

# Spirited Away

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## ABSTRACT

At first sight the fields of magic and science do not have much of an overlap. This notion however is completely untrue for the fairly long period between 1860 and 1930. A surprisingly high number of scientists and inventors of this time were fascinated by spiritualism and believed in the existence of paranormal forces. Marie Curie for example regarded mediumistic séances as "scientific experiments" and thought it possible to discover in spiritualism the source of an unknown energy that would reveal the secret of radioactivity. Thomas Edison for his part announced an extension to his phonograph in 1921 that would extract thoughts and feelings from dead bodies in order to store and play them back. He claimed that this was possible due the existence of "life units" - tiny energy particles that are the scientifically proved equivalent to the human soul. Away from ideological judgment these examples illuminate an interesting crossover between the utopian vision of a boundless technology that helps to reveal even more mysteries of the immaterial world and an anti-modernist thought-space that is filled and nourished by ghost stories, an animistic world outlook and a dazzling array of esoteric philosophies. In this context the praxis of the commercial magical show plays a very interesting and intermediate roll that connects and correlates these two assumed opposite spheres.

## KEYWORDS

Magic, Film, Science, Memory

*Every great magic trick consists of three parts or acts. The first part is called "The Pledge" in which the magician shows you something ordinary: a deck of cards, a bird or a man. He shows you this object, perhaps he asks you to inspect it to see if it is indeed real, unaltered, normal, but of course... it probably isn't. The second act is called "The Turn". The magician takes the ordinary something and makes it do something extraordinary. Now you're looking for the secret... but you won't find it because of course you're not really looking to find it, you don't really want to know. You want to be fooled, but you wouldn't clap just yet because making something disappear isn't enough; you have to bring it back. That's why every magic trick has a third act, the hardest part, *art* the part we call "The Prestige".<sup>1</sup>*

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<sup>1</sup> Quoted from the opening sequence of the feature film *The Prestige*, directed by Christopher Nolan (USA-UK: Touchstone-Warner Bros, 2006). The film is based on the 1995 novel by the same name by Christopher Priest.

## INTRODUCTION

Nowadays the fields of magic, spiritualism and science do not appear to have much in common, however this notion was completely accepted for the fairly long period between 1860 and the late 1920s. A surprisingly large number of scientists and inventors of that time believed in the existence of paranormal forces and around the same time professional magicians started to utilize up-to-date technology for their stage tricks in order to make the latest scientific discoveries look like magic. They played with the notions of the impossible and the unreal in order to demonstrate the very contrary: Repeating the paranormal phenomena every evening in front of hundreds of witnesses IS the very definition of a scientific experiment, but what does it prove?

*The Prestige* (2006) British-American film directed by Christopher Nolan – perfectly illustrates the strange alliance between natural science, spiritualism and magic performances. Not only does the movie visualize the close relationship between turn of the century technology with the popular magic-biz, but it also introduces a meta-discourse about scientific truth and the will to believe the impossible.

What we learn from the movie's opening sequence is that in a great magic performance there are always two gaps - one between the "Ordinary Something" and the "Unexpected" and the second one between the "Unknown" and a magically restored order. I believe it is exactly these two gaps that are the key to decode and understand an interesting crossover between the utopian vision of a boundless technology and an anti modernist thought-space that is filled and nourished by ghost stories and a dazzling array of esoteric philosophies.

In this context - and in the movie - the praxis of the commercial magical show plays a very interesting intermediate roll that connects and correlates these distant spheres; it turns out that at the time they were not considered in opposition, but rather as implementations of the very same uncertainty that started to thrill the scientific community and the wider public to the same extend. One reason that this specific era was so receptive to the supernatural and occult lies in the fact that science opened new and puzzling doors that radically questioned established doctrines and revealed even more mysteries of an unknown immaterial world almost everyday.

Independently from the fact that a lot of the strange phenomena observed in the laboratories were poorly understood for decades, quite a few of them were instantly turned into new and useful applications like wireless transmission or X-ray technology.

## THE PLEDGE - SPEAKING WITH THE DEAD

In the wonderful sequence of Jean Cocteau's 1949 movie, Orpheè sits in his parked car listening to the radio playing encrypted codes transmitted from an unknown source. Although his wife Eurydice thinks that the messages are without any meaning, Orpheè insists that these codes are more beautiful than any poem he has ever written. "I'm on the trail of the unknown" he defends his strange new obsession. The others might not understand yet, but Orpheè is sure that he is receiving wireless messages from the dead, amplified voices from the hereafter, and he is right! This intense cinematographic moment clearly shows how modern spiritualism and the technical possibilities of the time overlapped and intersected.

In 1877 the invention of the speaking machine came completely unexpectedly and was regarded as a miracle. It was also due to this invention that Thomas Alva Edison got his nickname the "Wizard of Menlo Park". The most interesting fact about the Phonograph is the radical paradigm shift it implied. Starting in the mid 19th century a lot of physiology experiments were conducted to visualize sound, a significant number of which produced graphs that looked almost the same as the mechanical soundtrack Edison engraved in his Phonograph cylinders. Edison was the one to invent the idea of playing the recording back in order to recreate the original input signal, but since this was obviously possible, could other aspects of life itself also be reproduced or at least re-played in this way?

The phantasm that death could be overcome with the means of science and technology was certainly not new in 1880, but until then associated with mechanics, animal magnetism and electricity rather than with transforming life into abstract signals and playing them back. One main difference between Edison's attempt and the experiments conducted by Galvani (and his notorious nephew Giovanni Aldini) a hundred years earlier was the absence of the dead body. Describing the genesis of her novel *Frankenstein*, Mary Shelley wrote: "perhaps a corpse would be re-animated; Galvanism had given token of such things."

The main difference between Shelley's butt-jointed monster and the kind of reanimation Edison proposed was the bodiless quality of the latter. The Phonograph allowed us to hear voices from people absent or long gone - a fact that equally troubled and amazed his contemporaries. The previously unimaginable possibility of listening to a dead person's voice spurred not only the imagination of the public, but also that of authors such as Salomo Friedlaender. In his 1916 short story *Goethe speaks into the Phonograph* a certain Dr. Pschorr builds a tube-type-enhanced version of the Phonograph that is able to listen into the past and to record the residual vibrations of words spoken by people some hundred years ago. Such ideas were certainly also inspired by a number of other inventions such as electromagnetism, radioactivity and the theory of relativity, that ignored the formerly unquestioned relations of cause and effect in a Newtonian universe.

In 1896 the 22 year old Italian inventor Guglielmo Marconi began building up a worldwide network of radio stations. Marconi based his work on that of Heinrich Hertz and despite having no understanding of the fundamental electromagnetic principles by 1902 he was able to send the world's first radio message across the Atlantic and a few years later almost had the worldwide monopoly on wireless communication. With the help of the military and prominent supporters like Thomas Alva Edison he was able to extend his influence and power enormously over the years. In 1915, with the introduction of new tube technology, he was finally able to transmit the sound of a human voice where prior to that, signals only could be transmitted as single rappings.

So within a few years Edison's Phonograph, Bell's telephone and Marconi's wireless radio created an entirely new media-space filled with bodiless voices. The novels and movies of the time deal with the un-canniness and alienation of a voice that has been disconnected from its speaker: the criminals and detectives that tapped the wire or secretly recorded conversations; erotic fantasies surrounding the female switchboard operator. The human voice, formally an "Ordinary Something", was now transformed into something extraordinary. Suddenly it could travel through space and time, becoming immortal and ubiquitous. One could listen to it with excitement and fear. To a certain degree these technical possibilities were soon accepted and became part of everyday life, on another level, however, they maintained a disturbing undertone.

Although he also experimented with electric ghost-traps, Edison always refused any connection between his projects and the spiritualistic practices of his time (Anon, 1933). Still his audience must clearly have seen this convergence since not far from his factory, and almost for the same timespan as Edison's work, three spiritualistic mediums from New York thrilled the world with Morse-like messages from the dead: Leah, Margaret and Kate Fox, who played an important role in the upcoming of modern spiritualism. The trio enjoyed recognition as mediums for many years and were also extremely successful outside the USA. Kate Fox especially was considered to be a powerful medium, capable of producing spirit lights, direct writing, and the appearance of materialized hands, as well as the movement of objects at a distance. Between 1871 and 1874 she was one of the mediums examined by William Crookes, who later became one of the forerunners of radio technology.

Edison himself also took his invention to another level. In a New York Times interview dating from 1921 he claimed that the human body could be seen as a mortal storage medium that records his lifetime experiences, feelings and memories to invisible particles called "life units"(Rothman, 1921). According to Edison every human body holds 100,000,000,000,000 of such tiny and indestructible memory-bubbles. When the body expires the "life units" still stay for a while, but later diffuse into other life forms. In the same interview Edison announced an extension to his

phonograph capable of extracting thoughts and feelings from dead bodies and allowing them to be stored and played back again. This was immortality achieved in a modern, but strangely unphysical way.

Some years later, in 1927, Manfred von Ardenne - one of the fathers of German pre-war television - came up with a device that was intended to transfer thoughts as a substitute for the telephone.<sup>2</sup> Like Ardenne, many of the broadcast pioneers of his time took it as given that sooner or later radio waves would allow us to communicate with worlds beyond our understanding.

### **THE TURN - THE AGE OF RAYS**

Next to the bodiless voices produced by Edison, Bell and the Fox Sisters, other and even more irritating phenomena can be observed on the borderline between science and the super natural. Unlike the Phonograph and the radio, Doctor Roentgen's "Memento-Mori-Rays" did not make the body completely disappear, but transformed it into a transparent and anti-substantial ghost image by blinding out the flesh. Same as Marconi, Roentgen initially did not understand the origins and properties of his invention. This is also the reason his first publication was titled "On a New Kind of Rays" in which he referred to the new rays with the letter X. What initially meant to be provisional soon was adopted as a synonym for his discovery.<sup>3</sup>

Today the relation between wireless communication and X-rays is evident, since both are fundamental implementations of electromagnetism. Around 1900 however this correlation remained mysterious and the border between science and esoteric theories still permeable. During the nineteenth century influential scientists still speculated about the existence of the ether - an invisible and all-embracing substance, that continued to appear well after 1910, until its existence was finally denied by the scientific community. A similarity between ether and the X-rays was seen in the shared ability to penetrate objects and bodies without leaving any trace. The nature of the X-rays was also taken as a strong evidence for the existence of other forms of invisible energy like Mesmer's Animal magnetism and Baron Carl von Reichenbach's Odic force. Telepathic transfers seemed to be scientifically proven by electromagnetic waves, neither of them being perceived by the human senses alone, but both having powerful effects on reality.

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<sup>2</sup> The original German Article was published in: Manfred von Ardenne, "Kann man Gedanken hören?," Funkschau no. 27, July, 1928. A translated version was printed in: Manfred von Ardenne, "Thought Transference - Some Experiments on the Exchange of Ideas," Science and Invention, September 1928. Also see the article by Wolfgang Hagen, "Manfred von Ardenne's 'Gedanken hören,'" in *Trancemedien und Neue Medien um 1900*, ed. Marcus Hahn and Erhard Schüttelz (Bielefeld: transcript, 2009), 341- 350.

<sup>3</sup> More about this subject in Simone Natale, "A Cosmology of Invisible Fluids: Wireless, X-Rays and Psychical Research around 1900," *Canadian Journal of Communication* Vol 36 (2011): 263-275

Besides James Clerk Maxwell, who developed equations for the electromagnetic field as early as in 1862 and German scientist Heinrich Hertz who was the first to deliberately produce radio waves in 1887, British chemist and physicist William Crookes is one of the most important and dazzling pioneers that helped to connect the loose ends. Apart from his other important scientific contributions and discoveries, the so-called Crookes tube was to become his most momentous innovation in this context. More than just a scientific marvel, this early electrical discharge tube eventually turned out to be the first device capable of visualising electromagnetic fields. One decade later, the Crookes device would evolve into the coupling link between the radio tube and the cold cathode X-ray tube, both of which are based directly on his invention.

Almost at the same time as Marie Curie, William Crookes turned his attention to the newly discovered phenomenon of radioactivity and, same as she, Crookes regarded mediumistic séances as scientific experiments of equal value. Both scientists thought it possible to discover in spiritualism, the source of an unknown energy that would reveal nature's secrets. Around 1870 Crookes claimed that science had a duty to study preternatural phenomena associated with spiritualism. Among the mediums he examined was Kate Fox and among the phenomena he claimed to have witnessed were movement of bodies at a distance, rappings, levitation, appearance of luminous objects, appearance of phantom figures, appearance of writing without human agency, and circumstances which "point to the agency of an outside intelligence"(Crookes, 1874). As a consequence Crookes joined the Society for Psychic Research, becoming its president in the 1890s. He also joined the Theosophical Society and the Ghost Club, of which he was president from 1907 to 1912.<sup>4</sup>

The ray-craze of the 1900s certainly did not stop at the laboratory door and X-rays especially were soon adopted for stage tricks and by the early cinema.<sup>5</sup> Georges Méliès, who at the time was the owner of the Théâtre Robert-Houdin, came up with a show he called "Les Rayons Roentgen" as early as 1896. Two years later he made the short film "A Novice at X-rays" that unfortunately is lost today. In 1897 "The X-Ray Fiend" a British short silent comedy film, directed by George Albert Smith, was released featuring a courting couple exposed to X-rays. One main feature in all this presentations was the sudden transformation of a person into his skeleton. In a strange mix of horror and voyeurism, instead of the naked body the bones beneath were exposed - a burlesque but harmless striptease that did not conflict with the decency or morality of those days. The erotic connotation however also was

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<sup>4</sup> More on the pre-history of wireless communication in Wolfgang Hagen, *Das Radio - Zur Geschichte und Theorie des Hörfunks* (Munich: Wilhelm Fink, 2005).

<sup>5</sup> See also the relating chapter in the exhibition catalogue "The Perfect Medium: Photography and the Occult," edited by Clément Chéroux, Pierre Apraxine et al. (Yale: Yale University Press, 2005), 114-170.



nourished by the rumour that X-ray film could be used in normal cameras to see through women's clothes.

In a series of stage tricks called "Neoöcultism" a more sophisticated, and dangerous use was made of X-ray technology (Hopkins, 1906, pp.97–98). The trick was based on the effect that objects made of glass, porcelain or zinc sulphate glow in the dark when exposed to X-rays. In this way spirits or skeletons could be painted on dark cloth with glass powder or zinc sulphate and would only appear as soon as a hidden X-ray tube pointing at them was switched on. The name of the trick certainly referred to the occultist's sciences which had become extremely popular since their introduction by the Fox sisters. The founder of Modern Magic, Robert-Houdin divided magic into five classes.<sup>6</sup> According to his definition "Neoöcultism" is a crossover between the second class "Experiments in Natural Magic" which is defined as "Expedients derived from the sciences and which are worked in combination with feats of dexterity, the combined result constituting conjuring tricks" and the fifth class "Mediumship" which deals with "Spiritualism or pretended evocation of spirits, table-turning, rapping and writing, mysterious cabinets, etc."

### **THE PRESTIGE - STRUGGLE FOR DIFFERENTIATION**

Same as for their somehow similar strategies, so too are the exponents of these arts sometimes difficult to distinguish. Think of Edison and Tesla, of Charcot, Mesmer or Houdini: showmen and presenters rather than scientists, technicians, or magicians. All of them stepping in front of their audience, bowing low and eager to show their newest tricks. In this context the spiritualist that discovers a new chemical element and the technician that believes in the hereafter are not contradictions, but exponents of the same mind set. All of them have learned to deal with the phantasmatic space of the unknown in a creative way. They are the ones who specialised in dealing with the "gaps" while the audience is still busy with "not really looking" and not "really wanting to know". Despite their differences, all these proponents contributed something that became a rare virtue today: curiosity, faith in the new and unexplored, and a playful and unprejudiced approach to knowledge.

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<sup>6</sup> Magic is divided, according to old writers on the occult, into: White magic, Black magic and Necromancy. Modern magic, or conjuring, is divided by Robert-Houdin into five classes, as follows: (1) Feats of Dexterity. The hands and tongue being the only means used for the production of these illusions. (2) Experiments in Natural Magic. Expedients derived from the sciences, and which are worked in combination with feats of dexterity, the combined result constituting "conjuring tricks". (3) Mental Conjuring. A control acquired over the will of the spectator; secret thought read by an ingenious system of diagnosis, and sometimes compelled to take a particular direction by certain subtle artifices. (4) Pretended Mesmerism. Imitation of mesmeric phenomena, second sight, clairvoyance, divination, trance, catalepsy. (5) Mediumship. Spiritualism or pretended evocation of spirits, tableturning, rapping and writing, mysterious cabinets, etc. See Albert Hopkins, *Magic*, 2.

It is interesting how much more aggressive the fight for differentiation was just a couple of decades prior to this period. One interesting example in this respect is the case of Étienne-Gaspard Robert, in his days better known by the stage name “Robertson”. Robert was a prominent Belgian stage magician and influential developer of phantasmagoria. Charles Dickens described him as “an honourable and well-educated showman”. Born in Liège in 1763 Robert studied at Leuven and became a professor of physics specializing in optics. Soon he started to use his skills for magic performances and developed a show around his projection system and the use of other scientific based effects and techniques. He set up a successful performance that involved actors and ventriloquism alongside his projections, creating a convincing impression of the appearance of ghosts. The climax of every evening was the eerie appearance of a spirit that was projected onto a large piece of wax-coated gauze or white smoke.

Although Robert actually was a studied man and educated not only in optics, his occupation as a magician seemed improper to his fellow physicists. In 1804 André Jacques Garnerin, one of Robert’s academic critics went so far to discuss in public into which of two categories “Professor Robertson” would fit. His suggestions were:

*The Physicist who observes phenomena in nature and tries to find results which can be proven by experiment. One who tries to explain the phenomena but will never trick his audience. He will be paid for his efforts and discoveries only. We admire his ingenuity, and he earns our respect. He usually stays in one place and often receives important government positions.*

*The Conjuror who uses the physicist’s results and conducts experiments of his own, but does not explain them, instead he constantly tries to fool his audience and demands payment for these illusions. One admires his dexterity, but he does not gain any respect. Usually he travels the country and receives no government positions.<sup>7</sup>*

Robert for his part did everything to resolve all doubt about his professionalism by giving lectures about electricity after each of his phantasmagoria shows and even explaining the scientific principles he used in his tricks. For him the magical show was simply a lesson in applied physics, performed to amaze and educate his audience.

In my understanding the main reason why, from the 1850s on, there was a much more tolerant attitude toward go-betweens like Robertson was the radically changed economic situation. In an age dominated by the principles of capitalism and

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<sup>7</sup> Both quotes from: Oliver Hochadel, “Zauberhafte Aufklärung,” in *Rare Künste: Zur Kultur- und Mediengeschichte der Zauberkunst*, ed. Brigitte Felderer and Ernst Strouhal (Vienna and New York: Springer, 2006), 433-499; translation into English by the author.



industrialisation, scientific research was no longer considered a valuable contribution to human knowledge, but a source of enhanced productivity and the key to new products and processes. In England and Germany the formally rather neglected discipline of chemistry became of key importance for both industry and the military. The same is true for physics and especially for progress in the field of electricity. In this highly competitive environment the pure scientist became an obsolescent model. What was needed were visionary men like Guglielmo Marconi, Nikola Tesla and his outspoken enemy Thomas Alva Edison - eccentric geniuses with a disposition for megalomania, grandiose projects and ideas. Academic institutions were not necessarily the getaway to scientific research anymore and this new breed of entrepreneurs was much better prepared to meet the challenges of an ever-growing market. In a stock market financed research environment however, results have to be presented on a much tighter schedule and the potential for monetisation must be agreed beforehand. In this context the "scientist" becomes a seller of ideas, a dazzler, a conjurer - a magician.

I also believe that the rise of spiritualism in the mid nineteenth hundreds is directly connected to these changes. To my knowledge, spiritualists in no way rejected technology - on the contrary they often used it to prove their theories and utilized it to communicate with the spirit world. This approach was often criticised as pseudo-scientific and esoteric, but the sheer number of active spiritualists, some sources counting up to 8 million in the English-speaking world, is a strong indicator that their ideas had carried into almost every corner of society. Their approach to investigation of the invisible and techniques for dealing with unknown forces does, in a strange way, correlate with the up-to-date scientific methods of today. It is often stated that spiritualism only mimicked scientific methods in order to legitimize its own claims, but I believe this is only half of the truth. Considering the large numbers of scientists and intellectuals who where declared spiritualists, Marie Curie and William Crookes just to mention the most famous exponents, I would suggest an investigation into their influence on scientific praxis is well justified. This unfortunately goes beyond the scope of this paper, but it is very interesting to see that the most profound enmity against spiritualism did not come from the scientific community but from the stage magicians.

The "Neoöccultism" stage trick colourfully illustrates how magicians often mixed advanced technology with elements of spiritualistic séances. Meanwhile, showmanship became an increasingly important part of spiritualism and mediums began performing to paying audiences. The main difference in this competition was that the spiritualists claimed there were no tricks involved and the witnessed phenomena proof for the existence of the afterlife, while the magicians neglected the existence of spirits and were proud of deliberately hocusing their audience in a skillful way. Since the magicians put a lot of energy into feigned evocation of spirits, they were keen to uphold their professional standards by exposing fraudulent

spiritualists. The most famous scourge of fake magicians and spiritualists was Harry Houdini. Being one of the most recognized showmen of his time, he was also a member of a Scientific American committee that offered a cash prize to any medium who could successfully demonstrate supernatural abilities. Houdini chronicled his debunking exploits in his book *A Magician Among the Spirits* and gave public lectures to reveal the secrets of the admittedly often rather clumsy shams performed by spiritualistic mediums (Houdini, 1924).

## CONCLUSION

What really interest me in all this, is the connotations of truth and the scientific praxis in an environment where neither the nature of the object of investigation nor the expected result is clear anymore. Albert Einstein has analysed and dissected this situation in a wonderful way by introducing the figure of the “unscrupulous opportunist” and isolated the different aspects involved.

“The scientist, however, cannot afford to carry his striving for epistemological systematic that far. He accepts gratefully the epistemological conceptual analysis; but the external conditions, which are set for him by the facts of experience, do not permit him to let himself be too much restricted in the construction of his conceptual world by the adherence to an epistemological system. He therefore must appear to the systematic epistemologist as a type of unscrupulous opportunist: he appears as realist insofar as he seeks to describe a world independent of the acts of perception; as idealist insofar as he looks upon the concepts and theories as free inventions of the human spirit (not logically derivable from what is empirically given); as positivist insofar as he considers his concepts and theories justified only to the extent to which they furnish a logical representation of relations among sensory experiences.” (Schilpp, 1949, pp.682–684)

In my understanding the three personality traits Einstein refers to are the requirements a modern scientist must possess in order to cope with the post-Newtonian conceptions of the world. Einstein is aware that a pure positivist view can't possibly cover the full extend of what is comprehensible by the human mind. He therefor introduces two other components. One that does not stop at the point where things are not longer “objective” in terms of our ability to perceive them, since by the mid 1900s the fundamentals of physical laws no longer appear evident, but often remained invisible and obscure. The second, idealistic view, must always take in account that there are “external conditions” limiting the free inventions of the human spirit that are not logically derivable. I tried to show how magic, spiritualism and science intersected and how each sphere adopted aspects and techniques of the other. Personally I believe that in an odd, but still traceable way, magic and spiritualism contributed to modern physics in a much more tangible way, than one would expect.

In Christopher Nolan's "The Prestige" the real magic is performed within the sphere of science and not by the magicians. The trick becomes reality in terms of an unbelievable, but proven fact. The "Ordinary Something" is turned into a terrible reality, that has to be hidden and must not be revealed. The magic trick in this context is to obscure the truth and to bring to the audience something they can understand. If this would not already be enough "The Prestige" introduces another meta-level by turning the cinematic narration into a magic trick by itself. We, the meta-audience, are tricked as well.

## REFERENCES

- Anon (1933) 'Edison's Own Secret Spirit Experiments'. *Modern Mechanix and Inventions*, (October), pp.34–36.
- Crookes, W. (1874) *Notes of an Enquiry Into the Phenomena Called Spiritual, During the Years 1870-73*. Quarterly Journal of Science office.
- Hopkins, A.A. (1906) *Magic; stage illusions and scientific diversions, including trick photography*. New York: Munn & Co.
- Houdini, H. (1924) *A Magician Among the Spirits*. New York: Harper and Brothers.
- Nolan, C. (2006) *The prestige*. Touchstone Home Entertainment.
- Rothman, A.D. (1921) 'MR. EDISON'S "LIFE UNITS"; Hundred Trillion in Human Body May Scatter After Death-- Machine to Register Them'. *The New York Times*.
- Schilpp, P.A. (1949) *Albert Einstein, Philosopher-Scientist*. Evanston, Ill.: Library of Living Philosophers.

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