http://www.artefactsconsortium.org).

the discipline came to pay considerable attention to the material culture to which museums are devoted. I can well recall the importance of *Leviathan and the Air-Pump* to the 1992 Toronto meeting “History of Laboratories and Laboratory Science,” now an obvious topic, then a symbol of radical change.

However, the discipline has paid rather less attention to museums’ other distinguishing feature, their engagement with lay visitors. Those enthusiastic hordes have shown urgent interest in the experiences of people like themselves. While historians have explored the “popularisation of science,” only rarely have they followed the consequences of lay curiosity into the heart of their subject. Most have focused on professional, scientific communities, and the lay reader would find few people like themselves in the pages of most of the scholarly historiography. Many popular science books have resolved the disjuncture by appealing to inspiring mythos and have celebrated the scientist as a more or less isolated heroic figure fighting convention and the mundane.<sup>2</sup> In contrast, specialist scholars have routinely contextualised the same scientists, representing them as members of communities. The result has been perhaps a stand-off between the two genres of historical literature.<sup>3</sup>

The history of medicine, both as a scholarly endeavour and subject of television and writing, has taken a quite different trajectory. There, successful books and programmes take an interest in the patient and in the interaction between the lay and expert worlds. Scholars have been intrigued by the challenges of understanding the hybrid cultures that have populated our societies, and academic historians have been interested in how users engage with medicine. Recent experience has highlighted the importance of public attitudes to vaccines. However, the topics of personal health care, pharmaceuticals and public health have long been important, dominating the list of thirty-six works in the *Isis cumulative bibliography* dealing with “public trust” in the twentieth century. The issue offers historians concerned with the museum visitor rich opportunities to study and display. The linkage between trust in institutions, in respected individuals and in technologies still remains to be explored. How and why incomprehensible but science-based pregnancy tests, whether shape-changing fish of the 1930s or the monoclonal antibodies of today, are trusted – effecting life-changing new perspectives – would make an important temporary exhibition. In the wake of the Grenfell tower enquiry, the 2003 American doctoral thesis dealing with fire, technology and trust in modern America has a special

<sup>2</sup> Ludmilla Jordanova, “On Heroism,” *Science Museum Group Journal*, 1 (2014) <http://dx.doi.org.libproxy.ucl.ac.uk/10.15180/140107>; Rebecca Higgitt, “Challenging Tropes: Genius, Heroic Invention, and the Longitude Problem in the Museum,” *Isis* 108 no. 2 (2017): 371–80; Roger Highfield, “Heroes of Science”, Wilkins-Bernal-Medawar Lecture, The Royal Society, 26 September 2012, <https://www.youtube.com/watch?v=1ESLUu3SA4M>.

<sup>3</sup> David Philip Miller, “The ‘Sobel Effect’: The Amazing Tale of How Multitudes of Popular Writers Pinched All the Best Stories in the History of Science and Became Rich and Famous While Historians Languished in Accustomed Poverty and Obscurity, and How This Transformed the World ...,” *Metascience* 11 (2002): 185–200.

interest.<sup>4</sup> It suggests the great opportunities that still lie beyond the history of medicine for historians and museum curators to explore a material culture of consummate importance to the citizen and the specialist.

Issues of trust are just one category of concern lying between the areas of belief of the “reasonable” citizen and the cloistered expert. Others identified by historians I have classified as belief and awe. Anthropologists of medicine in Europe and America have been interested in the belief systems of their neighbours. Thus, Cecil Helman’s 1978 paper “Feed a Cold and Starve a Fever” examined the folk models of infection he had encountered as a GP.<sup>5</sup> Historians of science have come to look at public belief in evolution. Museums can do much more. Numerous scientists such as Francis Crick and Jacques Monod have emphasised their engagement with what they consider to be popular misconceptions and their responsibility to correct them.<sup>6</sup> The work done by scientists to encourage lay belief in human-caused climate change has been a remarkable feature of science in the last quarter-century.

Public engagement with science is most obviously associated with the spectrum linking admiring awe to terrifying fear engendered by science and its findings. The seventeenth-century French thinker Blaise Pascal famously admitted, “The eternal silence of these infinite spaces frightens me.” At the same time, the remarkable images rendered by telescopes from Galileo in the seventeenth century to Herschel and Lord Rosse in the nineteenth, to Hubble and the James Webb Telescope today has awestruck citizens the world over. Many responded to the 1945 atomic bomb with a combination of awe and fear, renewed by the spectres of both nuclear weapons and fusion-sourced energy. Such issues have engaged the public obsessively.

This perspective offers new opportunities for studying the past of science, technology and medicine that could inform exhibitions addressing the wish to identify held by millions of visitors. Through his career, Simon Schaffer has inspired interests in pushing the boundaries of the discipline. Not just through museums but also television, he has addressed new audiences. As a result, future generations of historians have an opportunity to stand on broad shoulders.

<sup>4</sup> Scott Knowles, “Inventing Safety: Fire, Technology, and Trust in Modern America” (PhD diss., Johns Hopkins University, 2003).

<sup>5</sup> Cecil G. Helman, “Feed a Cold, Starve a Fever’ — Folk Models of Infection in an English Suburban Community, and Their Relation to Medical Treatment,” *Culture, Medicine and Psychiatry* 2 (1978): 107–37.

<sup>6</sup> Jacques Monod, *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*, trans. Austryn Wainhouse (London: Collins, 1970); Francis Crick, *Of Molecules and Men* (Amherst, NY: Prometheus Books, 2004).

# Experiments and Demonstrations in Radical History

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JENNIFER TUCKER AND DAVID SERLIN

In 2014, we proposed a theme issue of the *Radical History Review* on the topic of “Political Histories of Technoscience.” As we began to imagine what an issue might look like and what (and who) such an issue would include, both of us agreed immediately on two things: 1) we should invite an esteemed historian of science and technology to join us in conceiving and editing the issue, and 2) that person should be Simon.

We invited him to join us as a co-editor.

Reader, he said yes.

Jennifer first met Simon in 1986 as an undergraduate biology student at Stanford who was specializing in neuropsychology of vision and perception. Jennifer’s undergraduate advisor at the time, neuroscientist Brian Wandell, loaned her Svetlana Alpers’s book *The Art of Describing*, which fascinated her and led to taking a history of science course with Peter Galison, where she encountered Simon’s research and his brilliant article “Natural Philosophy and Public Spectacle in the Eighteenth Century, 1760–1820.” Shortly after, Jennifer spent a few weeks in the UK to conduct senior thesis research on issues of seeing and representation in seventeenth-century English microscopy. She spoke with Simon by phone during her first week in England; Simon told her that the following week the Royal Society would be holding a conference on Robert Hooke and microscope at Carlton House Terrace in London and encouraged her to take a train down and join the proceedings.

Encountering this lively history of science community and exchange of ideas led Jennifer to a full conversion to become a historian of science – a decision that changed the course of the rest of her life. A few years later, Jennifer completed a MPhil in History and Philosophy of Science (hereafter HPS) supervised by Simon and Jim Bennett. At Cambridge she met many of Simon’s students, including Iwan Morus, Richard Staley, Alison Winter, Emma Spary, Shelley Innes, Jeff Hughes, and Adrian Johns. Long, inspiring, often challenging, HPS conversations about history of science took place in Free School Lane and the University Library as well as in pubs, curry restaurants, house parties, punt trips and gardens, across Cambridge.

David did not meet Simon in person until 2016 but had first encountered Simon’s work twenty-five years earlier as a graduate student at NYU. He had started working on a PhD under the direction of Andrew Ross and Dorothy Nelkin on a cultural history of

medical technologies developed during the 1950s as artifacts and mediums of Cold War technoscience. David remembers Andrew recommending *Leviathan and the Air-Pump* as an example of how to read material culture differently than texts or images since they are artifactual rather than representational. He remembers lights going off in his head and thinking: *this* is the kind of scholarship I want to do.

Like Jennifer, David was soon converted to the cause; and, as with Jennifer, Simon's work became for him a model for how to bring together the best of humanities and sciences. They both marveled at how Simon could put often disparate thematic and epistemological elements into dialogue (what Claude Lévi-Strauss called "unexpected affinities"), then tie them all together through a powerful narrative voice. Simon's example also served David professionally: when he arrived as an assistant professor at UC San Diego in 2004, David found Simon's influence was everywhere, especially in the organization and activities of the university's interdisciplinary Science Studies Program. Indeed, Simon's work was taught and referenced regularly by faculty and graduate students, found on undergraduate syllabuses and the bibliographies of dissertations alike. Not every historian of science produces work that affects conversations across the social sciences, natural sciences, and humanities. Yet that is precisely the case for Simon, and those conversations capture the influence of Simon in his totality.

Throughout 2015 and early 2016, the three of us worked in earnest via email and telephone co-editing our issue for the *Radical History Review* (the ubiquitous presence of Zoom was still a few years away). In summer 2016, with only a few months before submitting the final manuscript, Simon invited us to Cambridge to finalize the issue and co-write our Editors' Introduction. He installed us in rooms in Darwin College for a few days and plied us with good pub grub and beer while we got down to business. As ever, Simon's enthusiasm, wit, and polymath knowledge helped us shape the contents of the issue, occasionally transforming scraps into a veritable banquet. After one long morning of collaborative writing, Simon gave us an impromptu tour of the Whipple Museum. The collection itself is a marvel – globes and orreries, early navigation devices, clocks and other timepieces, scientific instrumentation and notes on the instruments' makers, photographic and optical toys, and varieties of mechanical wonders – but Simon's walk-through narration breathed life into the objects as he shared everything from describing earlier exhibitions of the objects to back-room debates about their future dispositions.

Walking through the Whipple's exhibitions reminded us in very material ways about one significant dimension of Simon's identity: his public profile and his translation of history of science into accessible forms for multiple audiences. Simon captivates listeners with stories that make you feel like whomever and whatever he is talking about is in the same room, and that we ourselves are virtual witnesses to those same people and objects. This is because he takes an ecumenical approach to the work of the historian, giving precise attention to social and political relevance even if it is way outside of the usual or conventional. Through his collaborations with museums and public venues, and across different media – from radio to TV to film to magic lantern shows and lectures – Simon has given shape to how the public understands the place of science in triumphant

histories of human ingenuity as well as in less triumphant (and always present) parallel histories of power and control and the political and economic transformations that were galvanized by such histories.

Our trip to Cambridge – ostensibly to give closure to the edited journal, and also to celebrate its completion after a long gestation period – reminded us of Simon's effect on generations of students, both through his radically influential scholarship as well as through his unique combination of spontaneity, humor, generosity, imagination, and above all his kindness. Perhaps this is why, when we all converged, there was a shared sense of exploration that was palpable for all three of us. It had the excitement of being back in graduate school, with three students trying to work things out for a presentation or a workshop.

Like the seventeenth- and eighteenth-century scientists whose laboratory equipment form the core of the Whipple's collections, Simon and his colleagues at the HPS have built something extraordinary: a place where worlds old and new are discovered as well as rediscovered; a place where experiments and demonstrations in radical history are nurtured and paid forward; a place where friends and colleagues can live a life of the mind without ignoring the pleasures of the stomach or the resolve of the heart.

Thank you, Simon, for showing us how it's done.

# A Letter of Appreciation

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SARAH DRY

Dear Simon,

You've written so many letters for me over the years and in the process helped me to do so many things – to get internships, postdocs, jobs, funding and more besides. It's about time I write one for you!

I feel the need to start, as ever, with your writing, which I've been reading as long as I've been a student of history of science. I read your work as a master's student before we met, continued to read it while I was your PhD student and have never stopped reading it. From your writing I've learned a lot of what I know of the history of science but I've also learned something more elusive and more interesting which is how to do, or write, or think about the history of science. It's not easy to put into words, but if I think hard, close my eyes, and try to make explicit the fundamentals of the lessons I've learned from you over the years, I come up with this: you showed me what productive restlessness looks like, and how it is possible to be simultaneously trouble-making and definitive. That's a hard trick to pull off and an even harder one to keep pulling off. It takes energy, at a bare minimum, plus a combination of playfulness and serious intent, and finally the ability to remain curious and open to the world while being disciplined and persistent enough to deliver on moments of inspired insight. I'm still learning, of course, but of course that's part of the fun, and part of the example you've set. We finish some projects (thank god we do) but we are never done with projects and that ongoingness is part of the joy of doing history, a quality of the work that happens also to be an attitude towards the nature of knowledge, the promise of a thing that can never be finished.

I've learned this from you, you might say, by observing rather than engaging, from reading rather than speaking. There's more to offer my appreciation for. Closer up, I've benefitted, as have so many others, from the gift of your talk, by which I mean to say your friendship and support, including but extending well beyond those letters of reference, to many votes of confidence, meetings and calls during which I asked you for your advice or your reassurance or your guidance. I know you have given this kind of support not only to me but to so many students over many years, which makes your generosity even more remarkable. We are a lucky crew.

I've hidden the phrase "vote of confidence" in that previous sentence, but of course that has been the greatest gift, to find in myself the image of the scholar you reflect back to me, both by your example and by your support. I feel so lucky to have been able to learn from you all these years, and simultaneously to be your friend, and, now, with the luck of the Making Climate History project, to be your colleague too. Thank you, Simon, for that, and for so much else that is hard to put into words but as with so much of the history of science, no less – but more! – important for being so.

Here's to you – to all that you've achieved, all that you've given and all that is still to come.

Love,

Sarah



# NETWORKS AND NORMS



# Simon, my fountain of knowledge

BRUNO LATOUR



In the early days, so many things to laugh about ...



Simon and Anita in 2005 with the optical instrument he had asked us to make again for the Making things public show to demonstrate Hobbes' hidden allusion to Father Niceron's visual trick! One of those moments when you need to go to Cambridge to get to the source of the fountain of knowledge called Schaffer.



At the Cini foundation in 2017 for the Body Politic dialog presided over by Simon with his usual maestria when we both sit at the big table not exactly sure who is playing Jesus.



Simon in digitally produced plaster cast made by his good friend Adam Lowe at Factum Foundation before being made in bronze!



And finally, but there is never any end, the pleasure to think and to think again, this time in Paris in September 2021 just as it was so many years ago.



# Simon Schaffer in France

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FRÉDÉRIQUE AÏT-TOUATI

While many observers can attest to Simon Schaffer's daily presence at Free School Lane since the mid-1980s, it seems that he has simultaneously had a rich intellectual life on the continent. His influence is attested to at the École des Hautes Études en Sciences Sociales, the Sorbonne, the Collège des Bernardins and as far afield as Venice. He has given the prestigious Marc Bloch lecture, courses at Sciences Po, and seminars at the Koyré Centre. Above all, he irrigated the French history of science, even though it is not well known for its STS leanings. How can we explain such duplication, such mysterious influence? How did this central voice in the Anglo-Saxon world make itself heard so strongly in the land of epistemology? Through which networks, channels and techniques? Did Adam Lowe manage to scan Simon Schaffer to offer the French intellectual world his





avatar? Has some genius engineer turned him into an automaton? Should we believe in the power of facsimiles?

This brief note does not claim to answer this thorny question, which future historians will have the task of resolving. We will simply add a document to the file: this photograph taken at Bruno Latour's home in Paris, in which Simon Schaffer and Chloé Latour are discussing two bronze busts (those of Bruno and Chantal Latour, given on that very evening by Adam Lowe) exhibited on the mantelpiece, while Bruno Latour, seated in front of the same mantelpiece, is taking a photograph of a scene outside the frame.

One could go on at length about technical reproduction, immobile mobiles, the power of artefacts and the history of Anglo-French relations. But here I will simply point out that there are forces more powerful than national, generational or disciplinary boundaries. These hidden forces are friendship, admiration and intellectual generosity. Simon Schaffer, more than any other, cultivates them, to the point that his name (undoubtedly among the most quoted in the acknowledgements of books published in our field over the last 30 years), if we could follow it in all the texts, mouths and minds of the time, would draw the map of a new Europe savante.

# “Experimental lives” in the modern period: a view from Paris

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CHRISTIAN LICOPPE

In the early 1990s, Paris was an exciting place to be, especially if one happened to be interested in respecifying science and technology from a social science perspective. At the Ecole des Mines, Bruno Latour and Michel Callon had been developing actor-network theory. At the Cité des Sciences in La Villette, researchers such as Dominique Pestre and John Krige were training a younger generation of students and researchers to this new and exciting way of doing the history of science, opposing earlier, more “internalist” and epistemology-centered traditions. At the Centre Koyré at the Ecole des Hautes Etudes en Sciences Sociales, such a sociologically-minded approach was encountering other traditions of French historical research, such as Roger Chartier’s work on the history of books and reading. Of course Paris was not the only place in which things were happening. After all, Science and Technology Studies (STS) were emerging globally as an academic force, soon to create professional positions and whole departments. But Paris was still significant enough for many international researchers to visit. Simon was one of those, regularly coming to encounter Bruno Latour and Dominique Pestre, among others.

This was my first introduction to Simon. At the time, I had been a researcher in experimental physics for some time, very naive in all matters pertaining to social science and the humanities, but attracted enough by all this to start a Ph.D. project in history of science with Dominique Pestre. Because I wanted to study a kind of science which was far away from the type of experimental physics I had been practicing, I chose to look at French natural philosophy in the modern period. This proved “exotic” enough for me. Moreover, it allowed much room for my concerns with experiments and investigating what “experiments” might actually be about. Several colleagues mentioned that I might find it useful to read *Leviathan and the Air-Pump*, published a few years earlier, and not translated into French at the time.<sup>1</sup> The discovery of the book was indeed a shock, not only because of its obvious originality and depth, but also because I immediately found its emphasis on the combination of material, discursive (especially when it came to descriptibility and accountability), and social technologies (especially witnessing assemblages) immediately relevant to the French experimental accounts of the same period that I was

<sup>1</sup> Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton: Princeton University Press, 1985).

actively collecting at the time. For me, who was new to the historical field, it also framed the emergence of experimental natural philosophy in a broader historical perspective, standing against earlier and different “epistemic assemblages,” in which alternative theories would be proliferating, and be argued publicly in a disputational mode (something, which, by the way, echoes some of our contemporary concerns). The book thus provided me with both a research question and an intellectual basis from which to try to analyze the evolution in the production and accounting of experiments in the modern period. Somehow, I think of my own work on French natural philosophy, particularly for the seventeenth century and the early eighteenth century, as a tribute to *Leviathan and the Air-Pump*’s seminal analyses.<sup>2</sup> All of this also gave me the opportunity to start to meet Simon at one or the other of his sojourns in Paris. I remember him fondly as a sympathetic listener with a keen eye for my blunderings, and also as a constant provider of new and original ideas for research. I also attended some of his talks in Paris and remember being fascinated by his enthusiasm and persuasiveness in bringing new associations to light.

After bringing that project to fruition, and before leaving the field of history of science, I had another occasion to work more directly with Simon. It happened in the late ’90s. Simon was the driving force of a collective project regarding material technologies and instruments in the eighteenth century, with a focus on mobilities, circulation and travel, and he invited me to participate. It was characteristic of Simon’s professional generosity to refuse to be at the front and to insist that Marie-Noëlle Bourguet, Otto Sibum and I should edit the book which was the outcome of this joint project and workshop.<sup>3</sup> I remember his own contribution, linking together Boyle and Newton, balances and assays, the gold and the slave trade, and the colonial expansion in the Gulf of Guinea, as pure Simon in its breadth and audacity.<sup>4</sup> But it was also an occasion for me to come to Cambridge, and to experience at first hand Simon’s intellectual creativity and breadth of thinking in its natural habitat, so to say. I particularly remember a heated pub discussion, which was, as a French researcher more accustomed to discussing things at dinners (The French and their relationship to food ...), something both new and strange. Simon was vividly conjuring many “mobile” figures of relevance for modern natural philosophy. Pilgrims, in particular, have stuck with me, because it was a category I would not have thought to associate with “mobile” natural philosophy within my much narrower view.

Finally, I think the legacy of *Leviathan and the Air-Pump* is as relevant today as it was 35 years ago. As the book showed us, “matters of fact” are not only materially, discursively and socially constructed, but, because of that, they always constitute potential sites for political contest and controversy. Today, when even the very notion of controversy (or

<sup>2</sup> Christian Licoppe, *La formation de la pratique scientifique. Le discours de l’expérience en France et en Angleterre (1630–1820)* (Paris: La Découverte, 1996).

<sup>3</sup> Marie-Noëlle Bourguet, Christian Licoppe, & H. Otto Sibum, *Instruments, Travel & Science: Itineraries of Precision from the Seventeenth to the Twentieth Century* (London: Routledge, 2003).

<sup>4</sup> Simon Schaffer, “Golden means: Assay Instruments and the Geography of Precision in the Guinea Trade,” in *Instruments, Travel & Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*, ed. Marie-Noëlle Bourguet, Christian Licoppe and H. Otto Sibum (London: Routledge, 2003), 20–50.

rather the hope it will eventually resolve) is undermined by the belief that one could legitimately advance “alternative facts,” it is once more timely to invoke one of the book’s many lessons: we should always look at the way “matters of fact” are supported by collectives and practices, which they in turn reinforce. This is a powerful tool to navigate today’s debates, from climato-sceptics to anti-vax and various brands of conspiracy-mongers. Let’s investigate time and again, systematically and thoroughly, contemporary experimental lives and how today’s empirical claims are constructed, as well as the political interests of the collectives who coalesce in their design and their use.

# The French Simon Schaffer

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JÉRÔME LAMY

Simon Schaffer has special ties with France. During the preparation of his doctorate he stayed in Paris (spring 1980), consulted the archives of the Paris Observatory, worked at the Alexandre Koyré Centre and, every Wednesday, listened to the lecture of the philosopher Michel Foucault at the Collège de France.<sup>1</sup> Since then, Simon has been a regular guest in France. In June 2014, he delivered the prestigious Marc Bloch Lecture at the EHESS. His perfect fluency of French and his deep knowledge of the history of science “à la française” explains, at least in part, this Francophile tropism. But there is more. In this text, I propose to return to the various links that Simon’s work has with French historical and sociological research. To the extent that his own research is tinged with a discreet, but very noticeable “French accent.”

In the first part, I will discuss the influence of Michel Foucault on Simon Schaffer’s work. In a second part, I will explain how Simon responded to the theoretical proposals of the sociologist Bruno Latour. Finally, the third part will focus on the references to the *École des Annales* in his research. Drawing (among others) from these three sources (Foucault, Latour, the *Annales*), Simon has produced an original *œuvre*, informed by the French historiographical debates.

## The influence of Michel Foucault

Simon Schaffer followed Michel Foucault’s lectures at the Collège de France in the spring of 1980. That year, the French philosopher was working on “the government of the living.”<sup>2</sup> Foucault was exploring the regimes of truth, in particular the ancient and Christian techniques of truth-telling. Simon acknowledges that, a priori, there was no connection with the archives of the Paris Observatory, which he was examining at the same time. But he speaks of an “extraordinary brilliance.” Foucault’s influence on Simon Schaffer’s work is more direct in the article “Herschel in Bedlam: Natural History and Stellar

<sup>1</sup> Simon Schaffer, “Newton, les Sex Pistols et la pompe à air (1/2),” interview by Volny Fages, Jérôme Lamy et Arnaud Saint Martin, *Carnet Zilsel* (17 mai 2014), <https://zilsel.hypotheses.org/706>.

<sup>2</sup> Michel Foucault, *Du gouvernement des vivants* (Paris: EHESS, Gallimard, Le Seuil, 2012).

Astronomy,” published in *The British Journal for the History of Science* in 1980, which is the text of the lecture given at the Bath Colloquium in 1980, bringing together the Bath and Edinburgh schools.<sup>3</sup> Simon wanted to “juxtapose what [he] had read in *Les Mots et les Choses* [*The Order of Things*] with Herschel’s natural history. The colloquium wanted to question taxonomy, classification.”<sup>4</sup>

*Les Mots et les Choses* was published in 1967. Foucault described the different *epistémâi* delimiting coherent epochs in the way knowledge and its forms are considered.<sup>5</sup> In his article Simon Schaffer argued that Herschel had not “founded modern sidereal astronomy” but was conducting a “work (...) of a natural historian.”<sup>6</sup> Herschel had managed to isolate “a set of natural types – species – which had then to be arranged in orderly series connected by established physical law.”<sup>7</sup> In particular, the astronomer “used this discourse to isolate a set of nebular species, and then connected them together in a series linked through the agency of gravity acting through time.”<sup>8</sup> Simon Schaffer specified the borrowings he made from Foucault to carry out his investigation. Firstly, he adopted the idea “that classical natural history functioned as a discourse, and that therefore there may be no impropriety in characterizing as natural historical a set of practices not directed at the normal object of natural history;” he then “used his idea of a discourse as well-policed space of theory and practice, in describing which it is as important to discuss what could not be thought as merely to state what was thought.”<sup>9</sup> Here, Simon confronted the formidable paradox of *epistémâi* which, for Foucault, constituted coherent systems of ideas, but they also closed in on themselves and there was no possibility of communication between them. Simon explained that “Herschel both constructed and came to break with the discourse of natural history in the heavens (...).”<sup>10</sup> Simon thus analysed the evolution of Herschel’s ideas by following Foucault’s proposals on the history of science in the eighteenth century, centred on the search for “connected signifiers” and the reconstruction of an “order” of nature.<sup>11</sup> Herschel thought and reasoned in the register of natural history. His classifications and taxonomies were structured by this way of thinking. Thus, for Herschel, “the natural history of the heavens assumed the existence of a confused but continuous set of specimens, and, through an observational practice which could serve to transcribe these elements into an order, established the possibility and necessity of

<sup>3</sup> Simon Schaffer, “Herschel in Bedlam: Natural History and Stellar Astronomy,” *The British Journal for the History of Science* 13, no. 3 (1980): 211–39.

<sup>4</sup> Simon Schaffer, “Newton, les Sex Pistols et la pompe à air (1/2),” interview by Volny Fages, Jérôme Lamy et Arnaud Saint Martin, Carnet Zilsel, 17 mai 2014, <https://zilsel.hypotheses.org/706>.

<sup>5</sup> Michel Foucault. *Les Mots et les Choses. Archéologie des sciences humaines* (Paris: Gallimard, 1967).

<sup>6</sup> Schaffer, “Herschel in Bedlam,” 211.

<sup>7</sup> Schaffer, “Herschel in Bedlam,” 211.

<sup>8</sup> Schaffer, “Herschel in Bedlam,” 212.

<sup>9</sup> Schaffer, “Herschel in Bedlam,” 212.

<sup>10</sup> Schaffer, “Herschel in Bedlam,” 212–213.

<sup>11</sup> Schaffer, “Herschel in Bedlam,” 214.

ordering these specimens as separate but closely connected species, and the arrangement of these species in a series.”<sup>12</sup>

Herschel’s aim was not only to isolate single species, but to find a logic in the collection of different species discovered. Part of Herschel’s work was to try to relate the “planetary” nebulae to the “milky nebulae and star clusters.”<sup>13</sup> However, Simon noted, Herschel “accepted the necessity of a theory of central forces acting through time as the principle of connexion of the natural types of the series, rather than a visual similarity.”<sup>14</sup> The introduction of gravity into Herschel’s taxonomic system was indeed a “contradiction” – classification in natural history did not involve the use of dynamic forces.<sup>15</sup> Here we can see that Simon is a demanding, precise and nuanced reader of Foucault’s theses. By focusing on Herschel’s work, he documents the classificatory substratum of the classical *épistémè*.

In later work, the analyses of Foucault are very much present in Simon’s work. In his article “Self Evidence,” published in *Critical Inquiry* in 1992, Simon used the concepts proposed by Foucault in his 1975 book *Discipline and Punish*. The aim was to take into account the importance of the body of the scholar in experimental practice. Simon described his work

as a contribution to this ‘political anatomy’ of experimental philosophy. Here evidence is treated both as the result of certain theatrical rituals through which the person of the experimenter was integrated into public performances, and also as the result of the accreditation of experimenters’ stories by the public community of natural philosophy. Bodies are treated both as the objects on which experimenters worked and as the collective to which they belonged and from which they drew authority. These links between the privacy of the experimental trial on the individual body and the public warrant of collective authority can be clarified through the concept of evidential context, the proper implications of some trial. Experimenters who used their own bodies tried to shift the evidential context from the body itself to some wider natural philosophical concern.<sup>16</sup>

Electricity experiments in the eighteenth century involved the body of the experimenters, which implied a controlled theatricality of the public demonstration.

Similarly, *Discipline and Punish* provided the backdrop for Simon’s article on Babbage and his machine industry. This time it was the force of Bentham’s panopticon that Simon used to explain Babbage’s obsession with the “factory system.”<sup>17</sup> Simon is the most con-

<sup>12</sup> Schaffer, “Herschel in Bedlam,” 217.

<sup>13</sup> Schaffer, “Herschel in Bedlam,” 225.

<sup>14</sup> Schaffer, “Herschel in Bedlam,” 226.

<sup>15</sup> Schaffer, “Herschel in Bedlam,” 229.

<sup>16</sup> Simon Schaffer, “Self Evidence,” *Critical Inquiry* 18 (1992): 329–30.

<sup>17</sup> Simon Schaffer, “Les machines calculatrices de Babbage et le ‘Factory System,’” *Réseaux* 1, no. 1 (1997): 222.

sistent historian of science when it comes to the engagement with Foucault's work. He did not merely comment on or discuss it on particular points, but actually used it to produce illuminating analyses of large-scale socio-epistemic phenomena – such as the classification of nebulae or the distribution of bodies in the space of public demonstration.

## Against Latour

Simon Schaffer took part in the (many) debates that animated the Sociology of Scientific Knowledge (SSK). In particular he discussed the positions of the French sociologist and philosopher Bruno Latour. Latour published in 1984 *Les Microbes. Guerre et Paix*, translated into English in 1988 as *The Pasteurization of France*.<sup>18</sup>

The work had an international resonance. But in France, it aroused incredulity – and sometimes irritation. Let us recall Latour's general thesis: Pasteur was only able to convince the French medical profession by making microbes visible and by enlisting them in a chain of argument that extended from laboratories to ordinary health practices. The historian of medicine Jacques Léonard was not very receptive to this proposal. In the *Annales*, in 1985, he vituperated against “the seduction of the artist.”<sup>19</sup> Above all, he noted that Latour was “rigorously opposing hygienists and practitioners,” whereas the two activities had long been mixed. Léonard shows that Latour neglected the already long-standing affinities between medical practices and bacteriological research, which explains, at least in part, “that Pasteurism discovered so many natural and conjunctural allies.”<sup>20</sup> In a broader critique of Latour's work, the sociologist Olivier Borraz pointed out the errors of an actor-network “empty of any content of its own:” its ability to cross domains of activity strips it of any specific socio-epistemic qualities.<sup>21</sup>

The French reception of Latour's work on Pasteur was therefore sceptical – to put it charitably. In the English-speaking world, the reviews were more complimentary. Certainly, in *Isis*, Evan M. Melhado doubted that we will ever see the “Latourization of the history, philosophy, and sociology of science,” so much so that the method used missed important data series.<sup>22</sup> But Ian Hacking, in *Philosophy of Science*, was enthusiastic; Ann F. La Berge in *The American Historical Review* praised “an exciting and challenging book”

<sup>18</sup> Bruno Latour, *Les Microbes: guerre et paix* (Paris: Métaillié, 1984); Bruno Latour, *The Pasteurization of France* (Chicago: The University of Chicago Press, 1988).

<sup>19</sup> Jacques Léonard, Review of Bruno Latour, *Les microbes. Guerre et Paix*, suivi de *Irréductions*, *Annales. Economies, Sociétés, Civilisations* 40, no. 1 (1985): 167.

<sup>20</sup> Léonard, Review of Bruno Latour, 167.

<sup>21</sup> Olivier Borraz, “La science est-elle une sociologie? A propos des travaux de B. Latour et M. Callon,” *Politix* 3, no. 10–11 (1990): 142.

<sup>22</sup> Evan M. Melhado, Review of Bruno Latour, *The Pasteurization of France*, *Isis* 83, no. 2 (1992): 271.

which “greatly enhances our understanding of science and society;” and Keith Vernon assured that “Latour is impeccably reflexive.”<sup>23</sup>

Simon’s 1991 review in *Studies in History and Philosophy of Science* of the two versions (English and French) of *Microbes: Guerre et Paix* was clearly on the side of the sceptics. His text contrasted with the English-language praise. Simon did not content himself with pointing out the weaknesses of Latour’s book, he systematised his criticisms and brought to light the principal aporia of the actor-network theory. Simon specified that “by suppressing the controversies which surrounded Pasteurism, Latour is able to use ‘the microbes’ as willful actors. Instead of symmetry, he tries hylozoism.”<sup>24</sup> By endowing microbes with intention (like human beings), Latour overlooked the socio-epistemic determinations of controversies and delivered a truncated account of Pasteur’s argument. By pointing out the limits of the Latourian approach to science, Simon revived the critique of actor-network theory. His proposals were consistent with the scepticism of the French reception, but went further.

### At the *Annales* Schools

Simon Schaffer has written two articles for the famous French history journal, the *Annales*. Founded by Marc Bloch and Lucien Febvre in 1935, the *Annales* was the mainstay of the revival of economic and social history, under the direction of Fernand Braudel, and then from the 1970s onwards, notably with Jacques Le Goff and Emmanuel Le Roy Ladurie, of cultural and anthropological history. More recently, the journal has turned to the theme of globalisation.

Simon’s social history of science is indeed close to that of the *Annales*: comparatism, lability of social forces, extensive resonances of practices ... In 2005, Simon published an article in the *Annales* entitled “L’inventaire de l’astronome. Le commerce d’instruments scientifiques au XVIII<sup>e</sup> siècle (Angleterre-Chine-Pacifique).” He explained in particular that in “1791–1792, the East India Company organised a mission equipped (...) with astronomical instruments in order to convince the Chinese to trade in tea.”<sup>25</sup>

Chinese officials in the imperial court mocked the instruments of the British as emblematic of their weakness. Scientific instruments thus became objects capable of reproducing geopolitical differences. This way of considering the social and political depth of

<sup>23</sup> Ian Hacking, Review of Bruno Latour, *Science in Action. How to Follow Scientists and Engineers Through Society* and Bruno Latour, *The Pasteurization of France*, *Philosophy of Science* 59, no. 3 (1992): 510–1; Ann F. La Berge, Review of Bruno Latour, *The Pasteurization of France*, *The American Historical Review* 95, no. 4 (1990): 1216; Keith Vernon, Review of Bruno Latour, *The Pasteurization of France*, *The British Journal for the History of Science* 23, no. 3 (1990): 346.

<sup>24</sup> Simon Schaffer, “The Eighteenth Brumaire of Bruno Latour,” *Studies in History and Philosophy of Science* 22, no.1 (1991): 185.

<sup>25</sup> Simon Schaffer, “L’inventaire de l’astronome. Le commerce d’instruments scientifiques au XVIII<sup>e</sup> siècle (Angleterre-Chine-Pacifique),” *Annales. Histoire, Sciences Sociales* 60, no. 4 (2005): 791–792.

objects is reminiscent of the Braudelian approach. Fernand Braudel composed an immense work, first by examining the stratified life of a vast geographical space, the Mediterranean, and then by recomposing the modern matrix of capitalism.

In *Civilization and Capitalism*, the French historian tried to follow the networks of nascent capitalism: money, techniques, fairs, foodstuffs, maritime and land routes. Everything was brought into play to understand how human exchanges were structured on a global scale. In Volume 1 (*The Structures of Everyday Life*), Braudel discussed luxury objects, their trade and their importance at length. His conclusion, about their multiple uses, is strikingly consistent with Simon's proposals about the scientific instruments of the modern era. Here is what Braudel said:

If luxury is not a good way of supporting or promoting an economy, it is a means of holding, of fascinating a society. And those strange collections of commodities, symbols, illusions, fantasies and intellectual schemas that we call civilizations must also be invoked at this point. In short, at the very deepest levels of material life, there is at work a complex order, to which the assumptions, tendencies and unconscious pressures of economies, societies and civilizations all contribute.<sup>26</sup>

Simon showed precisely that scientific instruments were part of a plural reading of the world. The ways in which these objects are considered and used provide information about the distant connections between very different cultures.

In 2014, Simon was invited to the Ecole des Hautes Etudes en Sciences Sociales in Paris to deliver the prestigious annual Marc Bloch Lecture. His paper was published in the *Annales* in 2015, under the title "Les cérémonies de la mesure. Repenser l'histoire mondiale des sciences." This time, it is to Marc Bloch that Simon paid his debt as an historian.

Simon was interested in the "act of measuring" which allows the organisation of commensurabilities on a large scale.<sup>27</sup> Above all, the challenge is to understand the "ceremonies of measurement" that broke the "inevitable asymmetry between the quantitative reason of Europeans and the qualitative uses of other peoples."<sup>28</sup>

Simon asserted, "all practices of measurement are rituals;" indeed, "they require that rigorous care be given to a sequence of performative actions ..."<sup>29</sup> Simon drew from Marc Bloch's *Les rois thaumaturges* the idea that ceremonies (such as that of the healing kings) contain a certain worldview. Rituals linked knowledge with political efficacy. For Simon, Bloch "understood that the way power is represented is also a kind of power."<sup>30</sup> In eight-

<sup>26</sup> Fernand Braudel, *Civilization and Capitalism 15th-18th Century*, vol. I : *The Structures of Everyday Life. The Limits of the Possible* (London: William Collins Sons & Co, 1981): 333.

<sup>27</sup> Simon Schaffer, "Les cérémonies de la mesure. Repenser l'histoire mondiale des sciences," *Annales. Histoire, Sciences Sociales* 70 no. 2 (2015) : 409.

<sup>28</sup> Schaffer, "Les cérémonies de la mesure," 412.

<sup>29</sup> Schaffer, "Les cérémonies de la mesure," 413.

<sup>30</sup> Schaffer, "Les cérémonies de la mesure," 413.

eenth-century science, it was “the balance and the pendulum” that animated “the rituals of measurement” and gave a global coherence to the way the world was conceived.<sup>31</sup> By reactivating Marc Bloch’s thesis on the political power of rituals, Simon reinscribed metrological practice in its anthropological dimension. Commensurability is never dissociated from issues of power.

### A French Accent

I have tried to show that Simon Schaffer’s history of science has a slight French accent. It is, of course, much more than that. However, the Foucauldian work, the critique of Latour and the references to the *Annales* constitute original markers of a practice of social and cultural history of knowledge. This way of searching in the archives for deep coherences (as with Foucault), critical philosophical readings (as in the dialogue with Latour), or political properties inscribed in the ordinary course of the world (as with Marc Bloch) does not constitute a French specificity. But all these French references make Simon’s history of science unique. It has inspired and continues to inspire young researchers. In France and elsewhere.

<sup>31</sup> Schaffer, “Les cérémonies de la mesure,” 429.

# Trust in the balance: a word play for Simon Schaffer

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JENNY BULSTRODE

It is well known that the first documented performance of *Hamlet* took place in 1607 on board East India Company ship the *Red Dragon*, attempting to entertain West African dignitaries and a Portuguese interpreter while it was anchored off Sierra Leone. It is less well known that this popular fact was invented in 1825 in the postscript of a *European Magazine* article that purported to quote three extracts from the journal of the Captain of the *Red Dragon*. When “Ambrose Gunthio” (a pseudonym) generated the so-called extracts in 1825, the Captain’s journal had already been missing for at least three years – recorded lost since 1822. Other extant journals documenting the same voyage do not record any theatricals, let alone Shakespeare’s gloomy Danish tragedy. Gunthio was very likely *Morning Chronicle* political correspondent John Payne Collier, already with an established record of improper reporting on parliamentary debates.

The (unadulterated) journal of the *Red Dragon* documented one of the founding voyages of the East India Company that launched Britain’s Gold Coast trade. Under Assayer to the Mint Isaac Newton, this Gold Coast trade would become the basis of Britain’s gold standard in 1717. That Gunthio/Collier located his forgery on a Company ship anchored off Sierra Leone was significant. Four years earlier, the British crown had abolished the African Company of Merchants, which had taken over from the East India Company in 1660, laid claim to territory previously under the control of the Asante ruler (the Asantehene), and declared Sierra Leone the seat of its government. By 1825, the decapitated head of the Sierra Leone colonial governor, Brigadier-General Charles MacCarthy, was in the ossuary of the Asante royal court, and the *Morning Chronicle* publishing breathless reports of war-time atrocities alongside European analyses of Asante customs. Reproducing the work of African Company official, Edward Bowditch, and his Danish informants, the *Morning Chronicle* reported how, in the Asantehene court, the blowpan, boxes, scales and figurative weights for weighing gold dust were all themselves made of solid gold. Sierra Leone and the Asante had become household names that gave new salience to the provenance of Britain’s gold standard and its national balance.

In the same years that saw this escalation of conflict, lobbyists campaigning for reform to Britain’s standard weights and measures represented the problem of variable standards as a problem of corruption of the gold standard by fraudulent practice. Seeking to establish a more reliable set of standards, in 1822 they had sent an expedition

to where else but Sierra Leone. There, hosted by MacCarthy, Copley medallist Edward Sabine measured pendulum lengths using instruments made with a slice of a cake of “wootz” steel sent to East India Company advisor and Royal Society president Joseph Banks in 1794, launching a popular market in the metal. By 1823 the expedition and its pendulums were back in London. They had measured wootz-edged pendulum lengths at key sites along Britain’s global colonial trade and now they brought them into relation with Greenwich time. The globalising reach of this exercise in calibration was part of the lobbyists’ success in making their case for standard reform to protect the gold standard from corruption by counterfeit. In 1824, declaring inconsistency and ignorance of standards “the Cause of great Confusion and of manifest Frauds,” an Act for ascertaining and establishing uniformity of Weights and Measures was passed and the legal standard length remeasured by Sabine’s patron, the heroic observer Henry Kater, to the beat of a wootz-edged pendulum. The instruments swung off Sierra Leone had been designed as perfect replicas of the one designed and used by Kater.

While the standard length was remeasured, the legal standard weight was to remain the troy pound constructed by the virtuoso instrument maker John Bird in 1758. Bird’s hands were in themselves a standard that embodied the integrity and trust of national standards. Greenwich time was read from Greenwich mural quadrants. To perfect the division of these scales, the bench artist had used the inherent symmetry of a circle to check the points against one another, and, with just the pressure of his fingertips, coaxed the marks in the metal into position. His method of hand-dividing was famous not least for being a matter of public trust: for his disclosure of the craft secret he was awarded a Longitude Prize in 1767 and with every sextant divided from his circles, this trust in his hands was replicated and reinforced. In eighteenth- and nineteenth-century Akan cultures, the weighing scales (*nseña*) were not free standing. Two circular pans were respectively suspended from the ends of a horizontal beam that hung from a long central thread looped over the trader’s left thumb. Gold-dust, transported in the hollow cavity of a porcupine’s quills, was tipped into tiny, specialised spoons (*saawa*), which the trader would lift in their right hand and carefully add to the scale pan. The design of the Akan balance secured trust in weighing by ensuring both hands were always visible.

Gestures of trust, whether Bird’s hands or the thumb loops on Akan *nseña*, are not natural kinds. For every user, they exist within that individual’s framework of cultural referents. When users agree to shared frameworks, gestures become institutions. In the mechanisation of sextant production, scales were cut from a circle divided by Bird’s method. Every new sextant recalled the work of his hands from the Greenwich mural arcs to the measures of weight made for parliament and the Royal Mint, and in return every Greenwich time signal or newly minted coin recalled Britain’s maritime power. Across Akan cultures, gold was balanced in scale pans against weights (*abrammuo*), cast in brass from wax models of figures moulded to represent proverbs and societal principles. Since 1701, the crested porcupine (*kōtokō*) had been the emblem of the Asante king and nation. Not only were porcupine quills used to mould the wax models, but, as already mentioned, to transport the gold-dust itself. Every time gold dust was tipped

from the cavity of a porcupine quill, to be weighed against quill-moulded proverbs cast in brass, the power and unity of the state was evoked and reinforced. An edifice of trust gestures to shared cultural referents.

In 1825, the same year the 1607 *Hamlet* performance off Sierra Leone was invented, amazing the literary community with its provenance, the results of the pendulum expedition that brought Sierra Leone in relation to Greenwich were published, amazing the scientific community with their unprecedented precision. If this weighing of the world was the height of scientific hubris, then nemesis followed in the balance. While Collier established a reputation as a Shakespeare scholar, Heinrich Christian Schumacher, a Danish astronomer who oversaw Europe's trade as it passed through the Elbe, undertook a survey of weights and measures, and began to question Kater's care in weighing. It became apparent that no one knew what the Bird troy pound was made of. Bird's "brass" pound might be the imperial standard of weight, but its metal was no alloy familiar to Schumacher and his peers, and the standard weight did not weigh what was expected of its volume. To use the modern terminology, they did not know the "mole." At the same time, the incredible precision of Sabine and Kater's pendulum researches began to elicit incredulity, culminating in a searing public attack in 1830. While their reputations were badly scorched, the standard endured until, in 1834, the houses of parliament caught fire and Bird's "brass" pound melted into nothing; and, with it, the edifice of trust. Imperial standards, heroic observers, and Bird's hands themselves came into question.

In later years, Collier's exposure would scandalise the literary community with his forgeries, many of which took the form of retrospective insertions into original manuscripts. Instead of authentic Elizabethan ink, microscopic scrutiny revealed sepia paint overlaying pencil marks in Collier's hand. But the exposure of the forgeries did not come before Collier had published his own Shakespeare anthology, quoting critic Samuel Taylor Coleridge that he believed *Hamlet* was crafted by the bard "to exemplify the moral necessity of a due balance." For Collier, as for Coleridge, the work he considered to be Shakespeare's masterpiece was a meditation on "balance between our attention to the objects of our senses, and our meditation on the workings of our minds, – an equilibrium between the real and the imaginary worlds." Balance is a powerful evocation for these purposes. The figurative balance is affective because it recalls its material antecedent. The material balance is effective because it makes imaginary relations. "In *Hamlet*," Collier argued, "this balance is disturbed." It is precisely this balance and its disruption which makes *Hamlet* the foil of Jacques Derrida's famous analysis of Marx, and the "old mole" and "fretful porcupine" of *Hamlet's* father's ghost instruments for exploring the spectres of capital he described.

This then brings us to the question that presses anyone who has had the privilege of sitting and sharing a drink with Simon and heard the familiar phrase "I could tell you a story that will make your hair stand on end like the quills on the fretful porcupine." Why is the porcupine fretful? What happened to its quills? *Hamlet* scholars say it was just a spectre, and one should attend to the mole. But the mass is not the weight. The porcupine connected the Asantehene with their council and people – quills carried gold dust for

weighing, the tips moulded the beeswax lost in casting *abrammuo*, the wetted body was a spindle, to turn wax into threads that, in turn, turn brass into fish skin and the saying that anything the mudfish gets will go to the crocodile. All this in the trust-gesture of weighing, requiring both hands to balance the scales. So it was with the fingertips of John Bird, the master divider who made measures for Isaac Newton's successor as Assayer to the Mint. The pressure of his touch coaxed points in the metal until trust was reflected, and, measure for measure, every sextant cut from his circle repeated the same. Decades later, the Parliament of Bird's Standards became quite unbalanced as its administrators cried "[Bird's] hands could not well be out 0.001 [of a toise]!" When Westminster burned the House became a crucible, tally sticks, charcoal, and the Standards, a gesture: nothing less, nothing more. Melted out, their metal no longer counted as brazen: forgive the anachronism but they'd got the wrong mole. Derrida did describe how it happens. What you need is, he said, identifying Marx. These material metaphors are revenants that "come from and return to the earth ... not the figure of the old mole ('Well said, old Mole'), nor of a certain hedgehog, but more precisely of a 'fretful Porpentine.'" This metal can't be trusted, said the masters of this fetish; nor gun – nor gold because how can we know? "Wootz," on the other hand – imported Indian *utsa*. No substitutions, just the strength of commodity chains. Twenty years earlier they had tested their Standards with wootz-edge knife-pendulums, and brought those same knives and chains to the Asante porcupine. Such a capital performance they really lost their heads and went to the ossuary grinning like Yorick, and there porcupine gold turned faces into masks that, in turn, turned heads once more. Foucault gave his *regards* to the source of such madness. See, Marx insists we must "*umsehn*" to power relations not the spectre, and, in turn, "*umsehn*" turns into "*tourner nos regards*." Perhaps that is why the porcupine is so fretful? Because metaphors are resources that demand to be regarded and belief in *regards* makes the spectres and gestures of capital real.

# Between Paraquaria and Albion: Britain and Jesuit Science in South America

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JUAN I. NEVES-SARRIEGUI AND EOIN PHILLIPS

This is how the English poet Robert Southey chose to describe the Jesuit global expansion in the proem of his 1825 epic *A Tale of Paraguay*:

But Science too her pride would display / Faith gave the martyrs of Japan their fame  
/ And Charity on works of love would dwell ... And where the happier sons of Paraguay  
/ By gentleness and pious art subdued / Bow'd their meek heads beneath the  
Jesuits' sway / And lived and died in servitude.

Southey's verses suggest in poetic form what the historian C.R. Boxer perceptively termed "the militant church." One of the characteristics of the Iberian imperial experience was the critical role played by the Church – and especially by the Society of Jesus – in the construction of overseas domination. In the southern cone of South America – with the exclusion of Chile – the Jesuits were organised in a province that embraced the historical regions of Paraguay and the Rio de la Plata in present-day Paraguay, Argentina, Bolivia, and southern Brazil. The Latin name of the Jesuit province was Paraquaria.

The Jesuits founded universities in the cities of Charcas – Upper Peru in today's Bolivia – and in Cordoba, in the centre of present-day Argentina. They also ran colleges in other Spanish settlements in the region. Importantly, their missionary enterprises were concentrated in the establishment of *Reducciones* (Reductions), towns supervised by Fathers in which native peoples lived with no interference from European colonists. The most significant of those Reductions were the Guarani Missions in the borderland of present-day Paraguay, Argentina, and Brazil. From their missions and institutional centres, the Society of Jesus launched campaigns of exploration that, in the course of the 18<sup>th</sup> century, produced a body of knowledge that intersected in several instances with Britain. Here we show some of those instances through the cases of the missionaries Buenaventura Suárez, Thomas Falkner, and Martin Dobrizhoffer.

Father Buenaventura Suárez was born in the city of Santa Fe – today's capital of the homonym Argentine province – in 1679. Suárez never travelled outside Paraquaria and was entirely trained in Jesuit institutions. First in the college of Santa Fe, then in the novitiate of the city of Cordoba, and finally at the University of Cordoba. At the time, there was no formal training in mathematics in the Rio de la Plata and Paraguay, and Suárez

is believed to have been self-taught. After teaching in the college of Corrientes and in Cordoba, he was sent to the Guarani Reductions in the northeast. There, Suárez set up an itinerant astronomical observatory that moved among different Guarani *pueblos*.

In order to carry out his observations, Suárez had to build his own instruments, which included pendulum clocks, quadrants, and telescopes. Contrary to common belief, recent scholarship has established that Suárez did not receive telescopes from England. It used to be thought that he modelled the telescopes employed in the reductions after the English ones that he could have acquired through European Jesuit networks. Although some open questions remain, there is no reason to believe that Suárez depended on overseas telescopes to produce his own. Local resources proved helpful in the fabrication of the telescopes in the Guarani Missions, crystal rock providing a suitable material for the lenses, which Suárez likely made himself. However, for the pendulum clock, a complicated timekeeping machine, Suárez would have had to rely on the Guarani artisans of the Reductions. We know that among the indigenous populations there were skilled artisans capable of making the necessary parts.<sup>1</sup>

The instruments produced in the Guarani Reductions were used to carry out observations that reached the Royal Society. Initial contacts between Suárez and the Royal Society were made through an agent of the South Sea Company. After the War of the Spanish Succession, in the context of the Peace of Utrecht, Britain was granted the privilege – the *Asiento* (settlement) – to engage in the slave trade with Spanish American ports. Among the patrons of the South Sea Company was the Society of Jesus. In that initial contact, a paper by Suárez with observations of the moons of Jupiter was delivered by a Mr Pym and read to the Royal Society in 1731. Over the following decades, until his passing in 1750, Suárez kept in touch with the Royal Society through connections with Jesuit scholars, many of them of Iberian origin. In 1748, Suárez published in the *Philosophical Transactions* observations made between 1706 and 1730 of lunar and solar eclipses and of an eclipse of Jupiter by the Moon.

The Society of Jesus in Paraquaria counted among its members some Jesuits foreign to the dominions of the Iberian crowns. This was the case of Thomas Falkner, an English physician born in Manchester in 1707. Falkner was the son of a Presbyterian apothecary and was educated in a Manchester grammar school. It is not clear how he got his training in medicine, but it is possible that Falkner worked in London with Richard Mead. In any case, Falkner found himself employed as a surgeon in a slave ship of the South Sea Company that arrived in Buenos Aires in 1730/1. Once in Buenos Aires, Falkner became ill, recovering thanks to the attention received from the Jesuits. In the Rio de la Plata, he converted to Catholicism, joined the Society, and attended philosophical and theological studies at the University of Cordoba.

Between 1744 and the expulsion of the Jesuits from Spanish America in 1767, Falkner participated in various expeditionary and missionary enterprises to the far south,

<sup>1</sup> S. Galindo and M.A. Rodríguez-Meza, “Buenaventura Suarez, S.J. (1679–1750) Part 1: Telescope maker, Jovian satellites observer,” *Revista Mexicana de Física* 57 (December, 2011): 121–133.

a region inhabited by native peoples with no effective Spanish dominion. He established two unsuccessful missionary settlements in what is today the interior of the province of Buenos Aires, exploring the Patagonian south in the process. In 1771 Falkner entered the Jesuit province in England, becoming the chaplain of the Catholic political writer Robert Berkeley. That relation was instrumental for the publication of Falkner's *A Description of Patagonia and the Adjoining Parts of South America* (Hereford: C. Pugh for T. Lewis, 1774). An advocate for closer relationships between Britain and Spain, envisioning the growth of British commerce in South America, Berkeley joined forces with the writer William Combe to edit Falkner's *Description*. The book circulated among members of the Royal Society. Robert Southey tells us that he read a copy that had belonged to Joseph Banks. Thomas Pennant, another Royal Society naturalist, composed a text on Patagonia dedicated to Daines Barrington partially based on conversations with Falkner. And Charles Darwin referred to having profited from reading *A Description* on the Beagle voyage.

Martin Dobrizhoffer was born in Bohemia in 1717 and passed away in Vienna in 1791. He was another of the foreign Jesuits in Paraquaria. He joined the Society of Jesus in 1736 and sailed from Lisbon to Buenos Aires in 1749. There he made the inland voyage to Cordoba. From the headquarters of the Jesuits in that city Dobrizhoffer was assigned to a group sent north to the Chaco region, a great expanse of territory in present-day Bolivia, Argentina and Paraguay that embraces plains, tropical wetland, and flooded grasslands. Although nominally claimed by the Spanish crown, it was wholly in control of native nomad peoples. In 1767 he relocated to his country of origin in the Viennese court of Maria Theresa.

In Vienna, Dobrizhoffer composed his *Historia de Abiponibus*, published in Latin in 1784. Dobrizhoffer's account was only translated into English as *An Account of the Abipones* in 1821 by Sara Coleridge. It is this version that Southey mentions at the beginning of *A Tale of Paraguay* to reassure his readers of the truthfulness of the setting in which he placed the poem. Southey contributed to the dissemination of Dobrizhoffer's work when he published a 47-pages-long review in the January 1822 edition of *The Quarterly Review*. Based on the first-hand missionary endeavours of Dobrizhoffer, the *Account of the Abipones* is a natural history of the region in three volumes focused on the equestrian indigenous people named in the title. The first volume is a history of the Rio de la Plata and Paraguay and of the expulsion of the Society of Jesus. The second and third volumes relate the costumes of the Abipones and the attempts to evangelise them. What was interesting about this work for Southey was the insight it gave into the lives of the Abipone people – and in his *Tale* we can sense the stock figure of *le bon sauvage*. For Southey it was an excellent example of the universal story of the transition from one stage of human society to another, from barbarism to civilised life.

In an era of increasing imperial competition and commercial growth, conceptions of the southern territories of South America came to be known thanks to the entanglement

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of knowledge systems filtered through the Jesuit missions in the region. The expansion of the slave trade, the artisan skills and experience of indigenous people, and the global Jesuit networks, all contributed to offer institutions like the Royal Society a *way of knowing* South America. But those savants in the Jesuit missions, too, benefited from their contact with Britain, from the circulation of personnel, knowledge exchange, material resources, and the British printing industry.

# The Smuggler, the Forger and the Transactioneer: Mapping the Imagined

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HILLARY RAY

My years spent studying with Professor Simon Schaffer in Cambridge were unique and memorable, and to this day, helped shape how I think. Here are a few words to describe the intellectual boot camp that was the experience of studying with Professor Schaffer (hereafter referred to as Simon). I landed in Cambridge at noon in late September 1990 from the mean streets of New York. I had never visited mythical Cantabrigia before, and to my delight it truly was “the loveliest confusion of gothic windows and ancient trees, grassy banks and mossy balustrades, of sun chequered avenues and groves, of lawns and gardens and terraces, of single arched bridges spanning the little stream ...,” as Henry James had described the university town.

It took me about 20 minutes to gather up the nerve to walk through the main door of the rather grand porter’s lodge at Trinity College to ask for the key to my room. I had proposed to study a French Jesuit scientific expedition to China in 1685 and this topic took me from the libraries of New York city to here. What I had not yet realised is that the library, the museum, the academy and the pub were not just the innocent buildings I thought they were. Thanks to Simon, I would learn that they were the institutions of knowledge, and I would discover that they would feature equally prominently in my thesis as in my life. Like my French Jesuit mathematicians yearning to sail to China, I longed to be Cambridge without ever having been there before, a perfectly Schafferian situation already.

By way of background, I first became interested in the French Jesuit scientific programme while I was completing my MA in history at Hunter College, part of the City University of New York in Manhattan. My MA thesis was on the mapping of the city of New York from 1774 to 1835, and I examined maps and the practice of mapping as a cultural and political practice as well as scientific one. I was only just realising that surveying was not just about measuring land but about possession and reconstruction, often for the person to whom the map was presented. My thesis was that maps were cultural documents and could be used for different purposes and audiences. Maps were chameleons, they could be military intelligence, as they were during the American war of independence, or they could be popular tourist guides, as were the first maps and guides that appeared in 1835 where I ended my thesis. These maps of New York were also legal and planning documents such as the Commissioner’s Map of 1811 which imposed the

grid pattern on the city, making invisible those neighbourhoods that did not fit within the new vision of the city and instead creating housing for workers, which was maximised and dense, and easy to buy and sell. This new metropolitan space would facilitate the building of high rise edifices on top of the existing villages, giving legal impetus for the destruction of the latter, such as Irish and African American vernacular cottages and houses, and the filling in of fishing locales such as Collect Pond. Some Native American paths, place names and distinguishing features in the landscape, and languages, appeared in the earlier maps, then disappeared. The freedmen and slaves also appeared and disappeared depending on who made the maps.

My thesis was supervised by an historian and a cartographer. I was able to combine my previous studies in art and history, working at a museum and in the rare map and book trade with learning how to survey and triangulate, an exhilarating mixture of scholarship and practice. I became utterly fascinated by the practice of cartography and wanted to understand its social, cultural, political and artistic dimensions through my MA research, and then through further doctoral research in England.

During my MA course, I became very interested in some maps of Canada that I discovered during my research. They were made by French Jesuits and, unlike the other maps made by European cartographers, were anthropological as well as topographical as they featured the place names, languages, customs, homes and boats of the indigenous peoples already established on the land. What was to become present-day Canada and North America was not a *tabula rasa* for French, Spanish, English or Dutch colonial aspirations, but had flourishing peoples with established cultures, languages and religions. My curiosity was piqued because of this full instead of blank cartographic canvas. Who were these Jesuits and what training was responsible for their world view? The term Jesuit itself was not necessarily a positive one, as with the term “Black Pope,” the other Pope. James Joyce was suspicious of the Jesuit Order as in “Come up, you fearful Jesuit” uttered by Buck Mulligan on page 1 of the beginning of *Ulysses*. I was intrigued. Theirs was the world of ambiguity and moral elasticity, perfect ground for intellectual exploration. What would happen, I asked myself, if I investigated a group of French Jesuits who went to a society that reflected European monarchs who had a warrior king, a court, an army, and what Europeans would understand as religion, medicine, scientific instruments, mathematics, visual and creative arts in written form? What would the Jesuits make of this society and what kind of astronomical observations would the Jesuits produce there? What kinds of maps would they make and for whom? Would they try to make themselves indispensable at the court of the Chinese emperor, as they had at Versailles? Wouldn't that make a great PhD thesis topic, I thought. And this was the path that led me to Simon and History and Philosophy of Science (HPS) at Cambridge.

The environment at the department of HPS on Free School Lane was unlike any I had experienced. It was social, supportive and rigorous – we had to prepare for our lectures, seminars and have questions at the ready. It was an environment where ideas could be discussed, explored, thrashed out and nurtured both within the department and outside, in the pub. After the weekly seminar in the department, attendees would reconvene at one

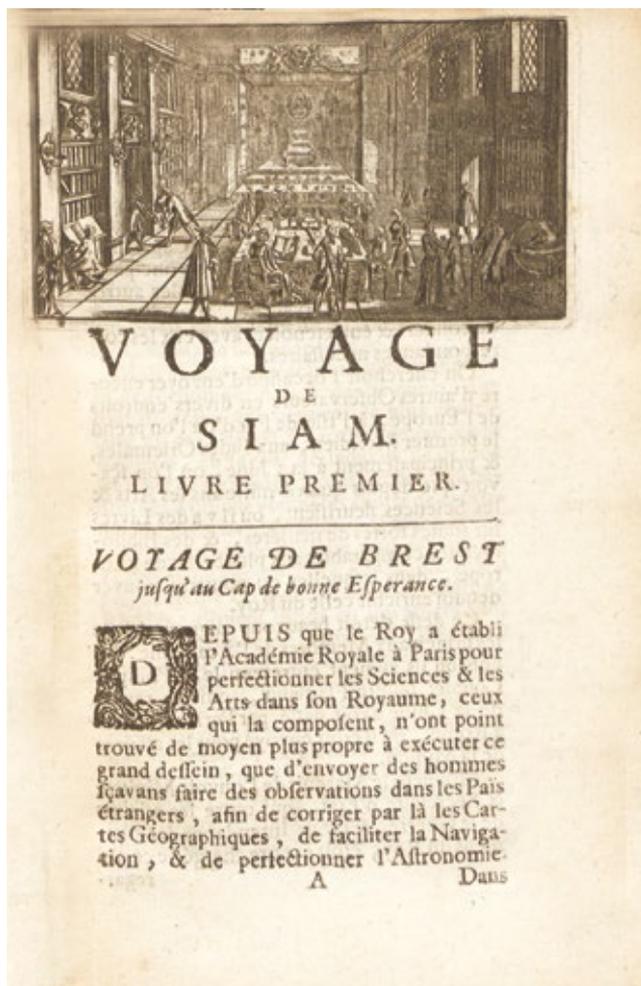


FIGURE 1. • Guy Tachard, *Voyage de Siam* (Amsterdam: P. Mortier, 1687), 1.

PhD thesis topic. I planned a first chapter on the training that my French Jesuits received through the *Ratio studiorum* in their colleges, the second chapter on their departure from France to Siam and so on, pretty much following a chronological expository journey. Well, Simon put paid to that idea, sending me back to the proverbial drawing board to start again. There I was thinking that I knew my niche topic better than anyone when Simon started firing away a barrage of questions to shape my ideas into an actual thesis: Had I read Bruno Latour as my Jesuits were really immutable mobiles? Had I read Louis Marin on the body of the king, as my Jesuits were in the service of Louis XIV? Had I read Rivka Feldhay on Jesuit ballet and how my Jesuits were also performing? Had I read Peter Dear on Jesuit education? Had I read Jonathan Spence on the memory palace of Mat-

of the nearby pubs, usually the Mill or the Eagle on Mill Lane. Imagine my surprise when I discovered that we would also have our supervisions in the pub. This was different to American academic life.

My first supervision with Simon was memorable for several reasons. First of all, it was in a pub. Second, it was a combination lecture and exam akin to a scene out of “Rosencrantz and Guildenstern are Dead.” Simon had the ploughman’s lunch and I had a salad. I should have had the ploughman’s lunch. I don’t actually remember eating anything due to the dizzying speed of the conversation, its breadth, depth and also to the sheer terror of speaking with someone who appeared to have read every book published on every possible topic under the sun. There I was thinking my topic was unique! I can still hear his sonorous voice in my head challenging my nascent ideas with interrogations in the imperative tense. The memory of it is still terrifying.

When I first began structuring and writing my thesis, I had in mind a more linear exploration of my

teo Ricci, and on Jesuits and mnemonics, which were encoded within their science (of course they were!)? Did I realise that the Jesuit Athanasius Kircher had brought Egypt and China to Rome with the obelisk, his museum and his 1667 book *China Illustrata*? Had I read what Umberto Eco had written about this geographic transubstantiation and the Jesuit search for a universal language, of which Kircher was a main proponent? Had I read Paula Findlen on museums, and thought about Kircher's museum and its function? How was I exploring the role of the Jesuit mathematicians as courtiers at Versailles, had I read Mario Biagioli on Galileo as a courtier? Had I read the Chinese accounts of the Jesuits at the court of the Chinese emperor in the works of Catherine Jami? Had I read Rob Iliffe on Newton's unorthodox theology to understand that there were many theologies and many sciences? And on and on it went, with tales of his time at Harvard and in the downtown New York of Lou Reed. My head was exploding in euphoric agony with all these thoughts and ideas. I had to have a lie down in a dark room for several days after this, heady stuff for a kid from the Upper West Side. I felt like that person in William Blake's engraving of a figure at the foot of a very long ladder leading to the moon, with an almost insurmountable expedition ahead of me. Creating a thesis out of nothing was a thrilling, inspiring, frustrating, despairing, exciting and difficult exercise. And I would not have wanted it any other way.

Upon reflection, one of Simon's greatest gifts was the scope of his inquiry, truly multidisciplinary, and his uncanny ability to synthesise the complex social narratives within the stories that we, his students, wanted to tell. I found that Simon would sometimes speak in haiku, such as "making the invisible visible" and with some of these, it has taken over twenty years for me to fully see their inner meaning unfold. Simon opened the door to other disciplines and ways of thinking when examining a question that I had brought back from sifting through many manuscripts in the unheated libraries of Paris, Rome, London, Cambridge and New York. His intellectual investigative approach helped me to craft a narrative that told a deeper and more complex story about these five French Jesuits and their programme.

But studying with Simon was not just about me, my ideas and putting together a defensible thesis, it was about building community and its values. Simon's self-effacing personality fostered a collegiate environment in the graduate tea room in our department, the library and the Whipple Museum. The humble tea room was where Simon could be found, cup in hand, in the corner chair, spontaneously holding forth on a particular topic. I think I gained as much from these visits to the tea room as I did from visits to the library. Looking back, I am grateful for the camaraderie among the graduate students and all of our conversations over cups of tea and instant coffee, through the haze of cigarette smoke. I still miss two colleagues who are no longer with us, Alison Winter and her encouraging words, and also Frances Wilmoth, who was equally kind and gave me supportive feedback on the Euclidean geometry used by the Jesuits. Rebecca Bertoloni-Meli looked after us in the library, managing to find relevant articles and books that we had hitherto not heard of.

What was also unique is that, as students in HPS, we gave each other our undivided attention. This was in the age before so-called smart phones had invaded our lives, Goog-

le to search for topics, before indignant arguments on social media such as Twitter or Facebook, and only the mere beginnings of email. There was no stream of constant interruptions, pings, smartphones, apple watches, emails, social media and the like. When we were together, we were really together. When we spoke with Simon, we were all present and he with us.

A normal day as a research student would look like this: We would meet in the department, read actual books in the library, look for more books, have a cup of tea and a biscuit, discuss an idea and obtain a reading list from Simon, chat with other research students, attend lectures and seminars, have another cup of tea, another biscuit until the day faded into early evening. We went on to the pub first, to discuss a point with Simon and other lecturers or visiting scholars, then to the Gardenia or Pizza Express to continue the conversation. We were a community of diverse individuals but there for a similar purpose, to learn as much as possible from Simon and the department, and hone our research, thinking and writing skills. I am especially grateful for the camaraderie from those days for those of us from overseas to read each other's work, discuss, debate, encourage and make comforting cups of tea.

Researching and writing up our topics was also "hard yakka," as they say in Australia. For example, I was working on the problem of trying to explain how to explain the impact that a programme of surveying and mapping would have on the indigenous inhabitants, whether on the Siamese or Chinese by my French Jesuits. Simon directed me to playwright Brian Friel's powerful work "Translations," which set out the consequences and political narrative of surveying and mapping, all the more so now that I live in Ireland. Simon made the parallel with the English imperial programme of mapping Ireland, just as the Jesuits mapped China for the French king. Simon brought in poets, such as the Australian Rodney Hall and his work "The Island in the Mind." He directed me to "Mr Bligh's Bad Language" by Greg Denning, an anthropological study of the mutiny on the *Bounty*. Kismet struck, and I was fortunate enough to meet Denning in Canberra where Denning, Simon and other scholars were at the Humanities Research Centre. Denning very graciously read and provided comments. Studying with Simon meant that anything was possible, the stars could align and you would meet other singular thinkers and be enriched by it. Anthropology, semiotics, architecture, indigenous activists, mathematicians ... all were a possible lens through which to interrogate our subject matter and ourselves, how we thought and analysed all events, not only scientific endeavours. Haddon's research on the Torres Strait, traditional medical knowledge from the Amazon, Inuit cartography, Chinese ceramics in European still-life paintings, and the fact these were produced for export, the Chinoiserie craze at Versailles and made-up Formosan language all went into the mix.

These are just some of my memories of Simon and of the department, and what he taught me about thinking, analysing and writing. Simon and I examined and interrogated the expedition by asking a series of questions: Were these Jesuits trustworthy, and what made them so? How did they use their astronomy and mathematics as a source of that legitimacy? How did they build their network with the newly-established scientific soci-

eties in London, Berlin? Why were the Jesuits not clubbable, but Psalmanazar was? We looked at the different technique used by my Jesuits: Depictions of predicting and demonstrating the solar eclipses using the French telescopes and astrolabes for the King of Siam, and then for the Emperor Kangxi of China. Our clerics mediated the heavens and brought the sun, the celestial body, to the ruler, the political body, within the court. Just as they had built mechanical monsters and automata for the court of Emperor Rudolph II, they brought clocks, machines, orreries, magic lanterns to Siam and China. The Jesuits performed spectacles of wonder with glass slides and the magic lantern (an early form, it has been argued, of cinema) and special light effects using phosphorous.

Based at court, their knowledge of the world, through their international networks from Jesuit missions, was formidable. Through my reading and discussions with Simon, I concluded that the Jesuits would build their network using paper theatres such as their works on China, and illustrations of eclipses, comets and the moon, for example, to demonstrate that their empire comprised all of nature and natural phenomena, extending to the heavens. They positioned themselves as mediators and translators of astronomical phenomena and far away cultures, becoming Mandarins in China and Brahmins in India, to paraphrase Voltaire. Engravings printed in Europe showed these Jesuits in Chinese courtly dress, holding a map of China and their French telescopes and astrolabes, extending the French empire to Beijing. By working with Simon through the knowledge-making process, I understood that the Jesuits made faraway places and phenomena, hitherto invisible, visible to their patrons in France, Italy, Madrid, Berlin and the other cities with court and scientific societies.

As a way to draft the dialogue within their network and join other networks, the French Jesuits would send back the *Lettres édifiantes et curieuses* to Paris and other European cities where they would be read aloud outside on street corners, as well as in salons, as we watch the news on television today. The Jesuits and the church controlled this information highway. The Vatican became jealous of these worldly and accommodating Jesuits, who were soon to be deposed by the scientific societies as makers of knowledge. With Simon's help, I investigated how and why the Jesuits generated their scientific knowledge as part of a courtly system of patronage of science. The Jesuits connected themselves to the king through images that they created to appear as an extension of the king. The Jesuits believed they were expanding the kingdom of Christianity, but they were appointed as agents to expand the French into Siam and China. Their expedition was funded by King Louis XIV, and to emphasise their royal patronage, they circulated an engraving of King Louis XIV holding audience with them prior to their departure to give them letters of passage and scientific instruments. Whether apocryphal or not, this was itself a material device, connecting the material Jesuits with the inscribed. Simon and I discussed how this use of images turned these Jesuits into instruments for France's expansion into Siam and China.

The Jesuit version of events emphasised the wonder and awe with which their scientific instruments and demonstrations were received, wonder that translated into trust and legitimacy of themselves, their knowledge and their presence and attempts at con-

verting the local people. The Jesuits were attempting to replicate their position at the court of King Louis XIV, believing that this would gain them political legitimacy and allow them to extend the reach of France in Rome in Siam and China. The Jesuits revealed celestial objects such as comets for the rulers of Siam and China, making the invisible visible thanks to their telescopes and mathematical tables. What we believe actually happened was that the Chinese astronomers were less than impressed with my Jesuits as they were also able to predict comets. The Jesuits were calculating horoscopes for the Emperor Kangxi, they declared that day for the visit of the Dalai Lama was unlucky, for example, because the Jesuit astronomers Schall von Bell and Verbiest were rivals of the Dalai Lama. Likewise, a duplicity of narratives was at play as Chinese accounts of the reaction to the French Jesuit clocks, for example. We know of some of the Chinese reaction thanks to scholars such as Jami. The reaction was either underwhelm or derision at the western clocks, which were far less accurate than the Chinese clepsydras. Thanks to Simon, I discovered many episodes, such as the battle of the calendars, which space prevents me from expanding on here.

What was clear through my research is, that by the early eighteenth century, the ground rules for trust and legitimacy were changing. The Jesuits' epistemic reality was shifting just as patronage was shifting from court to the scientific society. The objects that the Jesuits traded in, their books, engravings, inscriptions, maps and accounts, plants from their missions in South America such as quinine bark and antique Chinese books, which were tied to their social credit, were severed when these objects were now bought with currency. Sir Hans Sloane, the founder of the Royal Society in London, for example, commissioned Father Jean de Fontenay to bring him bark and Chinese incunabula for his collection. Simon knew about the English side of this episode and generously shared it with me, which made for a pivotal chapter in my argument about the expedition. Expecting social credit at the Royal Society, Father Fontenay instead was clearly no longer the recipient of patronage or of legitimacy, in a stark episode involving Psalmanazar, an imposter who pretended to be a Formosan kidnapped by Jesuits. Fontenay attends a meeting of the Royal Society and cross-examines Psalmanazar, contradicting Psalmanazar's claims. Because Fontenay was a Jesuit, the attendees of the Royal Society sided with Psalmanazar, and not with Fontenay. Psalmanazar established his credibility precisely in antithesis to the Jesuits and rode this wave of anti-Roman sentiment to the best tables in England, drinking with the likes of Jonathan Swift, and teaching his fake Formosan to students at Oxford until he recanted and confessed.

My doctoral experience stays with me: A walk in pandemic-locked down Dublin in 2020, I go past Marsh's Library. I notice on a placard at the doorway, a poster for an exhibit of works on China which features seventeenth-century Jesuit books and maps of China, including the map of China by Father Du Halde, one of "my" Jesuits. Centuries later, Jesuits' maps remain objects of fascination and interest for me and for others. A couple of blocks away, with few options for walks, I go inside St Patrick's cathedral, and come face to face with a statue of Robert Boyle as a child at the West wall of the cathedral. I had forgotten that Boyle was born in Ireland, the son of the Lord Justice. I think about

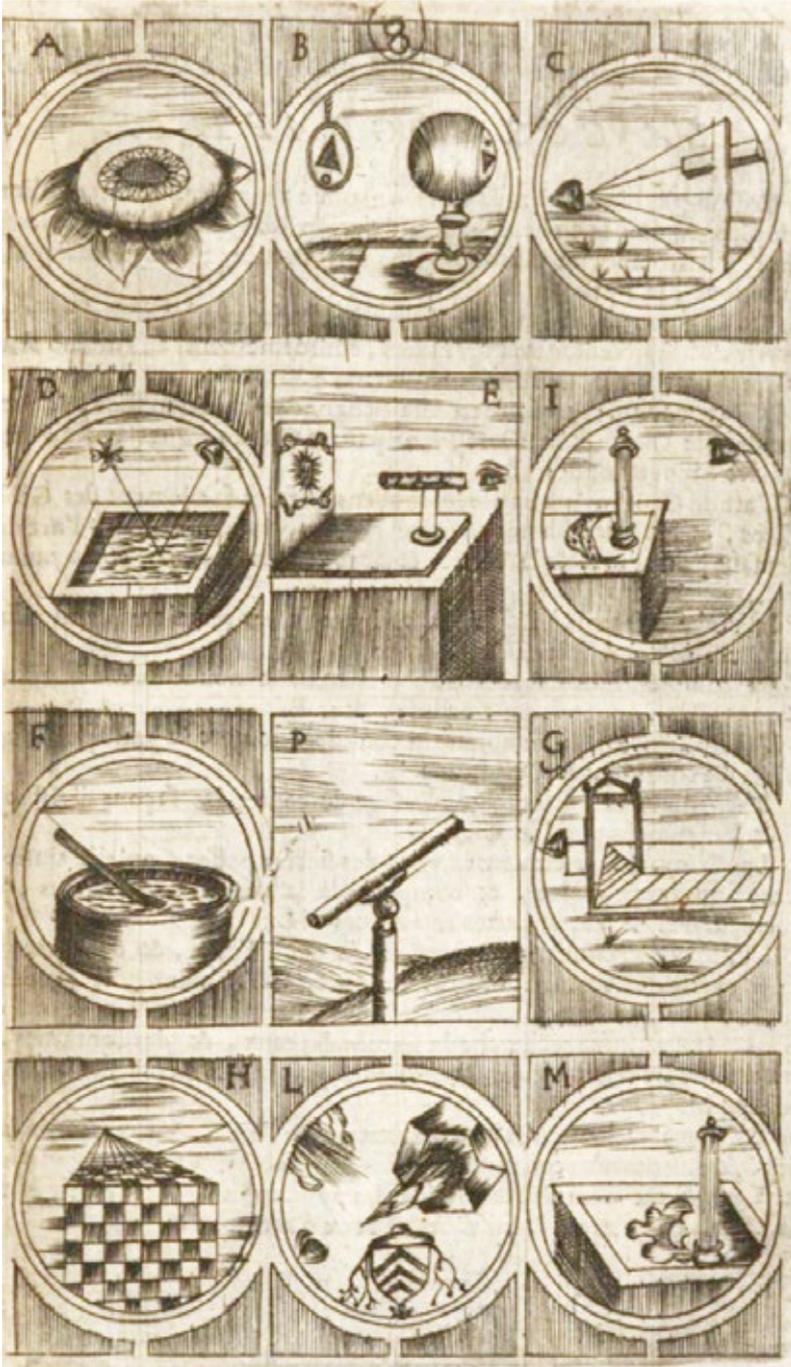


FIGURE. 2. • Pierre Bourdin, *Le cours de mathématique* (Paris: Simon Benard, 1661), 9.

the connection to the *Leviathan and the Air-Pump*, Shapin and Schaffer's seminal work on the controversy regarding the vacuum and how what we call science is produced. I am reminded of my time at Cambridge once more where I learned, through Simon's work, how Boyle, and his authority gave him the authority over experiments conducted by his assistant Papin.

Boyle was part of the narrative about networks and norms as he was part of the network of scientific correspondence. Jesuits were members of this network as correspondents until the suppression of the Jesuit Order from 1759 to 1773, when they lost all political power and authority. Many, including Sir Hans Sloane, relied on correspondence with the Jesuits from their far-reaching networks for scientific information and debate as with his correspondence with Father Fontenay, from my expedition. Boyle debated with the Jesuit Father Line over the nature of the vacuum. Astronomical phenomena, as I discovered with Simon, were currency: Sunspots, the moon, eclipses and comets, all were observed, measured and sometimes mapped by my Jesuits such as Scheiner and Riccioli, who circulated their letters setting out what they saw, like petitions to scientific societies across Europe to garner favour and patronage. Simon taught me to read these letters as links in a chain of a network. He taught me to not only look at the thing itself, but at its symbolic meaning, at their representation and use. It was a very different way of looking at books and maps and letters about an observation of a comet, for example, as a paper museum to bring the object to the ruler or the head of the Royal Society.

By pursuing these questions with Simon, my thesis told a story about the ties between knowledge and its patrons. Seen through the lens of my thesis, it became clear that the role of Jesuits as knowledge brokers was coming to an end, and the knowledge they had created was now being used against them by philosophers such as Voltaire and Locke. Scientific societies had displaced those controlled by the Vatican and the Jesuits.

Through these conversations with Simon, I learned how to inquire, how to challenge and how to trust my gut when pursuing a line of enquiry. I also hope I learned the values of the department of HPS, building community, relentless questioning, observation, independence of thought and fearlessness. I saw Simon in 2018 at our HPS reunion, and we effortlessly resumed our conversation from when I was his student, his mind was still whirring as he spoke about bees dancing, ants talking, and social structures, as vibrant and demanding as ever, still joining research from different disciplines and still going to the pub.

That Schafferian training continues to take me to many wonderful places by following the thread started many years ago with Simon, to a conference on Haddon's library, and fellow HPS student Michael Bravo leading a session at COP26 with Cambridge Zero in 2021, for example.

Reflection is a dangerous act as I have remembered far more examples, which I will not all recount here, for lack of space. If I have one regret, it is when Simon asked me if Father Fontenay had a rap song, what would it be? Never having been any good at improvisation, I answered with silence and wished I had given a rap song a go. Who knows, maybe I will have one to perform my Jesuit rap song at our next reunion.

I will always be grateful to Simon for teaching me to interrogate social systems like science and law, and to always “look under the bonnet” of every pronouncement, headline and claim. I am also grateful to Simon for sharing his enthusiasm for research and investigation of every topic with endless curiosity, deep scepticism and the ethical values of integrity and justice.

# Homage to an Interdisciplinary Reading Group

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JOAN-PAU RUBIÉS

We used to meet at John Forrester's flat in Richmond Terrace in the evening, to read a book previously agreed. Everybody interested was welcome, included people who had no formal relationship with the department of History and Philosophy of Science. For example, in one of these meetings I met Nigel Leask, who was in English, as well as, of course, the three leading luminaries of what seemed to me like an officially recognized radical wing in the History of Science, Simon Schaffer, John Forrester, and Nick Jardine, and many of their doctoral students. Myself, I was barely starting a PhD in intellectual and cultural history in another Faculty, with Anthony Pagden and Peter Burke as supervisors, but it was part of the stimulating atmosphere in Cambridge in the winter and spring of 1988 that I felt immediately welcome in that interdisciplinary setting. In retrospect I believe that people were very polite, because at that stage my spoken English was barely comprehensible. It was also part of that same welcoming atmosphere that we drank as we talked – it was Simon who usually brought a couple of bottles of wine. This was one of the many (pleasant) cultural codes in Cambridge academia that my previous degree at the University of Barcelona had not prepared me for. I guess that not being supervised by anyone in the room made it easier for me to try to realize the principled assumption that we were all equals when it came to discussing the books. Still, nothing could hide the fact that we were all waiting to listen to Simon, whose unique style of delivery was particularly emphatic, clear and creative (he always had an idea to begin with, but you could also see him finding new avenues as he went on). Personally, the intellectual congeniality that I immediately felt towards him, and which I believe many others also shared, is what brought me there for so many weeks to read books in no obvious way related to what my research was meant to be at the time. I learnt, of course, far more than if I had stuck to a more sensible reading list.

As far as I can remember, that winter we read, dissected and discussed Robert Darnton's *The Great Cat Massacre* (someone later commented that it sounded like the Great Darnton Massacre), Machiavelli's *The Prince* (or perhaps we only said we would), Bram Stoker's *Dracula* (that was, I must confess, my favourite session), Jacques Derrida's *Of Grammatology* (the most challenging), and Bruno Latour's then recently published *Science in Action*, roughly in that order.

For my own research project, then focused on a systematic assessment of early modern perceptions of cultural diversity through travel writing, one important issue was finding the right balance between the idea of human rationality and the evidence for cultural relativism. I thought I could only do that by starting from zero (methodologically speaking) and developing my own model, and therefore by considering all kinds of perspectives: historical, of course, but also anthropological and philosophical. Cambridge in the late 1980s was I must say a perfect place for that kind of enterprise. The fact that historians of science, apparently dealing with the one modern discourse where some sort of universal rationality seemed to be taken for granted, were willing to question any solid facts, and instead argued that all knowledge was socially constructed, was certainly inspiring. Learning how knowledge is constructed, socially and culturally, is of course at the centre of the new cultural history and history of ideas that I have been practicing throughout my career. I cannot say that when writing what became my *Travel and Ethnology in the Renaissance* and some other stuff, I ended up defending a very strong version of cultural relativism. Rather, whilst rejecting radical cultural incommensurability, I learnt how to define human rationality in such a way that it could encompass the vast range of human subjectivity. Thus, without denying the possibility of communication and cultural learning, it nonetheless made sense to focus on how a scientific discourse could be invented, and on the manner in which the eye of the traveller was taught what to see. Of course, in the pursuit of knowledge, we are all travellers. The effect of those stimulating reading sessions conducted in such a friendly and free environment was in some ways paradoxical: on the one hand, we challenged everything that smacked of solid knowledge, as conventionally understood. On the other hand, we thought that we were making sense of things. In particular, it was impossible to be in conversation with Simon in the room and not to *feel* that some sort of rationality must exist – even when we did not agree.

Barcelona and Cambridge, 2022

# A Genealogy of “Migrating Knowledge”

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RIVKA FELDHAY

Let me open my piece of writing, dedicated to Simon Schaffer upon his retirement, with some vivid memories from his visit – together with Steven Shapin – in Jerusalem, in the early 1980s. Simon and Steven were invited as guest professors to the Van Leer Jerusalem Institute, whose director at the time was Professor Yehuda Elkana, my M.A. and then my doctorate supervisor.

For me – as for many others – Yehuda was a teacher and a guide, confronting us with intellectual challenges and equipping us with the tools we needed in order to deal with them: books, but also conversations, feedback, and argumentation. Above all else, he offered us a place – the grounds and gardens of the Van Leer Institute – and interlocutors – prominent intellectuals who were his friends and colleagues. Schaffer and Shapin – prominent among those guests – brought with them new ideas, novel praxes, and unfamiliar modes of thinking. We learned from them, consulted with them, at times argued with them; we dined together; went together to concerts (some of which were held at the Van Leer Institute) and to the theater.

Yehuda, a benevolent patron, was a man who cultivated people; a nurturing man, providing intellectual nourishment, certainly. He was an extraordinary host and he loved cooking, which he did with simplicity and warmth. Thus, through all these different channels he created a community of scholars, or rather, communities of scholars.

The passion for ideas was always a driving force in Yehuda’s life, which he shared with Simon and Steve, among others. He took pride in his ability to recognize interesting ideas, new points of view. Thinking in terms of the sociology of knowledge was very compatible with his understanding of science, which he also shared with Professor Shmuel Eisenstadt, a sociologist and permanent fellow at the Van Leer Institute, who was, at the time, steeped in the work of Karl Jaspers and the “axial age.” Let me now elaborate my reminiscences of Yehuda and the Van Leer intellectual atmosphere as a background to my openness towards the lessons I could draw from Schaffer’s and Shapin’s presence in Jerusalem.

The first point to note is Yehuda’s understanding of ideas. An idea, for him, was no abstract concept. On the contrary: he ardently believed that ideas do not roam through the world bodiless, but are born from within a specific historical and cultural context and are always carried by people or embedded in objects, productive praxes or political acts.

On the basis of this insight, Yehuda claimed that scientists conceptualize the world rather than mirror it, and he attempted to construct a theory of this conceptualization. The distinctive aspect of Yehuda's approach was his use of potent metaphors that brought his theory to life. He gave names to the metaphors that guided him, and these subsequently evolved into concepts that took on a life of their own. The most oft-cited metaphor used by Yehuda was that of images of knowledge, a term that proved to be a salient tool through which to elucidate the analytical distinction he made between claims about the world and claims about knowledge of the world.<sup>1</sup> The network of theories, solutions, open questions, methods and scientific metaphysics comes together to form what he called a "body of knowledge." In contradistinction, the beliefs regarding the role of science, the sources of knowledge (whether faith, observation, or mathematical theory), the hierarchy between these sources, and their origins of legitimacy – all these come together to form the contextual filter: historically-embedded "images of knowledge." But these cannot be logically deduced from the body of knowledge. Rather, they emerge through a process of negotiation, held at times on the level of the individual, and at others on the level of the collective. Yehuda invented a name for the kind of rationality operating in these processes. He called it "cunning reason," or – in my own words – practical reason.<sup>2</sup>

Yehuda's emphasis on "cunning reason" led him to intervene in the anthropological discourse that served as the prime site for the discussion of rationality during the seventies and eighties. One of Yehuda's most prominent interlocutors was Robin Horton, a British anthropologist who lived in Nigeria, was one of the founders of Ife University, and perceived himself to be a Nigerian of British origin. Horton published a highly influential essay about traditional African thought and Western science.<sup>3</sup> In that essay he argued, by means of an in-depth analysis of ancestral cosmologies, that traditional African thought was characterized by an impressive coherency that did not fall short of the coherency found in scientific theories. Such an analysis, claimed Horton, refutes the assertions of mainstream anthropologists of the previous generation that "primitive" cultures are characterized by a lack of logical aptitude. In response to Horton's essay Yehuda wrote his "Reflections on the work of Professor Robin Horton," in which he agreed with Horton that traditional cosmologies testify to the cultural sophistication and the activation of highly developed logical capacities; both agree that the capacity for logic is a universal quality common to all humanity.<sup>4</sup> But in his response,

<sup>1</sup> Yehuda Elkana, "A Programmatic Attempt at an Anthropology of Knowledge," in *Science and Cultures: Anthropological and Historical Studies of the Sciences*, ed. Everett Mendelsohn and Yehuda Elkana (Dordrecht: D. Reidel, 1981), 15–21.

<sup>2</sup> Elkana, "A Programmatic Attempt," 41–48.

<sup>3</sup> Robin Horton, "African Traditional Thought and Western Science," *Africa* 37, no. 2 (1967): 155–87. See also Robin Horton and Ruth Finnegan, eds., *Modes of Thought: Essays on Thinking in Western and Non-Western Societies* (London: Faber and Faber, 1973).

<sup>4</sup> Yehuda Elkana, "The Distinctiveness and Universality of Science: Reflections on the Work of Professor Robin Horton," *Minerva* 15 (1977): 155–73.

Yehuda added to Horton's argument two claims of his own, of which I will only refer to the first. According to Yehuda, the choice to understand nature through models based on societal organization, rather than through mechanistic models that guided the "New Science" of the 17th century, reflects the images of knowledge that captivated the Africans, but that conquered no ground in Western thought. In other words, in the context of traditional cosmologies as well as in the context of the "new science," choices are anchored in interpretative strategies, or "cunning reason," rather than in a logical deductive process.

Thus, Yehuda – in full agreement with people like Horton – rejected the exclusive emphasis on the supremacy of the West, claiming that this conception was disconnected from a contextual discussion of other cultures. He tried to replace the determinist approach to progress in history in general, and in the history of western science in particular, with an alternative approach that he indicated by means of his metaphor of history as epic theater. Following others, he highlighted the bad seeds of the Enlightenment ripening into the Whiggish interpretation of history. Opposite the historiographical approach that assumed a predetermined progress of science – an attitude he compared to the concept of "destiny" in Greek tragedy – Yehuda posed an interpretative mode akin to the epic theater of Brecht and to the views of Walter Benjamin.<sup>5</sup> In a similar move, he recruited Ernst Cassirer's philosophy of symbolic forms in order to highlight the richness of scientific viewpoints and programs that coexisted in Western culture in every epoch. Such diversity obviously invalidated a method of selection of individual "heroes" who presumably led Science forward in a linear and deterministic mode towards necessary progress.

Yehuda's critics accused him of goading science. They said he supported irrational thinking. These accusations, however, were unfounded. Undoubtedly, rationality in the deep, not the technical, sense of the world – a sense that did not exclude emotions and did not ignore political and social interests – concerned him more than anything else; perhaps because he himself was a rare specimen of the complex emotional rationalist.

Two points, in particular, are worth emphasizing in my attempt to trace the background to the idea of establishing a humanities center at Tel Aviv University, and the genealogy of the notion of "migrating knowledge" within this institutional context. The first concerns the traces left by the affinity between Yehuda's ideas about "science in context" that intermingled – in my mind at least – with Schaffer's and Shapin's historical-sociological understanding of English mechanical science in the seventeenth century. This occurred just at the moment when I completed my M.A. dissertation on "Science and Religion in the Work of Robert Boyle," where I attempted to demonstrate the religious and political implications of Boyle's mechanical philosophy. I well remember my long conversations with our British friends on the topic, and their impact on the development

<sup>5</sup> Elkana, "A Programmatic Attempt," 67.

of my thought not just about Boyle but, more generally, about how to do the history of science. However, the long-term consequences of those conversations for my entire career came when I tried to consult with them about the next step of my studies, namely the Ph.D. dissertation. I was rather stuck with my determination to continue my work on Boyle, when Simon threw his comment that "this is a well-trodden path; you had better think of something else." It was Simon's comment, then, that led me to attend Yehuda's seminar on Galileo Galilei, to studying Italian seriously, and to my dissertation that matured into a book on *Galileo and the Church: Political Inquisition or Critical Dialogue?*, which came out with Cambridge University Press.

Now, let me finish by quoting one example of the way my thought developed under the impact of Yehuda, Simon and Steven, and also Horton, with whom I spent three years at the University of Ife in Nigeria. I shall start with the intellectual dimension of the fruits of my background, and say a few words about its institutional dimension.

### Migrating Knowledge

For me, migrating knowledge is a conceptual framework meant to emphasize that knowledge is a system connecting people, practices and instruments with representations of things, ideas and processes expressed in oral speech, in writing or in manners of performing both with matter and with ideas. Using the term "migration" in this context denotes the dynamic nature of systems of knowledge, where the relations among their various components or levels are constantly changing. While we cannot really verify Galileo's contention after his trial, "Eppur si muove," his words do reflect a historical moment in which constitutive scientific statements testify to the relationship between knowledge and authority, denoting a connection between knowledge and movement, and between doubt and destabilization. The historical "moment" of Galileo's trial thus represents the tensions between different sites of knowledge such as the university, the Jesuit Collegio Romano, the papal court and its relation to the Medici court. In other words, it expresses the way in which scientific knowledge is embedded in a cultural, political and theological context and the dynamics that establish its status in society and the narrative about it.

"Migrating Knowledge" is not just a theory about knowledge mobility and knowledge transfer. It is also the name of one of three departments at Minerva Humanities Center that was established in Tel Aviv University in 2009. The institute has been recognized as a unique crossroad between all the disciplines of the sciences, the humanities and the social sciences. There, the production of knowledge is not dissociated from reflection on the function and usage of that knowledge in the local and the global context, in history and in the present. Being a magnet for young Israeli-Jewish scholars, it also focuses on attracting young Palestinian scholars to the campus. Against the reality of scarce participation of Palestinians in the Israeli academia, our mission is to promote equal opportunities and common discourse among Jews and Arabs. I see this reality as a recent product

of a long-term dialogue with Yehuda, Horton, Simon, and Steven that bore a wonderful institutional reality, and a substantial body of knowledge produced by our scholars. Let me then end with a quotation from Kapil Raj:

Indeed ... localities constantly reinvent themselves through grounding (that is, appropriating and reconfiguring) objects, skills, ideas, and practices that circulate both within narrow regional or transcontinental – and indeed global – spaces.<sup>6</sup>

<sup>6</sup>Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke: Palgrave Macmillan, 2007), 21.

# Mischievous Magnanimity

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ADRIAN JOHNS

The photograph that accompanies this piece was taken in the grounds of the Senate House, at a Cambridge University degree ceremony that took place in 1992. Simon and his mother had come along to celebrate the achievement of a Ph.D. by Alison Winter, a student of his who would go on from that day to a research fellowship at St. John's College and then an academic career at Caltech and the University of Chicago. It makes sense to include it in this collection because the story behind it captures an aspect of Simon Schaffer's achievement that matters enormously but is all too easy to miss – or even to dismiss. That aspect is what may be called mischievous magnanimity: magnanimity because it is a form of selfless, curiosity-driven generosity, frequently extended over months, years, and even decades; and mischievous because it takes effect not merely in spite of institutional rules and expectations, but almost in defiance of them.

Alison and Simon had met almost five years earlier. At the beginning of October 1987, Alison arrived in Cambridge as a newly-graduated BA student from the University of Chicago. She had applied to the History and Philosophy of Science Department's M.Phil. programme, having been urged to do so by the renowned mathematician Yitz Herstein, then on his deathbed. "Go to Cambridge," Herstein had told her: "it will change your life." He turned out to be right, but in an unorthodox way. Her application in deference to this exhortation had come in far too late, so of course it had been rejected as a matter of course. Knowing this, she had set out on a solo bicycle tour of France. She decided to stop off in Cambridge before flying back to the United States, mainly in hopes of being able to talk her way into the University Library to see some of Darwin's papers. When she locked her bike up on the street and walked into the Department's building on Free School Lane, she therefore caused a kerfuffle. The office administrator, named Maureen, told her to wait while she phoned the department chair, David Papineau. From her position in the lobby Alison could hear one side of the short conversation that followed, and would later recall it frequently to friends. "David, you remember that American student who applied late to the Master's programme? ... Well, she's here ... Yes, here ... And she seems to have brought her sleeping bag."

If that sounds like a Chair's nightmare in the making, the sheer effrontery of her arrival turned out to have a beneficial effect. Alison had had the good fortune to arrive on the very day when Papineau's term of office as chair ended and his successor Michael

Redhead's was about to begin. Neither wanted any trouble. So it was that she gained entry to the department's building, and found herself swept up in the meetings and greetings of a new academic year, in those days of anticipation when all seems possible. A day or two later, the introductory meeting that the department always held at the start of the Michaelmas Term took place, and she went along to that too. It was held in the basement seminar room late in the afternoon. All the incoming doctoral and M.Phil. students – a group of perhaps two dozen – introduced themselves in turn, along with the entire population of faculty, postdocs, and college fellows who made up the Free School Lane community. In the way that these things always happen, each person was asked to say their name and their field of interest. The room was crowded, and Simon, having entered a little late, had perched himself on a window sill at the back, looking down on the room like a slightly disheveled magpie. It was easy to imagine that this was by design, so as to set himself at a different pole from the kind of stuffy airs-and-graces professor who would take a seat at the table. One by one, starting with the new Chair – who declared to some bewilderment that the mission of the department was “to push the boundaries of knowledge backwards” – the people around the room declared their names and topics. Towards the end of the sequence, it was Simon's turn. He announced in a deep, emphatic, and resonant voice, “I'm Simon Schaffer, and I'm interested in *everything*.”<sup>1</sup> And with that, everyone filed out of the room and tromped off to the pub.

That was the day when Alison met Simon for the first time. At some point they started talking, and he quizzed her to try to find out why she was really there. Finding that she had graduated from Chicago – which at that time was an outlier in the field, associated with a rather willful intellectual conservatism – he seems swiftly to have dismissed her ambition to see Darwin's papers as typical Hyde Park dilettantism. Instead he proposed that she work on something else: something endemic in nineteenth-century English society but at that time both largely unknown and urgently needing to be studied. The subject was mesmerism. And with that he dispatched her to the University Library. As so often, he had pointed someone to an exciting field at exactly the right moment, and she was very soon swept up in the discoveries that she began making. Indeed, the sheer experience of discovery itself was new and exhilarating: that it was even *possible* to do this kind of research came as a revelation to someone accustomed to a culture in which students were assumed to need years of cultivation before they could be trusted to find out something new. That fact of trust was immensely compelling. Before the week was out, she had resolved to find some way to continue doing it, and Simon had ended up recruiting her as a kind of informal assistant-cum-student, utterly without remuneration or registration for either of them. More such conversations followed – often undertaken at

<sup>1</sup> This declaration caused a bit of a stir, but in fact it was one of the few moments when I ever saw Simon upstaged. He was immediately followed by Frances Willmoth, a plain and soft-spoken expert on seventeenth-century mathematical sciences who had recently received her doctorate and was then consumed in the soul-destroying search for a job. “I'm Frances Willmoth,” she said, and added in a quietly plaintive tone, “I'm not sure that I'm interested in anything any more.”

the Eagle, the pub at the end of Free School Lane, or at the Boathouse or Portland Arms, similar venues close to his then home on Albert Street – and by the time she returned to the United States for Thanksgiving she was planning to reapply for formal admission. Eleven months later she was a bona-fide graduate student, and it was that that led to the graduation day in 1992 and, in due course, her independent career. During that all-important first year, however, the endeavor was entirely informal and “off the books.” There was no way to predict on that first day that any good outcome would arise. On the other side, Simon himself gained no measurable benefit from the entire interaction. It was even, perhaps, a little risky.

This kind of experience was surely not unique to Alison. In our time there (I started as a Ph.D. student that same day in 1987 when she showed up with her bicycle, and in due course she and I would end up married), we knew numerous people who could have told similar stories, and there have no doubt been many more since we left in the mid-1990s. Simon acquired a reputation for selflessly taking on, inspiring, and mentoring such lost souls, not a few of whom had their lives changed by the experience in the same way. As with Alison, so with other newcomers: what was so astounding, so radical a departure from everything they had encountered in the academic world before, was not only that such a brilliant and (to all appearances) omniscient figure would trust a newbie to venture into the vast holdings of the UL and find new knowledge. It was that he seemingly regarded it as self-evident that he should do so. It appeared that it had never occurred to him that anyone reasonable could think anything else. And so, what emerged were innumerable revelations large and small, and a generation of historians – and sociologists, anthropologists, and more – primed to continue producing them.

But when remembering experiences like Alison's, that word *measurable* is worth pausing over too. For historians of science, of course, it is a word that comes with many associations – not least because of Simon's own long record in revealing the importance of metrology in so many contexts. This is why it might be thought risky to take an unproven, unknown newcomer under one's care. A modern research university operates, to an extent, as a time economy. In the more humanistic wings of the institution, at least, the scarce commodity in terms of which potential labors are informally (and generally tacitly) “priced” is time rather than money. Most of what humanistic scholars do is not very expensive in cash terms, although the support systems for them, such as well-maintained research libraries, certainly are. But in order to be successful, an interaction with a neophyte researcher must consume large amounts of time, and time is always limited. In that context, real institutional pressures exist in the British and American academic systems against ventures that are not measurable. The chronology of those pressures bears emphasis. Starting at around the time when Simon arrived in Cambridge as a lecturer, and formalized for the first time a couple of years later in 1986, the nationally centralized “research assessment exercise” (latterly the “research excellence framework”) sought to arrive at quantified measures of research output for departments across the country's university system. Championed by Margaret Thatcher's Conservative Government, the idea of the initiative was to furnish objective measures of the “quality” of research be-

ing conducted in such departments, principally by counting publications – an initially crude metric that was qualified and improved in various ways over successive iterations. A never-ending string of complaints naturally followed – “three assessments in seven years,” as John Sutherland put it in 1994, “verges on harassment” – and they continue to simmer to this day.<sup>2</sup> There is no need to rehearse here the terms in which critics like Stefan Collini have inveighed against the “marketization” of higher education. It is important to recall, however, two obvious points. One is that everyone in academia from the mid-1980s onwards, from incoming student to emeritus professor, was well aware of the consequences of not hewing to the expectations of the measurers. The other is that the one thing all the various “exercises” and “frameworks” conducted since the ’80s (under both major political parties) have had in common is that they have all rigorously excluded any consideration of face-to-face, conversational, intellectual magnanimity, treating it as non-work. Regarded as untraceable, such practice is deemed valueless. Or rather, the message the system sends is a stronger one: that such conduct is actively deprecated. It is treated *de facto* as a deficit, because time spent doing it is time spent *not* doing those things that *are* quantified – teaching classes, writing papers, publishing books. Anyone who has spent time in a decent graduate programme knows how fictitious this central axiom of the assayers is. But that does not matter. For a generation now, this regime has constituted the reality of the UK’s university environment. And because, unlike counterpart systems in other nations, it is a coherent, centralized system operated at the behest of the state, there is not even the illusion of a saving diversity among different institutions. In this world, every act of sustained intellectual magnanimity is almost an act of small-scale, *sotto-voce* defiance. Earlier generations of dons renowned for their collegiality, such as Maurice Bowra or Christopher Hill, surely were generous with students and peers, but their efforts were not off the books in this way, almost as if they constituted a grey economy. Starting at roughly the time Alison showed up in Free School Lane, every one of those daily “supervisions” at the Eagle or the Bath would come to feel like a small gesture in sustenance of a humanism that is ignored or denigrated when it should be highlighted and hailed.

But that is to be altogether too po-faced about it. After all, mischief is fun as well as insubordinate, and when it comes to mischievous magnanimity both those things are virtuous. Originality, curiosity, discovery, and the changing of minds all emerge from that. The beneficiaries of these experiences have by now dispersed through the institutions of higher learning in several continents. One hopes that the many people who originally found inspiration, purpose, and an intellectual identity through experiences like Alison’s can replicate something of those experiences for the next generations. If so, we can be optimistic for the future of an intellectual culture that can genuinely thrive.

<sup>2</sup>John Sutherland, “An Inspector Calls,” *London Review of Books*, 10 November 1994.



FIGURE 1. • Simon Schaffer and Sheila Schaffer, Senate House Lawn, Cambridge. Probably June 1992.

# Simon Schaffer: Brighton and Cambridge

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SAUL DUBOW

I first met Simon at The Punter, shortly after taking up a position at Cambridge in 2017. We were to talk about the history of astronomy, a subject I was engaged in researching. The conversation moved easily from topic to topic and he mentioned, via talk of Parramatta and the Atacama Desert, that he shared with me not only roots under southern skies, but also on the south coast of Brighton.

I did not immediately register that Simon was the son of Sheila and Bernard Schaffer, well known double-stars of Sussex University. When I joined Sussex in 1989, my first permanent academic position, I was summoned to the Library within days of my arrival via a note in my pigeon hole. Sheila, a senior librarian, greeted me warmly but also with a sense of firm purpose: she scrutinised my reading lists and promised to order the books I required well before the start of term. And so she did.

Sheila reminded me a little of my mother, a school librarian in Cape Town, who believed that books and reading ought to occupy centre-stage in all aspects of teaching and learning. Librarians were educators in those days, not mere facilitators of information technology or teaching delivery. Sheila and my mother, I suspect, would have shared a great deal besides, not least a youthful socialism tempered by disgust at the Soviet invasion of Hungary. Sheila was energetically engaged in Brighton communal life and went on to become the town's mayor in 1995. I did not know Simon's father, Bernard, who died before I arrived. But he was well remembered at Sussex not least by the first friend I made at the School of African and Asian Studies, Ian Duncan, a specialist in Indian politics, who went on to succeed Sheila as Brighton's mayor in 1996. Ian's doctoral thesis was examined by Bernard, formerly a professorial fellow at the Institute of Development Studies, a specialist in public policy and an internationalist. Bernard examined Ian's PhD with together with W. H. Morris-Jones – "Jesus what a pair!" as Ian recalls, adding that Bernard was a "soft soul."

Although my meetings with Simon have been infrequent, our encounters have been memorable events. Always generous with ideas and fuelled by an irrepressible intellectual energy, Simon is simply one of the most incisive, eloquent and charismatic scholars in our firmament. He recently helped to launch my recent co-authored book (on zoom)

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resulting in several people, my family included, writing to me to enquire more about that astonishing man. Most people contributing to this Festschrift will know Simon much better than me, and over a much longer time; few Cambridge colleagues have done more to help me align myself within its celestial sphere. I am enormously grateful to Simon who, without directly knowing this, has done so much to help me navigate my transit from Sussex.



# A Fifth Slice

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RICHARD STALEY

“Onions, bunions, corns and crabs,  
Whiskers, wheels and hansom cabs,  
Beef and bottles, beer and bones,  
Give him a feed and end his groans.”

These are the words with which the title character in Norman Lindsay’s great Australian children’s book *The Magic Pudding* addresses a young, officious koala with a strong prejudice against whiskers and a proclivity for rhyme and song, and a hunger in his belly that was the inevitable result of leaving home (to escape the whiskers on his uncle’s face). The book was the literary result of Lindsay’s bet that he knew childrens’ reading desires better than a colleague who thought they really wanted to read about fairies and the like. Instead, with the Great War already in its fourth year, Lindsay wrote a tale about food and fighting featuring the rowdy sailor Bill Barnacle and his penguin companion Sam Sawnoff. The story’s main protagonist, the young koala Bunyip Bluegum, meets and then joins these travellers in order to become a puddin’ owner, committed to protecting and benefitting from their extraordinary charge. Albert, their bandy-legged pudding in a basin, was a “cut-an’-come-again Puddin’,” capable of ceaseless replenishment. Almost as remarkably, his contents could be changed in a moment by whistling twice and turning the basin, to shift from savoury steak and kidney (garnished with onions), to apple dumpling, plum duff or whatever took your fancy.

Leaving Australia I carried a memory of the book’s final page as the single most evocative image I had of home, with its pencilled drawing of a sprawling tree rising above a garden surrounded by a picket fence – for the traveller’s tale had resolved in their making a tree house. A wooden shanty with a water tank, tin chimney-pipe and a capacious porch perches improbably on one branch with the heroes in discussion over tea, while a “Puddin’ paddock” encloses the bandy-legged magician on another branch designed to prevent his escape and protect him from the inevitable thieves. Perhaps it was the fact that I’d built tree huts and carried out pitched pine-cone battles with my brothers and a few friends high above the ground on branches quite like those, that led me to take such joy in this image when I’d read the book as a child.

One evening spent with Otto Sibus and Bob Brain at Simon’s place in the early 1990s I recalled *The Magic Pudding*, prompting an immediate, wonderfully rich riff from Simon who linked its magical replenishment to the depression in a quick allegorical reading that stunned his listeners in different ways. It was an occasion on which Otto and Bob began to think of Simon as also Australian on account of his childhood there; while I suddenly

thought of both the book and my own home differently, as the historian I'd begun to become. Somehow conversations with Simon so often share heritage and in the process renew it, changing things.

Like many travellers I'd left home with an itch, a feeling that I hadn't yet found my people – though I'd had many good friends, somehow they were mostly distinctly older or younger, or had come from the school I'd left behind. That feeling changed in Cambridge, but at the same time that I found my generation, I lost a home. Britain had nothing of the natural rawness I'd walked and camped, the sky was so low, there were so few of the magnificent scruffy eucalypts I'd grown up with, and people here lived in houses of brick and street and maybe impossibly lush gardens, not amongst trees and dry ground as I had. I never looked for bushland here, and slowly I lost a home.

I don't know if I could have done that if Simon and others hadn't helped me look for more – in ways I've not tried to articulate before now, returning to think about *The Magic Pudding*.

First the teacher's recipe. As many know, supervisions with Simon were thickly associative; perhaps you could say they un-disciplined through rigorous imagination. One of the habits I learned to admire was his mapmaking, the concrete image he could convey of Newton's movements in London or the way he'd read a chapter and then offer a new sketch of the dissertation you were writing. Thus he'd inspire a richer result by seeing other stories in the elements I'd begun to weave together, and yet I often felt he both saw wonderfully more than I could write – and that this rich vision wasn't quite what I was still in the process of finding (he'd turned the pudding, and named a meal, but it became something else in the feeding). But perhaps the richest lessons came in the generosity Simon showed in seminars or the pub afterwards, when I sometimes found he helped an audience see new interest in another person's argument, just as I'd begun to pull it apart in my mind. He could do that even when facing the direct challenges to social constructivism that Michael Redhead as chair sometimes turned to him; finding a common ground that got beyond the quick slogans in intellectual debate – so generous, even in combat. Have you experienced awe? It took me years to learn to talk with Simon, because I felt I had so little worth his hearing. That's not a thought he would have countenanced: I'm so glad he's patient too.

Now to revisit the allegory. Lindsay's imagery whistles together both British mores (sailors' songs, mayors and constables, tea and bananas) and Australia's fauna in extraordinary conjunction, and he punctures the pretensions of the former even at the same time that he allows you to delight in them. For one example, he gives Bunyip Bluegum the manners and apparent naivety of a gentleman of leisure as he leaves home with only a walking stick, rather than the bag or swag that would have marked him as a more typical traveller or itinerant in the bush. Thus incongruities mark the settler-Australia that Lindsay conveys with his class-crossing characters, and despite the village with its church tower visible in the distance of that back page depiction, the tree house in the foreground is afloat in the air and bears an Australian flag. The patriotism must have been important, but Lindsay plays with it too: one means of discovering a stolen puddin' is to sing the

anthem to honour the King, requiring the lifting of the hat that hides it. Still more importantly, although most of the action concerns overcoming the deceit and trickery of the infamous puddin'-thieves (a sometime-singed possum and Watkin Wombat, Esquire), the Puddin' himself tells us that his present owners had first thieved and murdered to gain him, by rolling the cook his inventor off the iceberg they had all shared when escaping the shipwreck of the "Saucy Sausage." So even if Bill and Sam are our heroes as they fisticuff their way, justly enraged as wronged puddin' owners, and Bunyip Bluegum's poetic license finds ever new ways to ensure they find the Puddin' and try their own case, Lindsay gives us an origin story that resists any neatly asymmetric accounting of the morals and violence of those land crabs.

Although written in the midst of war and centring on battle justice, Lindsay thus offered seeds for other thoughts, and rather than a resolution his ending comes simply as a brilliant solution to the need to finish before the cover arrives, and to put an end to the puddin' snatching:

"The solution is perfectly simple," said Bunyip. "We have merely to stop wandering along the road, and the story will stop wandering through the book. This, too, will baffle the puddin' thieves, for while we wander along the road, our Puddin' is exposed to the covetous glances of every passing puddin'-snatcher. Let us, then, remove to some safe, secluded spot and settle down to a life of gaiety, dance and song, where no puddin'-thief will dare to show a sacrilegious head. Let us, in fact, build a house in a tree."

So even with its evocative, simple ending, Lindsay has shown us that despite appearances their home is not yet justly settled in the complex violence of colonialisms. At any rate, that's my conclusion. And having lost one home I will join the other lesson that Lindsay's characters offer – in friendship – with the inspiration of Simon's generosity across combat lines to build what I'm beginning to think of as a home unsettled, one found just in friendship.

