How the Magic Lantern Lost Its Magic

Thomas L. Hankins

Some of the earliest demonstrations of optical effects evolved around the "magic lantern," which spread from cloistered beginnings in the salons of European royalty to roadshows and public demonstrations in the great cities of Paris and London. The author traces the origins of the magic lantern and describes how its effects came slowly to be viewed as manifestations of scientific phenomena.

Above: Christiaan Huygens. Engraving by Edelinick. ©Rijksmuseum voor de Geschiedenis der Natuuringtenschappen. Courtesy AIP Emilio Segrè Visual Archives, *Physics Today* Collection. *Right*: Drawing room party with magic lantern. French School, circa 1800. ©Corbis.

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Figure 1. Christiaan Huygens' *laterna magica*. [From C. Huygens, Oeuvres A, Vol. 13, part 2, p. 786; Oeuvres B, Vol. 22, p. 197. Courtesy of the University of Washington Libraries, Box 352900, Seattle 98195-2900.]

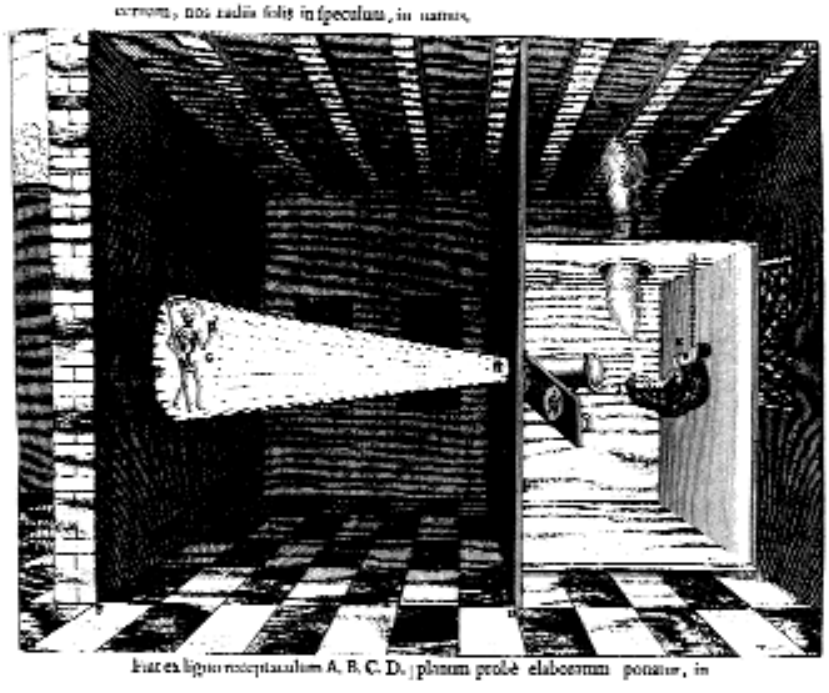

Figure 2. The magic lantern of Athanasius Kircher. Note the erect image and the position of the slide. [From A. Kircher, *Ars Magna Lucis et Umbrae (the Great Art of Light and Darkness),* 2nd ed. (Department of Rare Books and Special Collections, Princeton University Libraries, Princeton, N.J., 1900), pp. 768 and 770.]

In 1662, Christiaan Huygens complained to his brother Lodewijk that their father had asked him to make a magic lantern to show off at the French Court. Filial duty required Christiaan to comply, but as he told Lodewijk, such *bagatelles* wasted his time. To prevent their father from embarrassing the family further, he showed Lodewijk how to remove one lens so as to make the lantern inoperable.

Christiaan's reluctance is perhaps surprising, since he himself had invented the instrument—which he called *laterna magica*—some three years earlier. His first diagram of a workable lantern came complete with parabolic reflector, light source, condensing lens, slide stage and adjustable objective composed of two biconvex lenses. He even sketched a marionette skeleton designed to produce an especially ghostly image,[1] as shown in Fig. 1. But this first magic lantern was only for family viewing. As a distinguished natural philosopher, Huygens' believed that magic was beneath his dignity.

No such scruples hindered the great Jesuit polymath Athanasius Kircher, whose voluminous Latin tomes contained descriptions of all the known wonders of the world. Although Kircher claimed the magic lantern for himself, his statements to that effect are highly suspect, since the lantern as he described it would not have worked. Because he published his "discovery" prominently and because Huygens described his work only in correspondence, Kircher has traditionally received credit for inventing the instrument.[2] Kircher was an enthusiast of "natural magic." For him, science was about displaying the wonders of nature, the origins of which would remain a mystery.

The magic lantern took its place among the myriad assortment of gadgets that Kircher created to reveal these wonders; see Fig. 2. Attitudes towards magic were changing at this time, however, and it is worth looking at Huygens' correspondence to see what these changes were and how his view of nature differed from that of Kircher.

The Huygens family had produced generations of prominent Dutch statesmen and intellectuals. In 1624, Constantijn Huygens succeeded his grandfather, Christiaan Huygens senior, as secretary to

the stadtholder Frederick Hendrik, Prince of Orange. Constantijn Huygens made his first trip to England in 1618 in the company of Dudley Carleton, English ambassador to the Hague, and returned many times. On a trip in 1621, he met Cornelis Drebbel, a Dutch engineer, architect and natural magician serving at the court of James I. Constantijn Huygens spent a year in Drebbel's company and learned his secrets, returning home with, as he wrote, a *camera obscura* that was "indescribable in words" and a microscope that was "a passage to a new world by a new manifestation of nature." Drebbel must also have had some kind of projection apparatus among his many inventions, because he claimed to be able to make 20- or 30-feet-tall giants and ghosts appear in a cloud from the earth.

Natural magic or witchcraft?

Constantijn Huygens was enraptured by this "magic," but his father warned him against Drebbel. In the first place, Drebbel was not in the Huygens' social class. More importantly, however, his father feared that Drebbel's magic might be from the devil, an assertion the son rebuffed saying, "I laughed at your letter where you chose to warn me against the magic of Drebbel, and reproached him for being a sorcerer." The younger Huygens insisted in fact that all of Drebbel's magic was natural, and therefore safe.[3]

These disagreements among the members of the Huygens family illustrate the changing attitude toward magic in Europe during the Scientific Revolution of the seventeenth century. The grandfather saw magic as possibly demonic, his son Constantijn insisted that it was natural and therefore admirable, while the grandson Christiaan would have nothing to do with magic at all except as entertainment. Magic had enjoyed a revival during the Renaissance, but its practitioners had to make a careful distinction between good magic, which was natural, and bad magic, which was supernatural. In his *Natural Magick* of 1558, Giambattista Della Porta explained:

> *There are two sorts of magick; the one is infamous, and unhappie, because it hath to do with foul spirits, and consists of inchantments and wicked curiosity…The other Magick is natural; which all excellent wise men do admit and embrace, and worship with great applause; neither is there anything more highly esteemed, or better thought of by men of learning…I think that [natural] Magick is nothing else but the survey of the whole course of Nature.*[4]

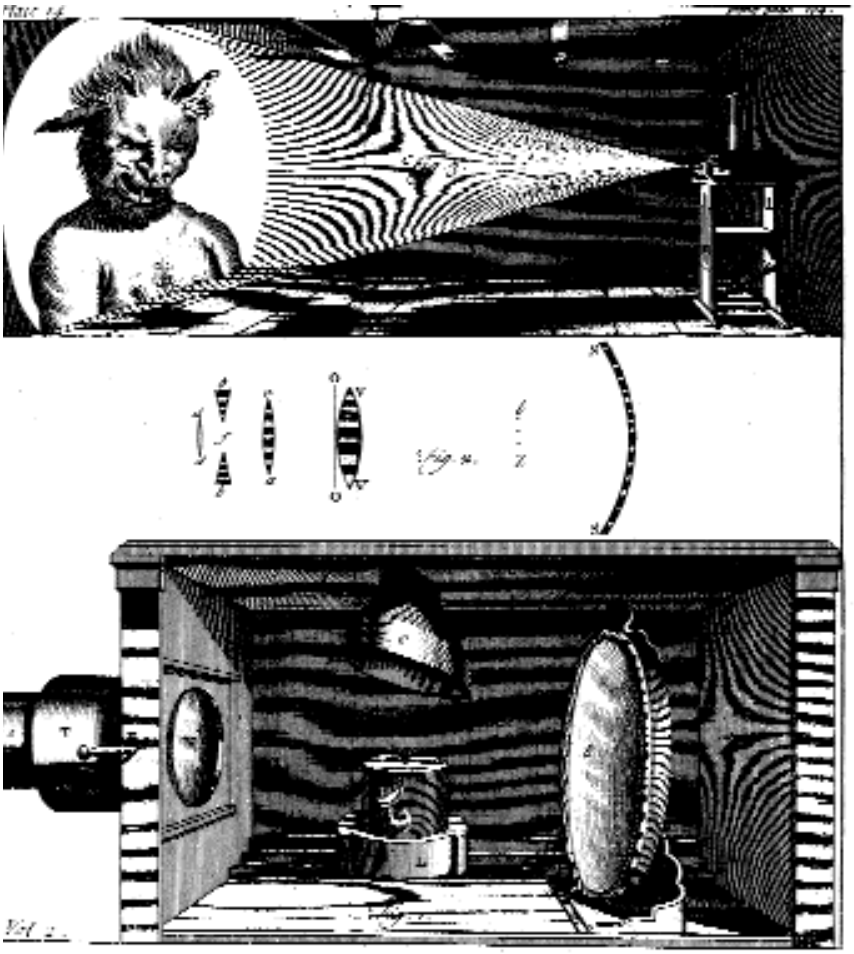

Figure 3. Willem 'sGravesande's magic lantern. [W. J. 'sGravesande, *Mathematical Elements* (Department of Rare Books and Special Collections, Princeton University Libraries, Princeton, N.J., 1747), Vol. 2.]

Della Porta's book was wildly popular. It contained all kinds of "secret" recipes for removing spots from clothes, curing diseases, eliminating pimples and hardening steel, as well as numerous practical jokes and magic tricks to be produced by use of compressed air, lenses, mirrors, hidden speaking tubes and magnets. These instruments of natural magic revealed the wonders of nature that were, according to the magicians, caused by hidden forces—sympathies and antipathies—that could not be observed directly.

Natural magic had two advantages over natural philosophy as that term was understood in the sixteenth and seventeenth centuries. In the first place, natural magic was practical. Some of its goals were to fly through the air and travel under the sea (Drebbel is sometimes credited with building the first submarine), communicate around the globe, produce images where there was no substance and imitate and preserve the human voice—all "magical" feats that are taken for granted today. Although they are of great practical value, we have ceased to think of them as magic. In the second place, natural magic used instruments. The "experimental philosophy" made famous by William Gilbert, Robert Boyle and Robert Hooke was introduced only around 1600. Before that time, natural philosophers

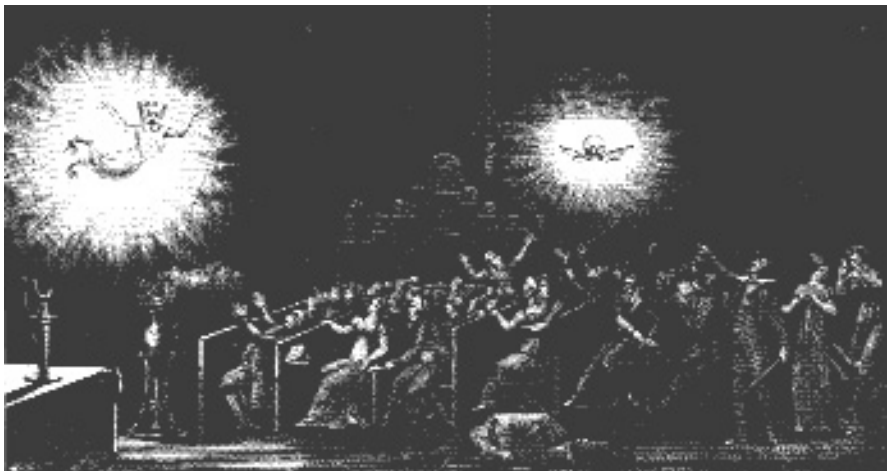

Figure 4. Depiction of a performance from Robertson's "phantasmagoria." [From the New Magic Lantern Journal, Vol. 4, p. 4 (1986). Courtesy of the Magic Lantern Society, 61 Desford Road, Newbold Verdon, Leicester LE9 9LG, England.]

did not perform experiments. Instead, they based their knowledge of nature on common experience. Instruments had always been used by "mathematical practitioners" such as surveyors, navigators and astronomers, but not by philosophers. The new "philosophical" instruments of the seventeenth century—the telescope, microscope, thermometer, barometer and air pump, to name the most important—probed nature in a new way and ultimately gave birth to a scientific revolution.

The magic lantern on the road

The closest things to these "philosophical instruments" in the sixteenth century were the instruments of natural magic. It is not, therefore, surprising that the earliest known sketch of a telescope is by Della Porta, that Galileo probably got his idea for the thermometer from a perpetual motion machine (actually a kind of thermoscope) that Drebbel built for James I, that Robert Boyle learned of the air pump from reading a book on natural magic, and that even Newton got his prisms at a fair where they were being sold as instruments of natural magic.5 When Christiaan Huygens built his magic lantern, the enthusiasm for experiment was just getting under way, so it is not surprising that there was some ambiguity over whether an instrument was magical, mathematical or philosophical. In any case, the magic lantern spread rapidly throughout Europe, so that on August 22, 1666, Samuel Pepys recorded in his diary that he had just purchased "a lanthorn with pictures in glasse to make strange things to appear on a wall, very pretty."[6]

Lantern shows by traveling entertainers became common throughout the eighteenth century as improvements were added to the instrument. In 1721, Willem Jacob 'sGravesande described a new lantern with a four-wick burner in his *Mathematical Elements of Physics Confirmed by Experiments, or Introduction to the Philosophy of Newton*; see Fig. 3. He wrote the book "in order to render the study of natural philosophy as easy and agreeable as possible." To do this, he "thought fit to illustrate every thing by experiments, and to set the very mathematical conclusions before the reader's eyes by this method."[7] The book contained descriptions of new apparatus such as collision balls and devices to illustrate the center of gravity in demonstrations of Newtonian mechanics. The volume became the main vehicle for the transmission of Newtonian physics to the Continent and it greatly increased the popularity of demonstration lectures. 'sGravesande's magic lantern, however, did not project anything scientific… only a particularly frightening devil.

The most successful show of the eighteenth century was Étienne Gaspard Robertson's "phantasmagoria," conducted in 1796 in Paris. Robertson ran his show in the abandoned convent of the Capuchins, a site that was imbued with the proper spooky atmosphere. Members of the audience, sitting in complete darkness, saw ghosts and other creatures surging towards them; see Fig. 4. Robertson gained extra illumination by employing the new Argand lamp and by projecting his images toward the audience onto a translucent screen. His lantern, which he called a "phantascope," was mounted on wheels so that the operator (called the "physicist") could zoom the image by rolling the lantern back and forth while adjusting the focus. When the phantasmagoria reached England, Thomas Young, of double-slit experiment fame, designed a linkage that automatically focused the image.[8]

The lanternists take flight

The scientific lecture became increasingly popular at the end of the eighteenth century because demonstration experiments had become so much more dramatic. The Leyden jar made it possible to generate huge sparks and the discovery of hydrogen allowed highly explosive chemical demonstrations. In France, many lanternists even took to the air. On June 4, 1783, Jean-François Pilâtre de Rozier flew the first hot-air balloon, which had been built by the Montgolfier brothers; Jacques-Alexandre Charles flew the first hydrogen balloon the following August. Robertson, of phantasmagoria fame, made fifty-nine ascents, setting the altitude record at Hamburg on July 18, 1803. But flight, one of the major goals of natural magic, had its dangers: in 1785, Pilâtre de Rozier tried to cross the English Channel in a contraption consisting of a hydrogen balloon mounted above a hot-air balloon. Somehow the two gases got mixed and the great scientist and aviator went down in flames.

Although the magic lantern was an important ingredient in the repertoire of late eighteenth-century showmen, until someone designed a more powerful light source, it could never project much more than a ghostly image. In the nineteenth century limelight, then arc light and finally light from an incandescent filament made it possible to use the magic lantern with large audiences and for instructional purposes. Lantern showmanship reached its apogee at the Royal Polytechnic Institution in London. The Polytechnic, founded in 1838, advertised "Lectures, Experiments, and Scientific Productions." London guidebooks recommended it for all visitors "who will leave it with remembrances of electricity, oxygen,

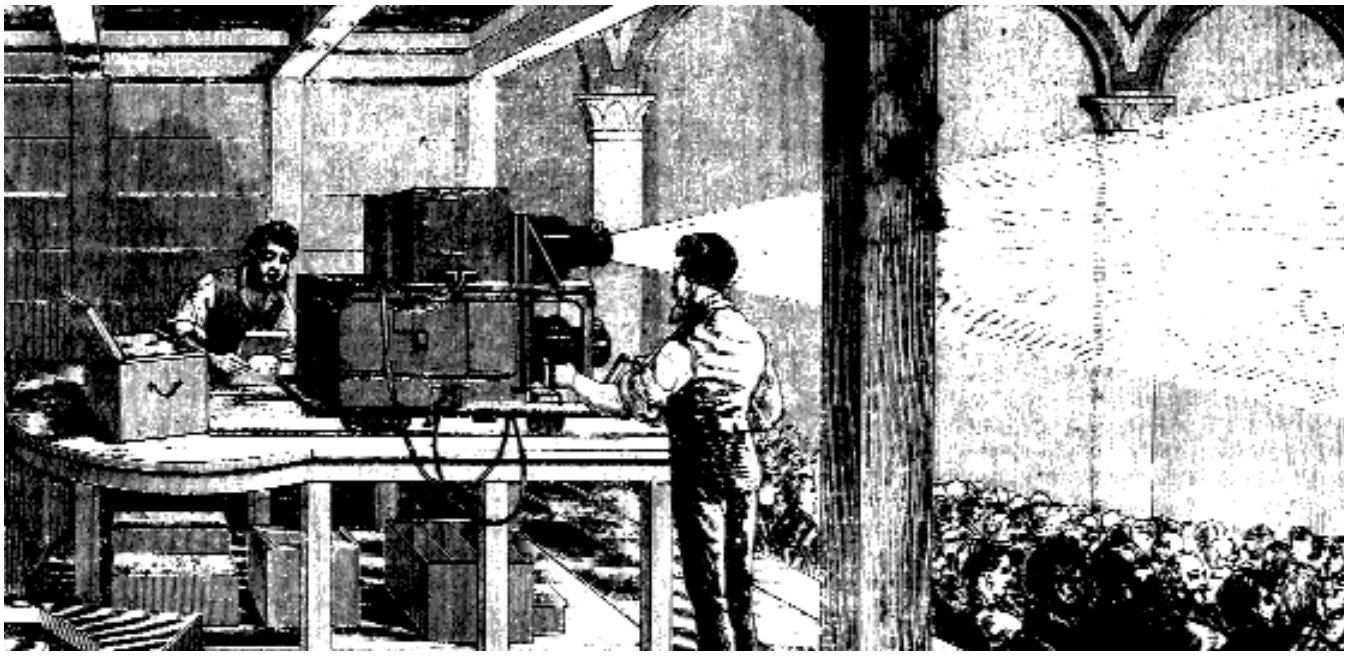

Figure 5. The "Optical Box" at the Royal Institution. [From the New Magic Lantern Journal, Vol. 4, pp. 48 and 51 (1986). Courtesy of David Henry and the Magic Lantern Society, 61 Desford Road, Newbold Verdon, Leicester LE9 9LG, England.]

hydrogen, and the diving bell." Another guidebook stated that it "partakes of the quadruple character of a Lecture Room, a Concert Hall, a Museum, and a Temple of Magic."[9] While the Polytechnic purported to be an institution of science, it was not ready to give up on magic. The projectionists at the Polytechnic used as many as six lanterns simultaneously projecting painted slides as large as 8 1/2 x 7 inches. This allowed them to include much more detail, motion and "dissolving views"; see Fig. 5. The first photographic slides, called "Hyalotypes," were made by the Langenheim brothers in Philadelphia in 1849, just in time for the Great Exhibition of 1851 in London, where they produced a sensation. Photographic slides and strong illuminants made the magic lantern a natural complement to the demonstration lecture.

The link to science is strengthened

An important version of the magic lantern was the solar microscope, usually attributed to Nathaniel Lieberkuhn of Berlin and first demonstrated in 1739. The solar microscope was mounted in a darkened room over a hole in a shutter; a mirror outside the shutter reflected a beam of sunlight directly through the hole. The microscope had an objective of short focal length that produced a greatly magnified image. Some natural specimen, such as a drop of pond water or a butterfly's wing, was placed at the slide stage and projected on the screen. It was a difficult instrument to use, because it required strong sunlight at an appropriate angle, constant adjustment of the mirror outside and a completely darkened room. The discovery of stronger illuminants made the solar microscope a much more useful apparatus. In 1884, Lewis Wright used an oxyhydrogen mixed jet apparatus to reach an illumination of one thousand candles, successfully responding to the Microscopical Society's challenge to make a microscope that would project "the tongue of a blow-fly six feet long."[10]

The Germans were especially active in devising lanterns for use in scientific lectures. Adolf Weinhold's *Physikalische Demonstrationen* (1905) described how to use the lantern to demonstrate a number of physical phenomena: Newton's rings, Airy's spirals, Ludwig's kymograph, Lissajous figures, Wheatstone's kaleidophone, König's manometric flames, Tyndall's sensitive smoke-jets, Taylor's phoneidoscope, Lippman's capillary electrometer, Fresnel's prism, Atwood's machine and others too numerous to mention. The lantern could not only magnify physical phenomena, it could also show them without disrupting the apparatus.

The invention of cinema in its various forms gave rise to new special effects that nearly put stage magic out of business. In 1896, Georges Méliès exhibited the "Man with the Rubber Head," "The Terrible Turkish Executioner" and "The Over Incubated Baby," all examples of "magical" special effects. And when the great Houdini visited the Théatre Robert-Houdin in 1901, he discovered that stage magic had completely given way to the cinema.[11] As cinema came into its own, it displaced the magic lantern and most of stage magic as a form of entertainment.

Moving away from magic

Sir David Brewster, the leader in experimental optics in the early nineteenth century, made the most important effort to finally separate natural magic from natural science. In his *Letters on Natural Magic Addressed to Sir Walter Scott, Bart* (1832), Brewster described and exposed magic tricks throughout history. His declared purpose was to show how natural science, not magic, was the greatest supporter of religion. In the past, "the prince, the priest, and the sage were leagued in a dark conspiracy to deceive and enslave their species," while modern science was

Figure 6. Masthead of the *New Magic Lantern Journal*. The magic lantern becomes the "optical lantern" with just a bit of magic left. [From the New Magic Lantern Journal. Courtesy of the Magic Lantern Society, 61 Desford Road, Newbold Verdon, Leicester LE9 9LG, England.]

"at once the hand maid and the companion of true religion."[12] If natural magic was so evil, one wonders why Brewster studied it in such detail. Moreover he had some difficulty explaining why the kaleidoscope, which he had invented in 1817, was science rather than natural magic. Brewster was, in fact, whipping a dead horse. By the nineteenth century, natural magic was entertainment, and no one was likely to confuse it with natural science.

On the other hand, if the magic lantern was to be used for serious educational purposes, it was embarrassing that it be called "magic." After one of the best home lanterns, the Sciopticon of L. Marcy in Philadelphia, was marketed in 1872 as an "optical lantern" rather than as a "magic lantern," the term "optical" replaced "magic" in lanterns designed for scientific demonstrations. The first journal devoted exclusively to the magic lantern was the *Magic Lantern* of the Magic Lantern Society of the United States and Canada, which was founded in 1874 by Edward L. Wilson of Philadelphia. Paul Liesegang in Düsseldorf added another journal, *Laterna Magica*, in 1877. In 1889, J. Taylor in London began *The Optical Magic Lantern Journal and Photographic Enlarger* with a small word "optical" and a huge word "magic" in the masthead. But when the second editor staged a competition in 1902 for a new masthead, the winner shrunk "magic" to near invisibility while expanding the word "optical" to prominence[13]; see Fig. 6. It was as if the lanternists wanted the respectability of "optical," but could not quite give up their last toehold in "magic."

The first optics-related professional societies appear

The motion picture engineers formed their own professional society in 1916, the same year that the Optical Society of America (OSA) was formed. Both organizations placed great emphasis on the need for standardization of optical instruments and both wanted to make applied optics more "scientific," but there was an obvious difference between the two societies. The speaker at the July 24, 1916, meeting of the Society of Motion Picture Engineers was Henry D. Hubbard, secretary of the National Bureau of Standards. Although the title of his address was "Standardization" and he declared standards to be the vanguard of progress in engineering and science, he could not resist a little nod to magic in his talk:

> *"The motion picture speaks the universal language of action. It is the magic carpet of Baghdad to take us to all lands, under sea and under land, among the clouds to fairyland, and into the world's markets, laboratories, hospitals, and factories… Through the motion picture, in fact, we may create new experience, for nowhere has the magic of the miraculous been so tangibly realized as on the screen."*[14]

Perley G. Nutting, the first president of OSA, was more interested in bringing American optical instruments up to the quality of German instruments. The need for increased professionalization in applied optics became apparent when World War I greatly increased the demand for high quality optical instruments while at the same time cutting off the supply from Germany. Nutting's classic *Outlines of Applied Optics* was a primer for the trend toward improvement, but it contained only a brief paragraph on projection systems.[15] Under his direction, OSA tended to distance itself from the entertainment business, which was thus seen as largely the province of the Society of Motion Picture Engineers.

In an era in which many of us spend the better part of our waking hours looking at projected images on monitors and screens at home, school and office, it is difficult to imagine a time when no such images existed. During the seventeenth century, the experience of viewing a magic lantern for the first time was truly wondrous. And as with so many of the other ambitious goals of natural magic, success at creating images turned optical magicians into optical engineers.

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