PORTRAITS OF SCIENCE

Quick and Magical Shaper of Science

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With his spectacular theatrics, "Professor" Pepper aimed to inculcate a sense of rational wonder in audiences fascinated by spiritualism and magic.

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John Henry Pepper was the celebrity chef of Victorian science. During the mid-19th century, children and their parents flocked to London's Royal Polytechnic Institution to witness his amazing experimental demonstrations. In the 1870s, as Pepper toured Australia, Canada, and the United States, a global audience marveled at his ability to conduct one experiment after another in quick and almost magical succession.

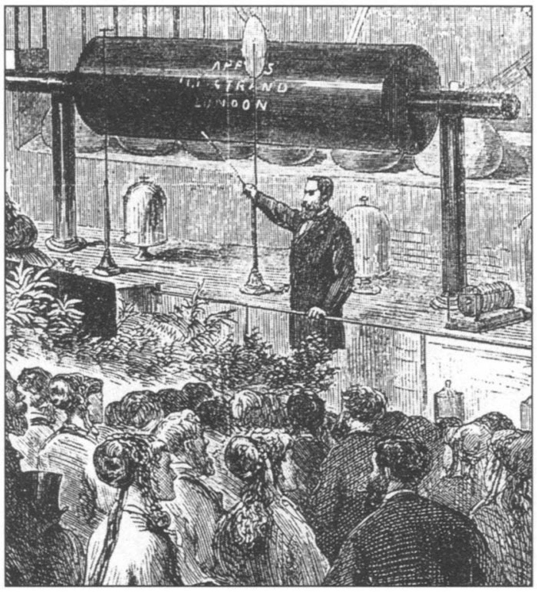
Known today as a pioneering precursor of cinema, Pepper's real significance lay in making the phenomena of physics and chemistry visible and hence accessible throughout the English-speaking world. The range of his interests challenges boundaries between laboratory science and theatrical spectacle that we take for granted today. Although he published few papers and made no scientific discoveries, Pepper shaped perceptions of science at a crucial historical moment.

Science had been associated with the London theater since the 18th century. Pepper's experiments came from authoritative sources, including works by Michael Faraday, William Brande, and other leading men of science. These authors were also public lecturers and had conducted their original laboratory researches so as to provide striking visual effects to a wide audience. Pepper's lectures were thus the culmination of a British tradition of experimental physics grounded in lecture demonstration and public display.

For example, Faraday conducted his electromagnetic induction experiments knowing that they could be publicly displayed in the Royal Institution's lecture theater. Pepper made such phenomena not only visible, but also spectacular and gigantic. His induction coil, added to his repertoire in 1869 (see the figure), produced a spark nearly a meter long.

Pepper had been attracted to science at a young age. He was born in 1821 in Westminster, the son of a civil engineer, and was educated in London and at King's College School. In later life, he remembered exploring the wonders of chemistry, and breaking an inordinate quantity of glassware, with like-minded school friends.

At the age of 19, Pepper began to make his way in the hand-to-mouth world of early Victorian commercial science, serving as a chemical lecturer at one of London's independent medical schools. But it was with the Royal Polytechnic Institution on Regent Street that his name was to be indelibly associated. The Polytechnic, founded in 1838, was a commercial showcase for invention and ingenuity. Located in the heart of London on Regent Street, it was celebrated for its diving bell, model atmospheric railway, photographic exhibitions, and striking public lectures.



John Henry Pepper
(1821—1900)

Pepper encouraged audiences to experience the pleasures of science and industrial innovation.

Pepper first spoke at the Polytechnic in 1847. In the following year, he was appointed as analytical chemist and lecturer, and from the early 1850s served as its director. He was a flamboyant and accessible showman, known universally as "Professor" Pepper, a title conferred upon him by the Polytechnic's managers. His commitments extended beyond the lecture hall to direct involvement in West End spectacular theater: In 1865, he provided "scientific arrangements" and scenery for a play entitled, *The Diamond Maker; or, the Alchymist's Daughter*.

Pepper's most famous stage demonstration was the production of realistic ghosts through a series of optical projections. Announced by the Liverpool engineer Henry Dircks at a British Association for the Advancement of Science meeting in 1858 and developed by Pepper for practical use, the technique involved placing a huge sheet of plate glass on stage at a 45° angle, together with screens and special lighting.

"Pepper's Ghost," as it is still known, made its debut at the Polytechnic in a Christmas performance of Charles Dickens's *Haunted Man* in 1862. Dircks signed over to Pepper all financial rights in their joint patent, worth many thousands of pounds. But the two men soon fell out over issues of priority. Pepper's Ghost later became associated with fairgrounds and popular cinema, featuring in Disney's "Haunted Mansion" ride and in classic films by Alfred Hitchcock and Francis Ford Coppola.

At the Polytechnic, however, Pepper took the spectacle as an opportunity to explain some of the underlying principles of optics. Such rational explanations for a mass delusion could be employed as ammunition against the contemporary vogue for spiritualism. Skeptics used Pepper's highly public stage ghosts to argue that mediums claiming to raise the spirits of the dead were fakes. The famous "Ghost Show," then, was an integral part of a wider attempt by Pepper to inculcate a sense of rational wonder by bringing the public's fascination with spirits, alchemy, and magic to the service of science.

As with many successful teachers, Pepper attracted his listeners through the sheer number and virtuosity of his experiments. In hundreds of demonstrations he traversed the phenomena of physical nature: mechanics, pneumatics, optics, heat, electricity, magnetism, chemistry, and astrono-

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my. Some experiments involved simple materials that any child could find around the house: an umbrella, a compass, a glass jar. Others required special equipment or expensive materials. But all seemed accessible because they were made visible. In one series, Pepper stuffed a large quantity of cotton wool into a container filled with alcohol; but the container did not overflow. This startling finding was followed by a series of investigations to demonstrate that matter was made of atoms.

Pepper had issued some of his lectures in pamphlets, including one in 1852 to meet the demand for information about the Australian gold fields, but the *Boy's Playbook of Science,* published in 1860, was his first full-length volume. It was widely and favorably reviewed, and it quickly went into many editions. Its success led Pepper to write other works in the same vein during the following decade, when his popularity was at its peak. The *Playbook of Metals* (1861), in which he described the phenomena of mines, minerals, and metals, has achieved some notoriety as one of the few 19th-century works to discuss the possibility of drifting continents. Other books included *Scientific Amusements for Young People* (1861) and *Cyclopaedic Science Simplified* (1869). Judging from the number of editions, all of these works were profitable, although only the *Playbook of Metals* rivaled the original in sales.

The publisher, Routledge, had built a dominant position in the children's market by updating classic works of science. To reach new generations of readers, such books needed to reflect current discoveries; otherwise, the message of constant progress through experiment would be undermined. In 1861, Routledge commissioned Pepper to revise Jeremiah Joyce's *Scientific Dialogues*, a work over half a century old. New editions of the *Playbook of Science* from the 1860s contain only minor revisions, but more substantial editorial changes were introduced from 1880 by Pepper's successor at the Polytechnic, Thomas Cradock Hepworth. Hepworth added exciting inventions such as the telephone and phonograph; but overall, the book became less entertaining. Even the title was changed to the simpler, but more pedestrian, *Boy's Book of Science*.

John Mastin, a novelist and author on chemical subjects, made further revisions for a 1912 edition. Along with many children's titles first issued in the 19th century, Pepper's works finally went out of print around the time of the First World War, a victim of changes in the publishing industry, the emergence of relativity and quantum physics, and the revolt against Victorian didacticism.

Pepper's books made science even more generally available than his lectures. They encouraged readers to experience the pleasures of science and industrial innovation for themselves. Hundreds of wood engravings conveyed something of the vivid immediacy of his lectures. The pictures, mostly from Pepper's own drawings, show steam generators, spectroscopes, telescopes, telegraphs, thermometers, optical lanterns, gas generators, magneto-electrical machines, and devices for crushing metallic ore. Sebastian Ziani de Ferranti, who became a great electrical engineer, loved the *Playbook of Science* and its illustrations so much that his schoolmates would sometimes hide it as a prank.

In 1872, after a bitter falling out with the Polytechnic, Pepper took his lectures to the competing Egyptian Hall on Piccadilly, but lost much money there. In the effort to recoup his losses, he began to tour the English-speaking world from Boston to Melbourne. After a decade of this unsettled life, Pepper accepted a post as a consulting chemist in Brisbane. He returned to England in 1889, probably for personal reasons, and lectured briefly on Australia at the Polytechnic before retiring. When he died in 1900, obituaries commented on a man who had literally "outlived his Ghost," a relic of a bygone age whom older readers might recall from childhood.

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In the burgeoning age of cinema, Pepper was remembered as a mass entertainer rather than a scientific educator; Pepper's Ghost was dismissed as an optical trick, not a part of a campaign to make science accessible. Indirectly, however, Pepper continued to inspire works for the "boy engineer" and "boy scientist." Theatrical science demonstrations have had a resurgence in the television era, notably in *Watch Mr. Wizard*, a show of the 1950s and 1960s in which a neighborhood enthusiast invited boys and girls into his garage to share in the findings of science.

Many of these presentations during the postwar and post-Sputnik era were aimed at recruiting children for careers in chemistry and physics. The underlying purpose of Pepper's scientific lectures and books—the moral improvement of boys—was very different. As Pepper wrote in the preface to the *Boy's Playbook of Science*, boys differed from the brute creation (and implicitly from girls) in possessing to the highest degree the God-given gifts of mind, thought, and freedom of will. Science should not be learnt by rote, but rather stored up as a treasure for life-long use. Sporting prowess and a healthy body counted for much in building character, as contemporaries often stressed; but Pepper argued for the need for scientific play and a rationally trained mind.

This mind was "manly," and hence Pepper addressed himself to a masculine audience. His campaign for science was thus an embodiment of, and contributor to, the increasingly gendered character of physical science from the mid-19th century onwards. Readers of the *Boy's Playbook of Science* were not asked to memorize experiments nor to follow careers as scientists and engineers; instead, what mattered most was mental preparation for the challenges of the modern world of competitive global capitalism, in which life was a race both with one's immediate fellows and with those of other countries. Science helped to build character and prepare for "The Battle of Life," to serve nation and empire. The great advantage of Pepper's method was that it allowed them to do this while having fun.

Pepper's approach bears the marks of a pivotal stage in the development of an industrial economy. No mathematics appears anywhere in his writings, nor is there any implication that mathematics might be relevant to understanding the deeper problems of physics. Scientific innovation, as the *Illustrated London News* proclaimed in the article announcing his gigantic inductive coil (see the figure on the previous page), grows from new and larger machines (*1*).

This was a physics based on visible phenomena, demonstrable experiment, and engineering technology. Pepper's science has been dismissed as mere stage magic. But examined in its setting, it exhibits precisely those qualities that led the Viennese philosopher Ernst Mach to depict British science, in the work of Lord Kelvin and James Clerk Maxwell, as an extension of the practical reasoning of the industrial mind.

References

1. *Illustrated London News*, 17 April 1869, page 401.
2. This essay is a revised version of an introduction to Pepper's *Boy's Playbook of Science*, which will be reissued by Thoemmes Press (www.thoemmes.com) in 2003 in its series of popular science reprints.