

## **In the Groove: Edison Kinetophone Film Sound-on-Cylinder System** **By Yuri Shimoda**

“In the year 1887, the idea occurred to me that it was possible to devise an instrument which should do for the eye what the phonograph does for the ear, and that by a combination of the two, all motion and sound could be recorded and reproduced simultaneously.” –Thomas Edison<sup>1</sup>

If you ask most people to name the first film with a synchronized soundtrack, they would be quick to reply with *The Jazz Singer*. While the 1927 musical drama is indeed the first feature-length motion picture to feature synchronized music, dialogue, and singing, it was not the first film ever to do so. Fourteen years before the Al Jolson feature dazzled cinema audiences using the Vitaphone sound-on-disc system, Thomas Edison utilized an earlier grooved audio format, cylinder recordings, to marry sound to moving-image media in the Kinetophone. Although film librarians, archivists, and preservationists may be familiar with Vitaphone discs, it is important for all professions working in a library, archive, or museum (LAM) setting to be able to identify Kinetophone films and their cylinder counterparts that might be accessioned into (or may already be in) their collections.

This paper examines the Edison Kinetophone system by delving into a case study of a 2016 restoration project headed by George Willeman, Nitrate Film Vault Manager at the Library of Congress National Audio-Visual Conservation Center (LC NAVCC). It provides background details of the endeavor, challenges met during the film and audio digitization process, and what insights these experiences can offer to those working in LAMs. In addition, the paper seeks to answer these research questions: Why didn't the Kinetophone system succeed? What challenges does this early film sound system present to archivists today? What can an archivist do when

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<sup>1</sup> W.K.L. Dickson and Antonia Dickson, *History of the Kinetograph, Kinetoscope & Kinetophonograph* (New York: Arno Press & The New York Times, 1970), 4.

they have a film element and want to match it with a cylinder soundtrack? What would an archivist do if a collection they just accepted contained a film and its cylinder recording, and she had no idea how to care for this item, let alone play it to find out if it really contained the sound elements for her specific film? However, before any of these questions can be investigated, a brief background of the Kinetophone system should be given.

### **Kinetoscopes, Kinetophones, and Kinetophone Systems**

The introductory quote for this paper is taken from a letter that Edison wrote to W.K.L. Dickson, his former staff photographer and his choice to develop motion picture technology in 1888. Dickson, often referred to as “the first director in the history of film,” is responsible for the 35mm film standard, the use of celluloid, sprocket wheels, and four-perf film.<sup>2</sup> He successfully carries out the first step in Edison’s grand plan when he presents the foundation for a new peep device, a Kinetoscope, to his boss in 1889. Using a Kinetoscope can be described in the following manner:

By inserting a coin into an appropriate slot, a viewer could peer into the eyepiece and observe a brief motion picture presentation. Inside the machine approximately 56 feet of 35mm film ‘circulated [at 46 frames per second] in an endless loop under a viewing lens, each frame briefly illuminated by a flash of light through a rotating shutter.’<sup>3</sup>

For the cost of a quarter (or less), Americans could catch these new attractions at their local Kinetoscope parlor. Though these films lacked sound, the Edison team still had their eyes locked on the ultimate prize of synching sound to film.

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<sup>2</sup> Jerry Fabris, “Edison Kinetophone Films” (presentation, Orphan Film Symposium, Culpeper, VA, April 7, 2016).

<sup>3</sup> Harry M. Geduld, *The Birth of the Talkies: From Edison to Jolson* (Bloomington: Indiana University Press, 1975), 18-19.

A short featuring two men dancing to Dickson playing the violin<sup>4</sup> dates from 1894 and provides evidence that the company had begun to reach that goal. Then, the first Kinetophone was delivered to an arcade in 1895. This machine was basically a Kinetoscope, but with a phonograph added to its base. A belt drive connected the two devices and insured that they would start and stop at the same time,<sup>5</sup> while a visitor could listen to the audio via ear tubes. The films shown in this first iteration of the Kinetophone were often of song-and-dance routines or marching band performances, and this was a strategic move on Edison's part. "Dance and band films portray people *keeping time to sounds*. Whereas people making sounds require exact instantaneous synchronization, dancers and marching bands easily tolerate loose synchronization."<sup>6</sup>

Synchronization presents a huge challenge to the Edison team, as well as all other developers of early film sound systems. The process involves "difficulties at two separate stages: first in *recording*, and then in *reproducing* the visuals and the accompanying sound. Success at the first stage did not automatically guarantee success at the second."<sup>7</sup> Synchronization of film and audio is a topic that this paper digs deeper into within later sections.

When public interest in these peep devices begins to wane, so does Edison's drive to make further developments in the realm of film sound. When competing systems start to arrive on the horizon – Edward H. Amat's Audo-Moto-Photo and Leon Gaumont's Chronophone – he resumes experiments in earnest. Edison adds Daniel Higham, inventor of a mechanical friction

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<sup>4</sup> <https://www.youtube.com/watch?v=Y6b0wpBTR1s>

<sup>5</sup> Geduld, 22.

<sup>6</sup> Rick Altman, *Silent Film Sound* (New York: Columbia University Press, 2004): 78.

<sup>7</sup> Geduld, 43.

amplifier, to the team in 1908,<sup>8</sup> and two years later, the company develops a method of pre-recording amplification, which enables “the phonograph to pick up sounds clearly from a distance of over twenty feet away. Kinetophones could therefore be filmed and recorded simultaneously, without the large recording horn appearing in the film.”<sup>9</sup> Now that the Edison team possesses a technique to capture the audio for a film that could be projected in theaters versus within a Kinetoscope peep device, they just had to figure out what equipment would be needed to exhibit these works.

Rick Altman deftly summarizes the issues that the Edison team was faced with at this particular time in history.

Early synch-sound systems suffered from divergent expectations regarding sound and image playing speeds. In order to avoid unpleasant frequency fluctuations, sound recordings require an absolutely stable speed, so a wind-up spring motor equipped with a speed governor was used for the phonograph ... Conversely, virtually all moving picture projectors were hand-cranked at speeds that varied according to shooting speed and on-screen action. Whereas variations in speed represented an aesthetic attraction for the image, they were stigmatized as a deadly fault for sound.<sup>10</sup>

Obviously a projector set up behind the audience’s seats at the back of the theater and a phonograph positioned near the screen were essential, but this configuration conjures a demand for an apparatus to enable the two machines to be connected. A synchronizer mechanism device is created for the projector, and a hole cut into a projection booth wall in order to run a linen cord from this synch system to the phonograph. In addition, a means of communication between the

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<sup>8</sup> Fabris presentation.

<sup>9</sup> Rosalind Rogoff, “Edison’s Dream: A Brief History of the Kinetophone,” *Cinema Journal* 15, no. 2 (Spring 1976): 61.

<sup>10</sup> Altman, 159.

projectionist and phonograph operator is also necessary.<sup>11</sup> A telephone transmitter is mounted to the phonograph to facilitate technician coordination via headphones so that the projectionist could advance or slow the projector relative to the phonograph.

It has taken over twenty years for Edison's dream to be realized, but by combining two of the corporation's inventions, the Kinetoscope and Kinetophone (version 1.0) into one, the Kinetophone system is born. Edison debuts the new system at vaudeville theaters in Manhattan, Chicago, and St. Louis on February 17, 1913 to mostly positive press, but also reports of technical difficulties.<sup>12</sup> All seven of the Kinetophone films restored in the Library of Congress case study are released this same year.

### **The Restoration Project**

The story of how these Kinetophone films and cylinders were brought back into the spotlight begins with the LC NAVCC's Willeman. "This has been my pet project for 25 years," he shared in 2016, the year that the project came to fruition. "When I started with the Library back in the 1980s and discovered these films on the shelf and realized what they were, I thought, 'Wouldn't it be great if someday we could see them with their soundtracks put back on?'"<sup>13</sup> Willeman teams with two sound experts, Jerry Fabris (Museum Curator, Thomas Edison National Historical Park (TENHP)) and Bryan Hoffa (Audio Preservation Specialist at the NAVCC), who help him do just that. [Note: This paper includes comments from all three of

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<sup>11</sup> *The Kinetophone: A Fact! A Reality!*, directed by Ben Model and George Willeman (New York: Undercrank Productions, 2018), DVD.

<sup>12</sup> Fabris presentation.

<sup>13</sup> Will McKinley, "The First Talking Pictures Regain Their Voice," *Cinematically Insane* (blog), November 11, 2016, <https://willmckinley.wordpress.com/2016/11/21/the-first-talking-pictures-regain-their-voice/>.

these, as told to the author via email correspondence, as well as details culled from conference presentation papers and slides that they shared with the author.]

As Willeman tells, the film elements were being housed at the NAVCC, but the cylinders were not. Head of the Moving Image Section at the LC Mike Mashon decided to reach out to the TENHP to see if the museum had any in its collection. Fabris replied by sending the Library an inventory of the 43 Kinetophone cylinders that are preserved at his institution, and Willeman compared this list of cylinders to LC's inventory of films.<sup>14</sup>

The restored Kinetophones were originally captured on 35mm nitrate film, two wax cylinder masters, and eleven blue celluloid cylinders on plastic cores, and all of the items were actually kept together at the Edison Laboratory until the early 1960s. These legacy formats come with inherent deterioration issues due to their physical composition, and preservation concerns are a primary reason why they became separated. As the cellulose nitrate in film ages, it releases nitric oxide, nitrous oxide, and nitrous dioxide. If these gases combine with atmospheric moisture, they form nitric acid, which causes further decomposition to the film and sometimes to its storage container.<sup>15</sup> Conversely, if nitrate is stored in overly dry conditions, the film can start to contract or shrink. Aside from being susceptible to mold growth and humidity,<sup>16</sup> cylinder sound recordings are very fragile, especially when they are exposed to drastic changes temperature.

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<sup>14</sup> Jerry Fabris, email message to Yuri Shimoda, March 7, 2019.

<sup>15</sup> Monique Fischer, "A Short Guide to Film Base Photographic Materials: Identification, Care, and Duplication," Northeast Document Conservation Center, accessed March 20, 2019, <https://www.nedcc.org/free-resources/preservation-leaflets/5.-photographs/5.1-a-short-guide-to-film-base-photographic-materials-identification,-care,-and-duplication>.

<sup>16</sup> Harrison Behl, "Audio Formats: Characteristics and Deterioration," in *ARSC Guide to Audio Preservation*, ed. Sam Brylawski, et al. (Eugene: Association for Recorded Sound Collections; Washington, D.C.: Council on Library and Information Resources and the Library of Congress, 2015), 16.

When the National Park Service (NPS) acquired the Edison Laboratory in 1956, TENHP was aware of the aforementioned deterioration risks, and as the film began exhibiting signs of shrinkage and decomposition, decisions had to be made about the continued storage of the nitrate holdings. After Superintendent Melvin Weig expressed these concerns to the Librarian of Congress, an agreement was reached in 1965. “The Park Service agreed to pay the cost of the first printing copy (negative from positive, or positive from negative), and the Library agreed to pay for a projection print and to store the negatives and make them available at any time to the Park Service for future prints.”<sup>17</sup> This is how fourteen Kinetophone film reels came to be stored at the NAVCC, while any cylinders that were gifted to the NPS by Edison Inc. / McGraw-Edison remained under the care of the TENHP.

Over fifty years later, Willeman compared the list of cylinders being stored at TENHP to the LC inventory of Kinetophone films. Cylinder matches were found for seven of these films. These include: “Musical Blacksmiths,” “Nursery Favorites,” “The Deaf Mute,” “The Edison Minstrels,” “The Five Bachelors,” “The Old Guard,” “Jack’s Joke,” and also the three-minute long “The Edison Kinetophone” lecture on the system given by Allan Ramsey, who directed the other seven films restored in the project. The original nitrate elements were scanned at 2K on the Lasergraphics ScanStation at the NAVCC, which created fabulous results, even in cases when the film had experienced shrinkage.

I was able to watch all seven of the restored Kinetophone films via the Undercrank Productions DVD release, *The Kinetophone: A Fact! A Reality!*, (2018). The films that were transferred from original camera negatives – “The Edison Minstrels,” “The Old Guard,” and

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<sup>17</sup> Cormac Donnelly, “The Dickson Experimental Sound Film,” DesigningSound.org, accessed March 8, 2019, <http://designingsound.org/2014/05/07/the-dickson-experimental-sound-film/>.

“Jack’s Joke” look especially beautiful. Overall, I really only noticed some signs of nitrate deterioration on “The Edison Kinetophone” and some minor base scratches during “Musical Blacksmiths.”

In terms of the audio elements, Fabris carried out the digitization of the corresponding cylinders on an Archeophone cylinder playback machine at the TENHP Recorded Sound Preservation Transfer Facility. He sent thirteen WAV files back to the NAVCC, along with a spreadsheet full of rich technical metadata (playback equipment specifications, preamp settings, general playback notes, etc.). Of particular note to engineer Hoffa were any mentions of pops, wow (pitch variation), surface noise, and pre-echo that he could attempt to eliminate in his audio lab. Hoffa utilized CEDAR Audio’s system and iZotope RX noise reduction and audio repair software to bring out the performers’ voices and reduce any playback noise and audio artifacts. When asked if he had any particular challenges during the restoration process, Hoffa replied, “I remember having a difficult time with ‘The Old Guard.’ In that one, the speech was so low, it made it very difficult to reduce hiss without affecting the voice. I didn’t dig in quite as hard, choosing to leave some noise over a very unnatural sound.”<sup>18</sup>

Next, Willeman combined the moving image and sound elements together using Final Cut Pro. With FCP, he was able to slow down the picture to match the sound. Event at 16 fps, the film and audio would drop out of synch, and he would have to cut, bring them back into synch, press play, and then repeat the process with two or three more 2-3 cuts. Some of the films, like “The Edison Kinetophone” required more cutting and pasting.

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<sup>18</sup> Bryan Hoffa, email message to Yuri Shimoda, March 21, 2019.



The most difficult re-synching job was “The Edison Minstrels” because Willeman realized that they had the British version of the audio and the American version of the picture. During the “So Amazingly Perfect They Are Really Weird: The History and Restoration of Edison Kinetophone Films” documentary included on the *The Kinetophone: A Fact! A Reality!* DVD, he admits that this specific film took lots of editing, “but because the performers and conductor were so time conscious, synching was easier.”<sup>19</sup> The challenges presented by the different versions of the “Minstrels” sound and picture were unique, but Willeman’s remark brings us back to the biggest challenge that faced the Edison Kinetophone system – and ultimately, one of a few reasons why it failed – synchronization of the visual and the audio.

### **The Rise and Fall of the Edison Kinetophone System**

Upon its February 19, 1913 debut, the Kinetophone system enjoyed initial success. North American rights for the device were sold to the American Talking Picture Company, Inc., which was backed by prominent vaudeville organizations. Vaudeville theaters were eager to show Kinetophone films because they were different from the pictures being shown in regular movie houses. Moreover, the system was applauded by critics upon its debut. “The Kinetophone business boomed into the summer of 1913, but audiences then lost interest. Each reel of film was only six minutes long, and pictures usually depicted mediocre vaudeville acts or scenes from plays.”<sup>20</sup> It was not possible for the films to exceed six minutes because the size of the cylinders dictated the length of the soundtrack and the moving image that went with it.

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<sup>19</sup> *The Kinetophone: A Fact! A Reality!* DVD.

<sup>20</sup> Charles Musser, *Thomas A. Edison and His Kinetographic Motion Pictures* (New Brunswick, NJ: Rutgers University Press, 1995), 52.

As soon as the phonograph began recording on set, the camera operator released the crank on the projector, and recording began. “The film goes at a pace dictated or set by the phonograph. The speech has the right of way, and the picture must follow. In this way, perfect accord is secured, and there can be no runaway dialogue.”<sup>21</sup> There could also be no editing of sound or picture. There was a moment in “Musical Blacksmiths” when the little girl is perched upon one of the smith’s shoulders. When she slips off his shoulder a bit, she lets out a giggle, yet no laughter can be heard. This is one instance where the lack of film editing capabilities is evidenced.

In addition, during the filming of Edison’s Kinetophones, there were no soundproof stages. “Shooting and recording were often done at night when there was less noise in the neighborhood. But ... microphones unavoidably picked up the sputter of the arc lights, whose heat also softened the wax coatings on the cylinders and sometimes blurred the recordings.”<sup>22</sup> Aside from these audible gaffes, Willeman points out several visible mistakes in the films they restored during the *Kinetophone: A Fact! A Reality!* DVD. Since the phonograph was perched above the on-camera action in the rafters during filming, the device’s shadow can be seen on the ground in a scene from “The Deaf Mute,” due to the fact that the film was shot outdoors on a sunny day. The bottom edge of a phonograph horn that was sitting in the rafters is spotted at the top of a frame of “The Old Guard.”

These details were in all likelihood missed by most movie-going crowds in 1913, but that isn’t to say that the novelty of these talking pictures didn’t rapidly wear off. However, it was both

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<sup>21</sup> Harry M. Geduld, *The Birth of the Talkies: From Edison to Jolson* (Bloomington: Indiana University Press, 1975), 66.

<sup>22</sup> Geduld, 68.

audience-member and theater-operator frustration with synchronization that was the true nail in the coffin for the Kinetophone system. While a small strip of celluloid (1/16 of an inch wide and 1/2 inch long) was removed from each cylinder to act as a visual cueing mark for the phonograph technician,<sup>23</sup> there were extenuating circumstances beyond human control (e.g. rats eating through the linen cord connecting the projector pulley and phonograph) that thwarted the synch system.

“A further problem lay in inventors’ regular recourse to electricity to stabilize speeds and to synchronize image and sound machines. ... electricity – was during the 1900s – still in its infancy. Some American cities employed direct current, while others used alternating current; voltages varied widely.<sup>24</sup> Issues posed by the new phenomenon of electricity were hardly the most challenging for Edison, though.

In the *A Fact! A Reality!* DVD, Willeman describes the maneuvering a projectionist had to perform whenever a Kinetophone would fall out of synch, and it is no easy process. Since New York state had mandated that motorized projectors were illegal to deter projectionists from leaving their posts of monitoring the flammable nitrate film, they had to simultaneously listen for directions from the phonograph operator, keep an eye on the film, and then reach between the projector head and hot lamp housing to grab the knob and crank the film until it synched to the sound. Moreover, “poorly trained or careless operators forgot to synchronise; the belt jammed or broke; the film itself broke in the projector (as often happened with all films screened at the time), and being shortened during repair went out of synchronisation with the recordings; the

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<sup>23</sup> George A. Blacker, “You Ain’t Heard Nothing Yet? Some Comments on the ‘Pre-Jolson’ Edison Talkies,” *The Antique Phonograph Monthly* 6, no. 10 (1981): 5.

<sup>24</sup> Altman, 159.

recordings themselves broke ... Given these conditions, it is easy to see why spectators and exhibitors quickly abandoned this invention.”<sup>25</sup>

The Edison Lab knew that this operator-dependent system was problematic, and the team tried everything to get the projector and phonograph to work together. Even though Americans were turning to other modes of entertainment, overseas interest in the Kinetophone remained strong. That is, until the onset of World War I. When a fire destroyed Edison Phonograph Works in December 1914, the Kinetophone studio was not affected. When the audio facility was rebuilt, though, “Edison discontinued production of all Kinetophone films and equipment.”<sup>26</sup>

### **Observations and Future Considerations**

Even though the Edison Kinetophone system ultimately suffered from forced obsolescence, its impact on the development of cinema is important. Scholars and other researchers should be able to watch the films and their soundtracks, but providing access to their contents inevitably means digitizing the legacy formats. As is the case with the LC/TENHP project, LAM professionals are unable to set up a Kinetophone system so that users can watch the films as they were seen by audiences in 1913. The equipment is not easy to come by, and even if it were, as this paper has shown, the system was not simple to operate. Instead, restoration is more akin to what Edison intended over a century ago, digitally marrying the images and audio. In doing so, what makes the Kinetophone system so special (presenting film sound on cylinder) is lost; the media’s context is no longer discernible.

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<sup>25</sup> Martin Barnier, “The Controversy Over the ‘Invention of the Talking Picture,’” *Film History* 11, no. 4. (1999): 482.

<sup>26</sup> Fabris presentation.

The *A Fact! A Reality!* DVD presents a bonus Kinetophone film, “The Politician,” which is still missing its sound cylinder. On the DVD, Willeman shares that the Library would love to locate the audio element for yet another film, “Votes for Women,” featuring scenes from the suffragette movement. During my research, I came across a list of twenty Kinetophone films, all of which appear to have been produced, that was published in 1976. In her article, the author states that

The most difficult items to find were the films, themselves. In 1972, nine kinetophones were available for screening at the Library of Congress in Washington, D.C.; however, only two had sound tracks. Because these films could not be played back on their original equipment, judgments of how they sounded at the time of release had to be based on newspaper and magazine reviews of the day.<sup>27</sup>

I also found a “Kinetophone Cyliandrography” published in a 1981 issue of *The Antique Phonograph Monthly*, but it only contained five titles.<sup>28</sup> This list was updated to include over 75 Kinetophone cylinders in a later issue (volume 7, no. 2), with a plea from the writer, Art Shifrin, to contact him with any information of their corresponding films. Establishing some kind of a central database, akin to Ron Hutchinson’s Vitaphone Project (<http://www.vitaphoneproject.com/>), that displays Kinetophone film and cylinder holdings in collections worldwide would be a great step in reuniting separated elements.

The Edison Kinetophone restoration project was driven by the dedication of a passionate and enthusiastic individual, who had the resources of the LC NAVCC and TENHP at his disposal. It took modern technology – the Lasergraphics ScanStation, the Archeophone, Final Cut Pro, CEDAR, and iZotope – to reformat and restore the images and sound. Not all LAM

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<sup>27</sup> Rogoff, 59.

<sup>28</sup> Blacker, 3.

professionals have access to a digital audio workstation (DAW) or a machine like the French Archeophone if they needed to listen to a cylinder that they think might be a Kinetophone element.

Rare cylinders like the Kinetophone soundtracks should not be played back, let alone transferred, using old phonographs. There are two other modern cylinder playback systems: one being utilized by the UCSB Cylinder Audio Archive (John Levin's CPS1, <http://www.cps1.net/>), the other by the NAVCC and Indiana University's Media Digitization and Preservation Initiative (Nicholas Bergh's Endpoint Cylinder Transfer Machine, <https://www.endpointaudio.com/>), these machines are too expensive for a LAM to purchase if they only have a few cylinders to digitize. Collaboration efforts across institutions or among different departments within a large institution are ideal for instances such as these.

The creation of the aforementioned Kinetophone online database could provide a foundation for LAMs to form relationships and build a network to partner on grant applications for restoration projects. Until then, using listservs run by organizations like the International Association of Sound and Audiovisual Archives (IASA), the Association of Moving Image Archivists (AMIA), and the Association for Recorded Sound Collections (ARSC) to establish connections is an option. I will be part of a panel presentation at the Joint Technical Symposium in Amsterdam this fall that calls for the creation of a network for smaller LAMs to become a part of in order to seek assistance with audiovisual and sound carriers within their collections. I believe that such a network can help provide all archivists, librarians, and conservationists with training to be able to identify and handle legacy formats, like Kinetophone films and their soundtracks.

## Conclusion

Never in the course of human history has the sound environment changed as fast or in as wide-ranging a manner as it did during the latter half of the nineteenth century in American cities. ... Early film accompaniment offers maddeningly incomplete evidence. Sound was held in such low esteem that it is never even mentioned in most reviews. Even more problematic, cinema's early years were a period of exceptions. Everything was a novelty, and thus received special treatment. Remaining evidence often relates to inaugural presentations of new projection systems, gala release of new films, or special introductions of new devices.<sup>29</sup>

Thomas Edison's dream of moving images synchronized to sound came to fruition in the Kinetophone system, although, it met a quick demise. Examining restoration projects like the 2016 Edison Kinetophone collaboration between the Library of Congress National Audio-Visual Conservation Center and the Thomas Edison National Historic Park provides valuable insights to all professionals within libraries, archives, and museums who steward audiovisual and sound materials within their collections.

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<sup>29</sup> Altman, 27 and 77.

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