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Scientific experiments

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Mots-clés

Audience
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Résumé

In eighteenth-century Britain, scientific experiments were shown in locations as varied as coffeehouses, learned societies, and public lectures. They conveyed natural knowledge through shared aesthetic experiences; they also elicited conversation and facilitated new forms of sociability. At the beginning of the era, William Whiston and others showed demonstrations of mechanics in coffeehouses. Later, Benjamin Martin commercialized experiments with static electricity, and Joseph Priestley and his associates introduced new gases in public lectures. Experiments were both commodities supplying a kind of cultural consumption and shared experiences within the new associational forms of the public sphere.

Scientific experiments played a significant role in the spaces of sociability that characterized British society in the eighteenth century. They were shown in learned societies, educational institutions, clubs, assembly rooms, coffeehouses, and taverns. Experiments occurred in settings of social interaction and conversation; they were performed as part of educational curricula and in public lectures offered to paying audiences. As epistemic practices, they were shaped by conventions forged in the Royal Society of London after its formation in 1660. The Royal Society had coalesced as a microcosm of the restored social order in England after the upheavals of the civil wars and interregnum. At its meetings, experiments were performed for an assembly of witnesses who could freely assent to the truth of what they saw. An audience of male aristocrats and gentlemen certified what they witnessed without involving themselves in controversial matters of metaphysics and religious doctrine. The aim was to produce consensus around factual matters, while allowing individuals to retain their private opinions as to interpretation. Beyond the circle of those immediately present, 'virtual witnesses' were recruited by the publication of written accounts of experiments and observations, couched in the appropriate style, in books and periodical publications.

As these practices were replicated in other locations during the eighteenth century, experiments were adapted to more common modes of sociability. The audience was widened to include women and even children, who attended public lectures and viewed experiments conducted in the home. Scientific instruments became conversation pieces, foci for polite discourse in public and domestic settings; they appealed to the senses and evoked the sensibility that was increasingly valued as a personal attribute. Those who viewed experimental phenomena experienced a wide range of emotions, including religious devotion, apprehension of the sublime powers of nature, and admiration for enlightened rationality. Experimentation elicited such feelings by bringing natural philosophy (in the words of Joseph Addison) 'out of Closets and Libraries, Schools and Colleges, to dwell in Clubs and Assemblies, at Tea-Tables, and in Coffee-Houses.'[1]

Public lectures with experimental demonstrations were initiated by a small group of London-based pioneers around the turn of the century. In 1705, James Hodgson, fellow of the Royal Society and mathematics teacher at Christ's Hospital, offered a course on natural philosophy and astronomy. He partnered with the instrument-maker Francis Hauksbee to show apparatus to 'Curious and Inquisitive Gentlemen' who paid two guineas for the opportunity.[2] Other lecturers soon followed in the metropolitan market, including Humphry Ditton and John Harris. William Whiston, expelled from his professorship at Cambridge University for religious heterodoxy, moved to London in 1710 and began a career of public lecturing that lasted until the middle of the century. During his first few years in the city, he offered lectures at several coffeehouses, including Button's in Covent Garden, Douglas's in St. Martin's Lane, and the Marine near the Royal Exchange. The Huguenot refugee John Theophilus Desaguliers assumed a similar profile, having studied at Oxford University before he arrived to teach in London in 1713. Collectively, these individuals mapped out the syllabus for lectures on mechanics, optics, and astronomy, and devised apparatus to demonstrate the basic concepts. As Desaguliers explained, through teaching by experiments, 'Things which otherwise would be merely speculative, [are] rendered Objects of the Senses, and better understood in a Month or six Weeks, than in a Year's close Application to books only.'[3]

The effects of static electricity were among the phenomena translated from the circles of scientific virtuosi to a wider audience. Desaguliers and the dyer Stephen Gray were among those who showed electrical experiments in public lectures. In the early 1740s, according to the *Gentleman's Magazine*, electricity became 'the subject in vogue'.[4] Electricity—identified as a fluid or 'fire'—was generated by a machine in which a glass plate or globe was rubbed against wire brushes. It could then be conducted through metals or the human body. As the charge passed from body to body, participants experienced peculiar sensations. They felt shocks or saw sparks fly as they approached or touched one another. Electricity was a force of nature generated from matter; it also stimulated an aesthetic sensitivity in the human body. This was a novel accompaniment to interpersonal interactions, a concretization of the sympathetic feelings that were understood to bind people together in civilized society.

By the 1740s, scientific lecturing was becoming common in locations outside London. Benjamin Martin, who began his career as a schoolmaster in Chichester, took to itineracy in that decade. In his first few years on the road, he visited Bath, Birmingham, Chester, and Shrewsbury, announcing his arrival in advance in newspaper advertisements and having subscriptions collected by a bookseller or publican. If customers appeared, he would give one or more courses, each of a dozen or so lectures, generally charging one or two guineas per course. Martin toured regularly until the mid-1750s, when he set up business in London, where he continued to lecture, published popular scientific works, and made and sold experimental apparatus.[5] His career-path was followed by dozens of others in the remaining years of the century. The Scottish astronomer James Ferguson toured England from the late 1740s, teaching with globes and orreries (mechanical models of the solar system) of his own manufacture. It has been suggested that he is the lecturer in a famous painting by Joseph Wright from 1766 (see above), which shows an orrery being used to demonstrate the motions of the planets. Adam Walker, an itinerant lecturer in the north of England, Scotland, and Ireland in the 1760s and 1770s, and subsequently based in London, exhibited a large vertical orrery he called the 'eidouranion.'

The scene depicted in Wright's painting is not one of theatrical exhibition but rather of experimental display in a domestic setting. The audience closely surrounds the apparatus and consists of two men, one woman, a boy, and two young children. It is possible the scene is set in the household of Washington Shirley, Fifth Earl Ferrers, at Staunton Harold in Leicestershire.[6] The image illustrates how domestic experiments enrolled women and children as spectators and even participants. These audiences were also addressed by printed books, including Francesco Algarotti's *Newtonianism for the Ladies* (1737), and *The Newtonian System of Philosophy Adapted to the Capacities of Young Gentlemen and Ladies* (1762), ascribed to 'Tom Telescope' (the publisher John Newbery).[7] Works by Harris, Martin, and Ferguson also addressed women and children, and envisioned them participating in experiments. The instruments sold by Martin, including orreries, globes, microscopes, and telescopes, became familiar artifacts and foci of conversation in bourgeois homes. Meteorological instruments, especially thermometers and barometers, became popular household artifacts. In the 1660s, barometers were said to have been 'confined to the cabinets of the virtuosi,' but by the 1720s they were reported as 'very common, and in every Body's Hands.' Barometers were labeled 'philosophical furniture,' and books were published that offered advice to their owners on how to use them and talk learnedly about them.[8]

Outside the home, experiments were also shown in the predominantly male ambience of clubs and societies devoted to science and general learning. Formally constituted scientific institutions in London, Dublin, and Edinburgh inspired the creation of a large number of less formal groups throughout the British Isles. Conversation societies, literary societies, student clubs, subscription libraries, and local improvement societies flourished, sometimes meeting in private dwellings but more usually in hired rooms in coffeehouses, inns, or taverns. Scientific topics were often central to the interests of these groups. Examples include the Gentlemen's Society in Spalding in Lincolnshire, the Philosophical Society presided over by Erasmus Darwin in Derby, the Bath Philosophical Society, and the Mathematical Society formed by weavers in Spitalfields in the East End of London. The Lunar Society, which embraced doctors, chemists, and industrialists around Birmingham in the second half of the eighteenth century, was perhaps the best known of those gatherings.9

The Coffee House Philosophical Society, which met in London in the 1780s and has left a record of its discussions, exemplifies the groups in which experimental knowledge featured as a focus of sociability and conversation. Choosing to meet at the Chapter coffeehouse, and for a while at the Baptist's Head, the society located itself in the commercial heart of the city. It adopted a series of regulations to keep the talk flowing freely, stipulating that discussions should be open to all present, and the chairmanship should rotate among the members. Jargon and 'disquisitions' by specialist members, especially medical professionals, were prohibited, as were mathematical demonstrations. Dogmatic or exclusionary talk was viewed as contrary to the egalitarianism prized by the members, who valued conversation as the means by which independent individuals could socialize on an equal basis. It does not appear that experiments were performed in the society's meetings, but empirical facts were frequently discussed. The members coalesced around acceptance of what were sometimes called 'gentlemanly facts,' whether viewed collectively or reported by reliable witnesses.10

The Dissenting minister and teacher Joseph Priestley wrote, in his *History and Present State of Electricity* (1769), that electrical experiments 'furnish the most pleasing and surprising appearances for the entertainment of one's friends'. He declared that the pleasure of viewing such experiments 'bears a considerable resemblance to that of the sublime, which is one of the most exquisite of all those that affect the human imagination'.11 To survey the history of scientific progress was to experience the sense of boundless magnitude central to the sublime, Priestley claimed. In later years, reviewing his own startling discoveries of new gases, he reaffirmed his conviction that future scientific progress would be unending, 'a prospect truly sublime and glorious'.12 To share this experience widely, Priestley encouraged public lecturers to reproduce the phenomena he had discovered. Itinerants, including Walker, John Warltire, Benjamin Donn, and Henry Moyes, who were already teaching experimental science in various parts of England, quickly incorporated his discoveries into their repertoires. They described the medicinal virtues of carbonated water and the use of 'inflammable air' (hydrogen) in balloons. Walker adopted the new gases in his lectures in York in the early 1770s, reproducing Priestley's rhetoric about the utility of chemical science for humanity and the sublime prospect of its unending progress.

In the 1790s, political tensions following the outbreak of the French Revolution began to impinge on the public culture of science in Britain. The government suspected debating and discussion societies of fomenting subversion and introduced restrictions that also impacted informal scientific groups. An atmosphere of suspicion was stoked by the writings of Edmund Burke and a lurid *exposé* by the former radical William Reid, which claimed that London was a hotbed of ‘infidel societies'.[13] Laws passed in 1795, 1799, and 1817 required debating societies to obtain licenses from the authorities. The Academic Society of London, the City Philosophical Society, and the Philomathic Institution were denied licenses, and the Spitalfields Mathematical Society was prosecuted after having been infiltrated by government informers. However, institutions with formal charters (such as the Royal Society) remained unmolested, and a new establishment for public scientific instruction, the Royal Institution, was founded in 1799, backed by aristocrats of impeccable respectability, including the Duke of Devonshire and Earl Spencer, along with such prominent men of science as Joseph Banks and Count Rumford.[14] In the climate of political reaction, self-organizing scientific clubs faced restrictions while a new venue for public experimentation was created in the heart of London.

At the same time, new experimental phenomena were emerging, with consequences for the conditions under which experiments were performed and witnessed. In the 1780s, two spectacular effects were imported from across the Channel: mesmerism and the launches of manned balloons. In the 1790s, these were joined by the fascinating effects of galvanic electricity, a force that seemed to be organic in origin and closely connected with vitality itself. These innovations opened up a new world of natural wonders and restructured the social relations surrounding public experimentation. It seems telling that several commentators likened them to the fervor of revolutionary political change, which threatened to spread through society with equally dramatic results. Priestley and his associates were accused of unleashing social unrest by their efforts at scientific education. An incautious remark by Priestley about the established church having reason to fear the influence of the air pump and the electrical machine was turned against him, and he was driven into exile in the United States after his house in Birmingham was ransacked and burned by a loyalist mob.

In this reactionary climate, attempts by the radical medical practitioner Thomas Beddoes to harness gases and galvanism for therapeutic purposes were met with censure and ridicule. But, when Beddoes’s former assistant Humphry Davy began showing these phenomena in lectures at the Royal Institution, he was spectacularly successful. Davy demonstrated the effects of breathing gases and displayed a large voltaic battery, the same device with which he discovered previously unknown elements, including sodium and potassium. He showed electrical sparks and explosions in the lecture theatre and used the newly discovered metals to create a model volcano, which he ignited to tumultuous applause. Davy’s lectures in the first decade of the nineteenth century were extraordinarily popular with the metropolitan elite, and his audiences included a significant proportion of women won over by his charm and passionate eloquence. He expanded the audience for scientific experiments by deploying phenomena that evoked viewers’ sense of the sublime, while displaying himself in the character of a scientific genius.[15]

Sir Thomas Lawrence, 'Sir Humphry Davy, Bt', © National Portrait Gallery, London, NPG 1573, unknown date.

Davy's remarkable success in the Royal Institution's lecture theatre set the terms for the nineteenth-century enterprise of scientific popularization. London, in particular, soon boasted entrepreneurial lecturers and showmen offering spectacular displays of galvanism, mesmerism, pneumatics, and electricity. Scientific experiments took their place in a metropolis that offered an unprecedented range of visual spectacles. A visitor to the city in 1807 took in demonstrations of a steam engine, a purported perpetual motion machine, and the phantasmagoria (a stage illusion that created a ghostly image using light and mirrors), along with more routine scientific exhibitions.16 Adam Walker's eidouranion became a fixture in the capital, and his son Deane Franklin Walker built a career displaying the sublime mysteries of astronomy with a contraption that showed the planets moving in a vertical plane on a theatre stage.17 Scientific experiments, previously performed as the focus of socialization in the eighteenth-century public sphere, had been translated into a context of showmanship and spectacular display, in which witnesses and hands-on participants were assigned the more passive role of spectators at occasions of mass entertainment.

1. [Joseph Addison], The Spectator, no. 10 (12 March 1711).

2. Daily Courant, 9 December 1704, quoted in Jeffrey R. Wigelsworth, Selling Science in the Age of Newton: Advertising and the Commoditization of Knowledge (Farnham, Surrey: Ashgate, 2010), p. 90.

3. John Theophilus Desaguliers, A Course of Mechanical and Experimental Philosophy (London, 1725), quoted in Larry Stewart, The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750 (Cambridge University Press, 1992), p. 123.

4. Gentleman's Magazine 15 (1745), pp. 193-7, quoted in Simon Schaffer, 'Natural Philosophy and Public Spectacle in the Eighteenth Century,' History of Science 21 (1983), pp. 1-43, p. 6.

5. John R. Millburn, Benjamin Martin: Author, Instrument-maker and 'Country Showman' (Leiden: Noordhoff, 1976).

6. Judy Egerton, Wright of Derby, (London: Tate Gallery, 1990), p. 54.

7. James A. Secord, 'Newton in the Nursery: Tom Telescope and the Philosophy of Tops and Balls, 1761-1838,' History of Science 23 (1985), pp. 127-151.

8. Jan Golinski, 'Barometers of Change: Meteorological Instruments as Machines of Enlightenment,' in William Clark, Jan Golinski, and Simon Schaffer (eds.), The Sciences in Enlightened Europe (University of Chicago Press, 1999), pp. 69-93.

9. Jenny Uglow, The Lunar Men: Five Friends Whose Curiosity Changed the World (New York: Farrar, Straus, and Giroux, 2002).

10. Trevor Levere and Gerard L'E. Turner, Discussing Chemistry and Steam: The Minutes of a Coffee House Philosophical Society , 1780-1787 (Oxford University Press, 2002).

11. Joseph Priestley, The History and Present State of Electricity, with Original Experiments. 3rd ed., 2 vols. (London: C. Bathurst and T. Lowndes, 1775) 1, p. xii, ii.

12. Joseph Priestley, Experiments and Observations on Different Kinds of Air and Other Branches of Natural Philosophy, 2nd ed., 3 vols. (Birmingham: Thomas Pearson, 1790), 1, p. xix.

13. William Hamilton Reid, The Rise and Dissolution of Infidel Societies in this Metropolis (London: J. Hatchard, 1800).

14. Morris Berman, Social Change and Scientific Organization: The Royal Institution, 1799-1844 (Ithaca: Cornell University Press, 1978).

15. Jan Golinski, The Experimental Self: Humphry Davy and the Making of a Man of Science (University of Chicago Press, 2016).

16. Jan Golinski, 'From Calcutta to London: James Dinwiddie's Galvanic Circuits,' in Bernard Lightman, Gordon McOuat, and Larry Stewart (eds.), The Circulation of Knowledge Between Britain, India and China: The Early-Modern World to the Twentieth Century (Leiden: Brill, 2013), pp. 75-94.

17. Jan Golinski, 'Sublime Astronomy: The Eidouranion of Adam Walker and His Sons,' Huntington Library Quarterly 80 (2017), pp. 135-157.

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