Film sound in preservation and presentation
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CHAPTER 3.

Film Sound Preservation:
Early Sound Systems

3.1 Film Sound Preservation

In the introduction I argued that the nature of film sound consists of different dimensions: the textual and material dimensions, the human and technological dimensions, the institutional, experiential and memorial dimensions. Each of these should be taken into account in preservation and presentation practices. Some of these dimensions were investigated in the first two chapters, where I outlined a set of key concepts related to recorded sound that I derived from social and artistic sound practices as well as media theories: the noise of the material carriers and technological devices, cleaned and cracked sounds, the notion of soundscape and high fidelity, and the concepts of media memory and audiovisual trace.

In the following chapters I will further analyze the nature of film sound and its core dimensions beginning with the analysis of film sound preservation and presentation case studies. In this chapter, I examine preservation and restoration projects of films where the issue of sound is particularly relevant, while chapter four analyzes the work of film heritage institutions with respect to film sound presentation. The case studies discussed here are prompted by the following questions: how can we preserve and restore film sound materials? What are the different approaches to film sound preservation and restoration? What are the problems and defects of different film sound carriers and apparatuses? Which kind of actions can be taken to solve those problems? How can the actions undertaken to preserve film sound be recorded and documented? How is it possible to exhibit and display film sound in present-day theatres? The answers to these questions as provided by the case studies will contribute to the definition of the nature of film sound, which will be elaborated in chapter five.
In order to understand the specific challenges posed by early film sound preservation, and the way that these practices inform a discussion of film sound in general, I will first describe the main principles behind the preservation of film sound. The term *film sound preservation* refers to different activities carried out in film heritage institutions and film laboratories. Film preservation starts with the identification and cataloguing process: the material carriers of each film are described and documented in a catalogue. Regarding film sound in particular, the catalogue information often refers to the film sound carrier (optical, magnetic, combmag, digital), the film sound formats (variable density, variable area, optical mono, optical stereo, RCA, Western Electric, Dolby A, Dolby SR, Dolby Digital, SRD, DTS, SDDS, etc.), and the number of channels (mono, stereo, 4 channels, 5.1, 6 channels, etc.).

Documenting the right material form of sound is crucial since this provides the right information for playing the soundtrack.

After cataloguing, the film sound carrier may be cleaned and duplicated before being stored. The duplication phase consists in the recording of the soundtrack on a new carrier for preservation or restoration purposes. In this phase it is important to perform a correct reading and playback, which means reading the soundtrack with the correct filter (Academy, Dolby A, Dolby SR, Dolby Digital) in order to record the correct range of frequencies of the sound information. If an optical soundtrack produced with an Academy filter is read, for instance, with a Dolby SR filter, the amplified sound is distorted because the Academy filter equalizes the frequencies differently than the Dolby SR filter.

The proper restoration work, usually completed at digital postproduction workstations, consists of trying to eliminate or reduce the disturbing elements, such as clicks and pops, which have formed because of time and other factors. The restoration work operates primarily in the field of noise, which in this case is conceived as unwanted sound. During the restoration process some adjustments can be made through sound equalization in order to make the restored sound resemble the “original” sound, by trying to recreate the supposed response in amplitude of theatre loudspeakers at the time when the film was first distributed.

This is only a brief description of the type of work involved in the preservation and restoration of film sound. Each case is different from another and no general rule

\[133\] For the identification of film sound materials, see Paul Read and Mark-Paul Meyer, *Restoration of Motion Picture Film*, 67-68.
can be applied. In preservation work, different variables determine what decisions should be made, such as the condition of the material carrier, the operator, the technologies, as well as time and funding.

In the following sections, I will describe the film sound preservation of early sound systems (chapter three) and early films (first section of chapter four). It should be noted that these cases do not represent the rule but rather the exception, since the films that I will consider were produced before the so-called “coming of sound,” which is usually dated to the end of the 1920s, with the film The Jazz Singer (Alan Crosland, 1927) and Lights of New York (Bryan Foy, 1928). Analyzing exceptional cases is a useful strategy for the purpose of this dissertation: whereas in most cases the specific features of film sound may be easily overlooked, in exceptional cases, by contrast, they cannot be avoided. Moreover, the consideration of the sound component of films produced before the “coming of sound” also offer new reasons for considering early cinema as sound cinema rather than silent cinema.

3.2 Early Sound Systems

In this part, the objects of analysis are preservation projects involving some early sound systems: Biophon, Chronophone, Phono-Cinéma-Théâtre, and Vitaphone. The Biophon-Tonbilder project was carried out at the Deutsche Kinemathek in Berlin and presented in 2012; the Chronophone and Phono-Cinéma-Théâtre projects were curated by Gaumont Pathé Archives and the Cinémathèque française in France and presented in 2012; the Vitaphone project involved the UCLA Film Archive, the George Eastman House, the Library of Congress and the Museum of Modern Art Film Archive, and was initiated in Los Angeles in 1987.134

These projects, conceived and realized at different institutions, places and times, can be associated with the work carried out on a similar typology of film sound system, namely sound-on-disc systems. These systems represent the first experiments in sound films, allowing the synchronization of the image with sound recorded on disc. Sound-

134 These projects involve the preservation and restoration of an entire corpus or collection of films rather than the preservation of a single film. This can be seen as a general tendency in the film preservation field, where the focus has shifted from the restoration of singular masterpieces to the preservation of partial or entire collections.
on-disc systems are characterized by the separation of the image and sound on two different carriers: the image is recorded on film, while the sound is recorded on gramophone discs or similar carriers. During exhibition, the film image was displayed on the screen through projection, while the sound was played by a gramophone and diffused in the theatre. These systems were produced from the 1900s until the standardization of film sound technology in the late 1920s and early 1930s, when the film industry supported the establishment of sound-on-film technologies that recorded image and sound on the same carrier, film stock. Before this standardization, film screenings were mainly accompanied by live music and performers who read the intertitles or produced sound effects.

Even if the standardization of film sound came almost thirty years after the birth of cinema, it should be noted that film pioneers experimented with methods and devices for synchronizing sound and images since the first definition of the cinematic medium. The exigency of combining image and sound recordings is expressed by one of the first pioneers, Thomas Edison: “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.” Just a few years after the introduction of the Kinetoscope (1888-89), Edison coupled it with the cylinder phonograph, thus realizing the Kinetophone (1895), which transmitted the sound through rubber ear tubes (fig. 4). In the following years, many attempts were made in different countries to present moving images with synchronized sound, as for example the Phono-Cinéma-Théâtre (Liotret and Gratioulet, 1900), Phonorama (Berthon, Dussaud and Jaubert, 1900), Chronophone (Gaumont, 1902), Biophon (Messter, 1903), Cameraphone (Norton, 1903).

The preservation of sound-on-disc films can be considered an exceptional case, since these systems represent one of the very rare circumstances in which film sound is stored on discs. Nevertheless, it should be noted that the separation between image and sound on two carriers is a common practice in film preservation as well as film production. During film production, the image recording equipment and the sound recording equipment are separated, thus sound is recorded on a different carrier. Image and sound are rejoined and recorded on the same carrier during the production of

theatrical copies. The sound information for film preservation is often taken from another source than the positive print copy (sound negative print or magnetic tape), so rejoining the image and sound is also a problem for the preservation of films produced with sound-on-film systems. In consideration of this, some issues related to the sound-on-disc systems can be referred to in the preservation of other film systems.

Analysis of the preservation practices adopted for early sound systems is very relevant and productive for the discourse on film sound: the fact that the sound and image are separated not only in the recording phase, but also in the exhibition phase raises specific challenges in their preservation. Present-day movie theatres are not equipped with sound-on-disc systems, therefore in order to preserve and present these films it is necessary to transfer them to new recording carriers, either analogue or digital, that can be displayed in theatres. The rejoining of image and sound is a particularly interesting operation, for it puts into question the nature of film sound and its relation with the image. Restorers and conservators have to decide on which carrier and at which speed to record the image and sound, while also finding a solution for synchronization that respects the original form of these films.

The Biophon-Tonbilder case provides interesting insight into understanding how the first sound-on-disc films were produced, how the technologies for synchronizing sound with image were developed, and how the audience responded to it. The Chronophone, Phono-Cinéma-Théâtre, and Vitaphone cases serve to show, first of all, that the Biophon was not exceptional, but that similar systems occurred in other countries. Moreover, each system raises other interesting issues about the preservation and presentation of film sound. In fact, these projects present diverse strategies and solutions for addressing the issues of rejoining image and sound as well as preserving and presenting them in contemporary contexts. These solutions will be described in this chapter in an attempt to answer the question: how is it possible to preserve film sound? The consideration of the different aspects that compose these systems and the decisions made in the work of preservation highlight some fundamental dimensions of film sound: the recording carrier, the technological device, the dispositif situation, the textual dimension, and the exhibition context. In the following sections I will analyze the Biophon, Chronophone, Phono-Cinéma-Théâtre, and Vitaphone systems in all these

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136 I refer here to cinematographic systems in which the image and sound are both recorded on film.
dimensions, first discussing their preservation, then their presentation in present-day theatres.

### 3.3 Tonbilder Carriers, Dispositifs, Texts, and Exhibition

The first case study considered is the preservation of five German Tonbilder films. Being involved in the project as a researcher, I gained direct insight into the preservation process, which was carried out from January 2011 to May 2012.\(^\text{137}\) The Tonbilder project was part of the preservation activity of a film archive, the Deutsche Kinemathek – Museum für Film und Fernsehen (SDK). Moreover, it was also part of a cooperative academic research project, *The preservation and restoration of obsolete image and sound in the digital domain*, involving the Hochschule für Technik und Wirtschaft in Berlin and the Università degli Studi di Udine in Italy.\(^\text{138}\) The binary orientation of the Tonbilder project, towards both archiving and research, made it possible to tackle theoretical issues during the realization of the work, giving the people involved the time to discuss and analyze the work in progress.\(^\text{139}\)

The German term Tonbilder, meaning sound (Ton) - images (Bilder), designates early sound films accompanied by synchronized soundtracks that were recorded on gramophone shellac discs and produced in Germany in the 1900s and 1910s. The first system used to produce Tonbilder films was the Biophon, patented by the inventor and entrepreneur Oskar Messter in 1903 and improved in the following years. The term Biophon – whose etymology refers to life (bio) and sound (phon) – indicates that the

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\(^\text{137}\) The restoration of Tonbilder is a collaborative project between Deutsche Kinemathek - Museum für Film und Fernsehen; Hochschule für Technik und Wirtschaft; Arri Film & TV; Università degli Studi di Udine and its film and video restoration laboratory La Camera Ottica. My personal involvement in this project consisted of the observation of the main phases of the preservation process, including the decision-making part, and of performing some tasks especially in the phase of digital restoration.

\(^\text{138}\) The collaboration between the two universities was possible thanks to the Vigoni Program of the Ateneo Italo-Tedesco, which financed the mobility of the researchers involved in the project: myself as a PhD student at the Università degli Studi di Udine and Dirk Förstner, a graduate student in Film Restoration at the Hochschule für Technik und Wirtschaft in Berlin. As an employee of the Deutsche Kinemathek, Förstner was involved in the project from its very beginning and carried out the research of the materials in the archive. The operational processes of the project were carried out at the Arri Film & TV in Munich.

\(^\text{139}\) The moments of discussion during the reconstruction of the Tonbilder played an important role in defining the main issue at stake in the preservation of film sound: for these moments, I owe my thanks to all of the people involved in this work.
device was able to sync images with sound through the use of a projector and a gramophone linked together. Messter’s system became so successful in Germany that other companies began to produce sound-on-disc systems similar to the Biophon: Alfred Duskes constructed the Cinephon for the Duskes Kinematographenfabrick, Guido Seeber developed the Seeberophon and the Synchroscope, and Karl Geyer produced the Ton-Biograph for the Deutsches Mutoskop- und Biograph Gmbh.140

Taking into account that Tonbilder films in Germany were produced and distributed on different sound-on-disc systems, I use the Biophon system as the device of reference in analyzing this case. Biophon was the first and most successful system in terms of production and reception. In fact, of the 1500 Tonbilder movies distributed in Germany from 1903 to 1914, around 500 were produced with the Biophon.141 Moreover, the Biophon was also the system used most often for projecting sound-on-disc films in Germany. The Biophon also provides us with better documentation: many related documents regarding the Biophon survived, together with some exemplars of the devices, which are part of the film equipment collection that Oskar Messter donated to the Deutsche Museum in Munich. A model of the Biophon device is in fact displayed at the museum (fig. 5). This is not the case for other systems that lack description and documentation, and whose devices did not survive. It should be also noted that, despite some technical differences between competing devices, the principles elaborated in the description of the Biophon can also be applied to the other sound-on-disc systems developed in Germany.

Considering the importance of the material carrier and the technological device for the transmission of audiovisual traces as argued in chapters one and two, I have decided to separate the investigation of the Tonbilder case into three core aspects of film sound: the film carrier, the film dispositif, and the film text. First, the film carrier refers to the material object that contains the recorded information. Second, the film dispositif refers to the recording and playback devices, and the human actors that

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140 “The other German film producers did not stay idle in the meantime, but soon began to produce Tonbilder and to produce devices for the recording and playback of Tonbilder, which were similar to the apparatuses made by Messter and Gaumont.” My translation from the original: “Die anderen deutschen Filmfabrikanten stehen indes nicht tatenlos abseits, sondern beginnen bald ebenfalls mit der Produktion von Tonbildern und mit der Herstellung von Geräten, die ähnlich wie die Apparate von Messter und Gaumont zur Aufnahme und Wiedergabe von Tonbildern geeignet sind.” Martin Körber, “Filmfabrikant Oskar Messter. Stationen einer Karriere,” in 100 Jahre Kino, Oskar Messter – Filmzionier der Kaiserzeit. Katalog zur Ausstellung, ed. Martin Loiperdinger (Frankfurt am Main, Basel: Stroemfeld, Roter Stern, 1994), 52.

141 Harald Jossé, Die Entstehung des Tonfilms, Beitrag zu einer faktorenorientierten Mediengeschichte (Freiburg, München: Karl Alber Verlag, 1984), 101.
operate these technologies. Third, the film text is to be intended as the communicative content of the recorded information.

Far from being separate entities, these aspects are very much interconnected: the type of carrier influences how the device is used, the device chosen for production or projection can modify the carrier, and also the text and the film content can determine the use of a particular device or film stock. These three elements and their interconnectivities form an integrated system that shapes the cinematic experience of the films.

**Tonbilder film carriers**

The first element that the archivist approaches and experiences in the work of film preservation is the recording carrier, which is usually identified by the film stock. However, this is not always the case, as the Tonbilder example shows. Tonbilder films had the peculiarity of being recorded on two distinct carriers: one for the image (in most cases a 35 mm nitrate film base, positive or negative, fig. 6 and 7, or alternatively a 16 mm copy) and one for the sound (a gramophone shellac disc, fig. 8 and 9).

The separation of the image and sound carriers is correlated to the separation of the devices: during production, there were two recording devices: the camera that captured the image and the gramophone that recorded the sound. Similarly, during exhibition there were two playback devices: the projector to display the images on the screen and the gramophone that played the sound. The material nature of the carriers also influenced the dimension of the text: the fact that the sound was stored on gramophone discs meant that the duration of a single movie could not exceed the length of a disc, which at that time was about three to five minutes.

The duplicity of the carriers is also part of the reason why Tonbilder films constitute an interesting case in the field of sound preservation: the rejoining of sound and image is in fact a challenging issue in preservation practices. The storage of sound and image on two different carriers conditioned the disappearance of these films. In fact, in the early 1910s, film exhibitors actively discarded sound-on-disc systems and replaced them with projection devices that could not play gramophone discs, thus making it impossible to screen the Tonbilder films in a movie theatre. Since Tonbilder films lost their ability to be exhibited and, thus, their economic value, the image carriers
were separated from the sound carriers and ended up in different places and institutions. The gramophone discs were sold in the music market, and many of the surviving few ended up in private collectors’ hands. Most of the films are lost, with only a few stored in film archives such as the Deutsche Kinemathek or the Bundesarchiv. The process of reuniting the image carriers with their corresponding sound carriers was one focal issue of this preservation project.

**The Biophon system: technological devices and dispositifs**

After a first consideration of the nature of material carriers, the next dimension concerns the devices that were used to produce and exhibit the *Tonbilder* films. In order to preserve these films correctly, it is in fact fundamental to take into account and understand the technological devices through which these images and sounds were displayed.

Before analyzing the Biophon system as a device and a technological development, we must first define the term *dispositif*. The French term *dispositif* became a notion of reference in sociology and media studies from the 1970s onwards thanks to the work of Jean-Louis Baudry and Michel Foucault, among others. As Frank Kessler argues in “Notes on dispositif,” the French term *dispositif* is only partially translated into English as apparatus or device: “‘apparatus’ does mainly underscore the ‘mechanical side’ of the term, and less the aspect of a specific ‘disposition’, both in the sense of ‘arrangement’ and ‘tendency’.” The theoretical elaboration of the notion of *dispositif* involves many aspects that are excluded by the term apparatus, which indicates the technological device: *dispositif* is in fact used as a broad notion that ties together different dimensions of media, such as the economic, artistic and institutional dimensions. The distinction made by Jean-Louis Baudry between apparatus (*appareil de base*) and *dispositif* helps to clarify this point:

> In a general way we distinguish the **basic cinematographic apparatus** (*l’appareil de base*), which concerns the ensemble of equipment and operations necessary to the

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production of a film and its projection, from the apparatus (le dispositif) discussed in this article, which solely concerns projection and which includes the subject to whom the projection is addressed.144

Following Baudry’s distinction, I differentiate between the concepts of apparatus and dispositif. I intend the concept of apparatus as referring to all of the technological devices (mechanical, electrical, digital) that are involved in the processes of production, distribution, exhibition, preservation and presentation of film heritage. In order to avoid the linguistic confusion between apparatus and dispositif, further on I use the term technological device instead of apparatus.

In line with Baudry’s definition of dispositif I include the audience in the screening situation. However, I do not restrict the notion of dispositif solely to the moment of projection, since I consider the subjects involved in a dispositif situation to be not only the audience but also what I previously defined as other human actors, referring mainly to the technicians and operators. In this sense, human actors interact with the film devices and the film objects not only in projection, but also in other phases of film production. Moreover, this concept allows preservation practices to be included in the set of dispositif situations, since preservation, like projection, requires an interaction between human and technological actors. I propose then to use the term dispositif to describe the situation of interrelation between the technological devices and the human actors that can take place in the context of the production, distribution, reception and preservation of films.

The case of Tonbilder, as well as other early film sound systems, illustrates the difference between the concept of device, dispositif, and system. The projector and the gramophone, considered singularly, are devices: they are independent and can function alone. A system is formed when different devices are linked together and function in an integrated way. In the case under examination, the projector linked together with the gramophone constitutes the Biophon system, as described in Messter’s patent. The same devices linked together with another type of connection compose a different system (the Chronophone, the Vitaphone systems). When the devices are linked together in a system, set up in a particular space and context, and operated by a human actor, they

constitute a *dispositif*. The human actor and the technique that he or she uses to operate the devices play a decisive role in defining the form that film takes in production or projection. In the *Biophon* system, the relation between human actor and technological actor guarantees the synchronization effect between image and sound, as will be further explained.

With the definitions of device, *dispositif*, and system in mind, I can now focus on the specific characteristics of the *Biophon* system. In 1903, the company of Oskar Messter, which produced film and film equipment, patented the *Biophon*145 for the exhibition of moving images and recorded sound in synchrony. According to the patent drawing (fig. 10), the *Biophon* system used for exhibition was composed of two playback devices: the gramophone (fig. 11) placed behind the screen and the projector placed in the auditorium.146 The projector and the gramophone were electrically linked together with an electromagnetic coil system that regulated the speed variations of the projector’s and gramophone’s motors, enabling the two devices to form a united playback system.

Film historian Harald Jossé identifies different recording and playback techniques in order to classify early sound-on-disc systems.147 Jossé describes three main techniques applied in the production of sound-on-disc movies: the film shooting can precede the sound recording in the “post-synchronous sound recording” (*postsynchrone Tonaufnahme*), the sound recording can precede the film shooting in the “presynchrone sound recording” (*präsynchrone Tonaufnahme*), or they can be recorded simultaneously in the “simultaneous recording” (*Simultaneaufnahme*). During exhibition, the phonograph and projector can be linked in a “unity method” (*Unitätsmethode*) if they are driven by a unique motor or in a “dependence method” (*Dependenzmethod*) if the motor of one device leads the other. With the “indicator method” (*Indikatormethode*), the two speeds of the projector’s and gramophone’s motors were indicated in a unique measuring scale, which showed when the two speeds diverged. Jossé’s distinction can be interpreted as a classification of the types of interactions between technological devices and human actors in the context of production and exhibition.

145 The first patent is dated February 19th, 1903 (DRP Nr. 145 780). After little changes, a second patent was presented on April 9th, 1903 (DRP Nr. 154 372).
Following Jossé’s terminology, the *Biophon* works according to the “pre-synchronous sound recording” principle during production and the “unity method” during exhibition. The shellac disc was recorded first, before the production and shooting of the film. The disc could be recorded for the purpose of the film, or alternatively, records produced for the music market were used, for instance arias or songs performed by famous opera singers like Caruso. During filming, the shellac disc was played and the actors on stage tried to follow with the lip movement and mimic the soundtrack (fig. 12). The films were shot in a single take and there was no editing afterwards. This enabled the synchronism between image and sound to be maintained.

For the screenings, the projectionist loaded the projector and put the disc on the gramophone, trying to start both of them in sync. To help him, sometimes there were specific marks on the film roll as well as on the shellac disc that indicated the starting point (fig. 13 and 14). However, matching the starting points of image and sound did not guarantee synchronization. Many technical problems could occur during the screening and cause a loss of synchronization: a jump of the gramophone needle on a groove because of a scratch, a film splice or a tear that caused parts or entire film frames to be missing, or a current fluctuation that produced a change in the transport speed of the machines. In those cases, the projectionist had to adjust the speed of the projector in order to regain synchronization during the screening. Therefore, the projectionist had a decisive role in the synchronization results of the projection. This observation demonstrates the importance of the human actor and of his or her interaction with the technological device in defining the frame of the *dispositif*.

In order to improve the efficiency of the adjustment operations, Messter implemented a warning device (*Synchrophon*) that used a flashing light to signal when the projector and gramophone speeds diverged. As reported by Jossé, this device and the technique involved followed the principle of the “indicator method,” according to which the projector and the gramophone were connected to a speedometer, which used an indicator to display the speed of the two devices.148 During the screening, the projectionist had to pay attention to whether the two speed arrows were aligned; otherwise, asynchrony would result. In this case, the projectionist needed to regulate (speed up or slow down) the projector speed until sound and image were in sync again. The speed of the gramophone was typically left unchanged since altering the speed of

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148 Ibid.
the sound is usually much more disturbing than changing the speed of the image. In this kind of device, the quality of the projection and the efficiency of the synching effect depended greatly on the capacity and attention of the projectionist.

Messter continuously improved the Biophon system in order to ameliorate the synchronization between image and sound, as demonstrated by the 35 patents for synchrony devices that he submitted from 1903 to 1908. In 1906, Messter released a new patent\textsuperscript{149} for a device that was connected electrically with the gramophone and mechanically with the projector:\textsuperscript{150} the motor of the gramophone set the speed while the projector’s motor followed the speed of the gramophone. Jossé calls this synchrony technique the “dependence method” because one device, the projector, depends on the other, the gramophone. Jossé explains that the leading device is the gramophone because the inertia of the eye allows a certain freedom in the speed range of the projector, while the ear notices immediately if a record is played too slow or too fast.\textsuperscript{151}

Even though the device used in the “dependence method” was more expensive to produce and more difficult to integrate with existing machines, Messter decided to adopt it and abandon the “indicator method.” The “dependence method” allowed him to improve synchrony by making it more dependant on the technological actor – the projection device – than on the human actor – the projectionist. It is useful to interpret the development of the technologies used for Tonbilder films in terms of the relationship between human and technological actors in the dispositif situation: while in the “indicator method” the result depends mainly on the human actor, synchronicity in the “dependence method” depends more on the technology (the connecting of the two devices’ motor) and less on the technique and operational capacity of the projectionist.

The concept of dispositif, intended as the relation between human and technological actors, when used as a tool for interpretation can underline where the emphasis in a particular system lies, that is, in the actions of the human operator or of the device. Thus the conception of dispositif as a mere device would not take into account the role of the operator as well.

In other words, Messter’s struggle for continuous improvement of the Biophon dispositif can be read in light of a continuous re-adjustment of the human-device relationship in the context of exhibition as well as that of production. The nature of this

\textsuperscript{149} DRP Nr. 200 469 (29th April 1906).
\textsuperscript{150} See Harald Jossé, Die Entstehung des Tonfilms, 76.
\textsuperscript{151} Ibid., 69.
dispositif underlines the importance of performance and liveness: the overall result of Tonbilder exhibitions, as well as the cinematic experience connected to it, depended to a certain degree on the live performance of the projectionist, or, in other words, on the interaction between the projectionist and the technological device.

The dispositif also has to be adapted to the physical space of the exhibition. With this in mind, one of the main problems of Tonbilder systems was sound diffusion: the gramophone was placed behind the screen, but the sound could not traverse the whole auditorium, especially in the case of a large theatre. To solve this problem, Messter decided to improve the sound volume by using more gramophones linked together and adopting a bigger horn (two meters long). He placed the gramophones near one another behind the screen or in different places in the auditorium, creating a sort of multi-channel diffusion. This solution still had some problems: increasing the volume meant an intensification of the noise and crackle created by the phonograph. Additionally, if the gramophones were not started at the same point and at the same time, they could also generate an echo effect. These problems were overcome in 1910 thanks to the introduction of the Auxetophon patented by Deutsche Grammophon AG: this device amplified the sound through the use of compressed air so that it could be heard by everyone in the auditorium.152

Considering the importance of an adequate space for guaranteeing a good exhibition, Messter decided from the very beginning to open a theater in the centre of Berlin, the Biophon-Theatre, which had 280 seats, with an average audience of 500 people per day.153 In this theatre Messter could set up the Tonbilder with the maximum amount of control over the exhibition space and the dispositif, i.e. the technological devices and the human operator. This fact sustains the idea that Tonbilder exhibition can be interpreted as a performance where contributing factors include the interrelation of technological devices and the human actor in the dispositif situation.

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152 Ibid., 70.
Tonbilder film texts

The third element that I use to describe the case of the Tonbilder is the film text, understood in semiotic terms as the content and narrative of the film. From the perspective of the text, Tonbilder films can be characterized as short films presenting brief drama or comedy scenes, most including a song. These musical numbers were adopted from musical theatre, cabaret, and variety shows; the songs could be borrowed from popular shows from Berlin’s musical theatre or could be arias from operas and operettas. The musical piece was performed alone or inserted into a dialogue scene, a short sketch or a dance scene. Messter also recruited the stars of Berlin’s musical and variety stage for shooting and recording the Tonbilder scenes and sounds.

Since the major innovation of the Tonbilder was synchronized sound, the frequent use of musical pieces and songs is not surprising: the main attraction for the audience consisted of the novelty of experiencing speech and musical accompaniment as an integral part of the film, hearing the actors’ voices synchronized with the image of their bodies. The use of songs also derived from economic and production factors: the fact that shellac discs were utilized to record songs for the music market favored the presence of songs in the Tonbilder scenes.

The relation between carrier, text, and dispositif in the Tonbilder films can be interpreted as follows. The use of previously released, commercial music recorded on disc, and the consequent presence of popular songs in film, is an example of how the carriers and devices determined the form and content of Tonbilder texts. The real attraction of these films depended on the dispositif itself much more than on the films’ content, which was organized in order to be adequate to display the potentialities of the dispositif and to hide its defects. In other words, the text was subordinated to a certain extent to the dispositif. Since the main potential and attraction of the dispositif was the possibility to display synchronous sound, the screenplays were constructed in order to bring out the songs or recorded sound.

The dispositif presented not only new opportunities on the level of text, but also restrictions: as already noted, the duration of the film depended on the maximum duration of the sound records (three to five minutes). In the beginning this was not considered a problem, since in 1903 the average length of movies was still around five minutes. Later on, however, with the emergence of longer feature films, it became a
limitation. This problem was partially overcome by using two alternating gramophones to play the sound; Messter employed this method to realize some longer films in the form of a series.\textsuperscript{154}

\textbf{The history of Tonbilder exhibition}

The history of exhibition is also an important element to consider in preservation practices. First, documentation of historical exhibitions and audience reception provide useful information for preservation and presentation. Knowledge of a film’s exhibition can help in locating other copies of the film. Moreover, the study of exhibition related material, such as billboards or reviews, can offer insight into understanding how a film supposedly looked and sounded to a contemporary audience.

When analyzing the ways in which \textit{Tonbilder} films were historically presented, it is important to note that these films were not usually screened on their own, but instead as part of theatre programs, usually in the drama or comedy slot. These theatre programs also contained films without recorded sound that were instead accompanied by a piano or an orchestra, or were mixed in with actuality films, as indicated in a program’s billboard (fig. 15).

The first presentation of a \textit{Tonbilder} film, which is also considered to be the first film screening with synchronized recorded sound in Germany, took place on 29 August 1903 in the Apollo Theatre.\textsuperscript{155} The reaction of the public and critics was enthusiastic. This is an impression of the screening as reported in 3 September 1903 edition of the \textit{Staatsbürger Zeitung}:

For that there is only one voice of admiration. Nostradamus and Cagliostro are orphans compared to Messter, and the inventor of Biophon should consider himself lucky that he is part of the modern world. In the 17th Century he would have been involved in a witch trial, or sent to a madhouse, like Mondecaus, the inventor of the steam engine.\textsuperscript{156}

\textsuperscript{154} An example is the five-part adaptation produced by Messter (1908) of \textit{Ein Walzertraum}, with a running time of 15-20 minutes.

\textsuperscript{155} Harald Jossé, \textit{Die Entstehung des Tonfilms}, 74.

\textsuperscript{156} My translation from the original: “Es gibt dafür nur eine Stimme der Bewunderung. Nostradamus und Cagliostro sind Weiskinder im Vergleich zu Messter, und der Erfinder des Biophons mag sich glücklich schätzen, dass er der modernen Welt angehört. Im 17. Jahrhundert hätte man ihn in einen Hexenprozeß verwirkelt, oder in ein Narrenhaus gebracht, wie Mondecaus, der Erfinder einer Dampfmaschine.” Ibid., 74-75.
The films were then screened in other theatres. The Tonbilder attraction soon gained recognition in the short film programs in Germany and was also distributed in foreign countries, such as Austria, Hungary, Russia, the Netherlands, Denmark, and Italy.\textsuperscript{157} Before 1914, Messter installed approximately 500 Biophon devices in theatres.\textsuperscript{158} The Tonbilder, whose devices required a closed and stable space for sound diffusion, played a role in the evolution of exhibition spaces. Around 1905 in fact the cinema exhibition space shifted from wandering spectacle (Wanderkinos) to stable theatres, the Ladenkinos with a capacity of less than 100 people and the bigger Kinotheatres with a capacity of 1000 people.\textsuperscript{159}

A Tonbildboom\textsuperscript{160} happened in Germany from 1903 to 1914 and resulted in the production of around 1500 Tonbilder negatives, of which 500 were produced by Messter. Competing companies, such as the Deutsche Mutoskop und Biograph or the Duskes Kineamtographenfabrik, also produced films with sound-on-disc systems similar to the Biophon. In 1913-1914, this boom came to an end mainly because of the progressive establishment of the feature film with a length of one to two hours. With the technology of the time, it was too problematic to produce Tonbilder films that lasted as long, since a single disc could play only around five minutes of recorded sound. Additionally, the language of film was also changing because of new possibilities provided by production devices: camera movements, alternate shots, elaborate editing, and effects. The stable single shoot required for shooting Tonbilder films and the inability to make cuts in editing relegated these films to an outdated form of cinema. Another reason for the end of the Tonbildboom was that films with synchronized sound were no longer a novelty; also, the synchronicity with the image was often compromised because of the many problems that could occur during projection, which was perceived as disturbing by an increasingly demanding public. Finally, the onset of the First World War brought an end to Tonbilder production and distribution.

For all these reasons, in the second half of the 1910s the Tonbilder films were no longer considered commercially exploitable: the technology became obsolete, exhibitors dismissed the playback devices, and projectors lost the capacity to operate them. Sound and image carriers were separated and ended up in different places, and most of the films were lost as a result. Collectors saved some film reels from destruction and

\textsuperscript{157} See Oskar Messter, \textit{Mein Weg mit dem Film} (Berlin: Max Hesses Verlag, 1936), 65.
\textsuperscript{158} See Martin Körber, “Filmmfabrikant Oskar Messter – Stationen einer Karriere,” 49.
\textsuperscript{159} Harald Jossé, \textit{Die Entstehung des Tonfilms}, 98.
\textsuperscript{160} See ibid., 101.
possibly screened them without sound in non-theatrical settings. Some of the films were
donated to archives. The shellac discs were still used privately as music records since
they very often contained songs; therefore they became part of the collector market or
ended up in specialized sound collections.

Examination of the end of Tonbilder exhibition was useful for locating the film
and disc materials. Moreover, investigation into exhibition history also served to better
understand the modes of display and the dispositif set-up. Providing information on how
the sound of Tonbilder films was presented in the past, exhibition history also plays a
role in defining how these films can be presented now, as will be clarified in the
following examination of preservation practices.

3.4 The Preservation of Tonbilder films

Before analyzing the preservation of the sound of Tonbilder films, which will be
described in the next section, I will first discuss the initial phases of the preservation
process. Here, the issues concerning the level of the carrier come particularly to the
fore.

The first step in the Tonbilder project consisted of finding and selecting the
material objects for preservation. As previously mentioned, the image and sound
carriers were separated after the end of their commercial distribution. The few
Tonbilder films and discs that survived were located in different places and institutions,
such as the Deutsche Kinemathek and the Bundesarchiv Berlin. Upon examination, the
catalogue of the Deutsche Kinemathek contained twenty-five film titles corresponding
to Tonbilder films. However, when searching the same titles in the sound collection
of the Kinemathek, only two items were found (a wax cylinder and a magnetic tape with
four musical accompaniments recorded in the 1950s), but no shellac records. Since the
archives provided no corresponding records, the search was extended to private
collections, taking into consideration the films’ exhibition history. In particular, the
German collector Christian Zwarg, who specializes in Tonbilder records, carried out the

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161 See Dirk Förstner, “Die Möglichkeiten des Digital Intermediate Prozesses in der Filmrestaurierung am

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research in the collectors’ world, finding four sound records that corresponded to the film titles.

The main criterion for selection was finding the corresponding sound discs. In the end, only four films could be found that met this requirement. However, an additional film titled *Babylied* was selected for preservation, despite the inability to locate the corresponding sound disc. This decision was made because of the qualities of the film copy, which was the only one to be hand-painted, and the comic value of scene, which showed the actor Henry Bender singing a song and dancing dressed like an infant. My analysis will not consider this last film, since its restoration did not involve sound. The five *Tonbilder* films selected for this preservation project were (see table, fig. 16 and 17):

1. *Am Elterngrab* (1907)
2. *Schutzmännlied* (1908)
3. *Liebes Männchen folge mir* (Albert Kutzner, 1910)
4. *Militärische Disziplin* (1910)
5. *Babylied* (1904)

Once the film and discs had been found and selected, the project needed to be defined. Considering the characteristics of the *Tonbilder* texts, the material carriers, the technological devices and the *dispositif* as described above, the preservation of *Tonbilder* films poses the following questions: what does it mean to preserve sound-on-disc system-based films like the *Tonbilder*? How can they be reconstructed with current technologies? How can they be made accessible to the public and presented in current theatres that are not equipped with the original playback system?

The objective of the project needed to be defined with respect to preservation and presentation. For preservation, the team of preservationists decided that the aim was the production of preservation copies, since the films were not already preserved neither by this institution nor any other. In terms of presentation, it then needed to be determined whether the restored copies were going to be screened in a theatrical setting or used as access copies for other media and settings (DVD, digital copy for the web, and so on). The team decided in favor of a solution that allowed the presentation of the restored *Tonbilder* films in a contemporary movie theater.
It should be noted that it is not possible to present the Tonbilder films in their original form, with the use of the original materials (film rolls and discs) and devices, mainly because of the obsolescence of the carriers and the dispositif. In the case of the carrier, the film and the discs are, in most cases, unique copies and have deteriorated over time. The nitrate film rolls, if they survived, are very fragile and most likely physically and chemically decomposed. Moreover, it is not possible to project nitrate film in today’s film theatres for security reasons since it is flammable; only few theatres in the world have the license to do so on special occasions. The original shellac discs are also very fragile: each time a shellac disc is played, the stylus scratches the surface of the track, eroding sound information. On the level of the dispositif, it is not possible to use the original playback equipment, since theatres no longer use this technology. Only a few examples of the machines still exist, some of which are preserved in museums. Even considering the very expensive possibility of putting the device in a theatre - assuming that it still works - no projectionist nowadays has the technical knowledge required for operating the equipment needed.

The choice of theatrical exhibition for the restored versions prompted questions surrounding how these films could be displayed using present-day theatrical playback equipment. In order to show the Tonbilder films in a cinematic context, it is necessary to transfer them to other carriers and formats that allow them to be displayed with today’s devices in the dispositif setting of contemporary movie theatres. Considering the need to transfer the material and the impossibility to use the same type of carrier as the original films there were two main questions at this stage: what kind of carriers (analogue or digital) should be used? Should sound and image information be combined onto a unique carrier or two separates ones? The project team considered two possible directions for answering these questions.¹⁶²

The first direction evaluated the use of separate carriers, one for the image and one for the sound. This option, which would be more accurate with respect to the original film form, using 35mm film for the image and maintaining the speed of about 16 fps, and using a vinyl disc for the sound, since it is no longer possible to record shellac discs. However, the possibilities of exhibition in this situation would be very

limited, since almost no theatres would have access to a projector with variable speed as well as a record or magnetic player, hence, this was not a viable solution.

Instead, a solution should be favored that accommodates the devices present in today’s theatres. Given this consideration, the carriers could be both analogue (image on film; sound on magnetic tape), both digital (image on hard disc; sound on Compact Disc, digital magnetic tape or hard disc), or a combination of analogue and digital (image on film; sound on Compact Disc, digital magnetic tape or hard disc). It should be noted that the use of digital carriers for the sound could be problematic because it is not possible for the projectionist to work the same way with digital means as with analogue ones. In fact it is not possible to put starting marks on a CD, and digital playback machines do not allow the alteration of playback speed. This leaves the combination of image on film and sound on magnetic tape as a possible solution, but only if the projection booth is equipped with a tape playback system, which is unusual.

The second direction the team investigated comprised solutions where the sound and image were stored on the same carrier, which could be analogue (a 35 mm combined film copy) or digital (a hard disk). In both cases, the synchronization would not depend on the projectionist, but on the display machine (a film projector in the first case or a digital projector in the second one), since the images and sounds would already be synchronized on the carrier. In this case, the original materiality of the film would be deprived of one of its most specific characteristics, the duplicity of its carriers. However, the film would have a greater possibility of being presented in contemporary theatres: the format and carriers would in fact be compatible with contemporary projection technologies, and special equipment or special skills of the projectionist would be not required.

The choice between the use of one or two carriers for recording the image and sound of the reconstructed Tonbilder films can be interpreted from my tripartite definition of preservation as featuring carrier, dispositif, and text. The strategy of using two different carriers could be considered more attentive to the preservation of the original dispositif and the materiality of the carriers, but requires extra equipment (variable speed projector, record or magnetic player) as well as a skilled projectionist, since synchronization depends on his or her precision in operating the projector and the sound playback machine. On the other hand, the recording of image and sound on the same carrier supports the reconstruction of the films on a textual level; in this case, the
requisites for contemporary presentation take precedence over the original *dispositif* and carriers.

Considering these two possibilities, the project team chose the option of using one unique carrier for image and sound. It was decided to produce both an analogue and a digital copy as output of the reconstructed *Tonbilder* films: the 35mm film combined copy with an optical soundtrack guarantees its preservation in the long term, while the DCP digital copy can easily be used for exhibition in theatres equipped with digital projectors.\textsuperscript{163}

The decision to use one unique carrier for image and sound betrays the original materiality of the *Tonbilder* films to a certain extent. However, this “betrayal” can be put into perspective somewhat, considering that each transfer of the film entails a change in the its materiality: this change is part of the process of a film’s reproduction and transmission to the future through migration in new carriers. In fact, some *Tonbilder* films had already gone through a migration when they were copied from 35 mm nitrate to 16 mm acetate film, as for instance in the case of *Liebes Männchen folge mir* and *Schutzmannlied*. In this transfer, they had already lost some characteristics of their original format: part of the 35 mm frame has been cropped to fit the 16 mm frame and the original color, which might have been done by hand, was lost when copied to black and white 16mm film stock, as shown in the case of *Babylied*. Considering the degree of material change involved in each migration, preservation work can also be intended as the ability to choose which characteristics of the film should be safeguarded and which characteristics can be modified, and to what extent.

In conclusion, the choice of the carrier in this project is an example of the delicate decision making process that is continuously being carried out by archivists and restorers, balancing historical against contemporary materials, devices, and screening practices. It also shows that preservation choices have a direct impact on presentation and that these two activities are closely connected. In fact, the decision to record image and sound on the same carrier, despite the fact that they were originally separated, is considered here to be the best solution to presenting the films in contemporary theatres. Finally, the choice of the carrier suggests that there is no absolute right or wrong solution, but each decision depends on the context, the people involved, and the technology available. Preservation practices can be interpreted using the concept of

\textsuperscript{163} See Dirk Förstner, “Rekonstruktion von Tonbildern in modernen Wiedergabesystemen,” 41.
dispositif, as I did for explaining the exhibition of Tonbilder films: the practice depends on the balance between human and technological actors in a particular situation. Preservation work turns out to be much more of a social practice than a merely technical or scientific one.

### 3.5 Synchronization, Sound Reconstruction, and Denoise

After discussing the choice of the carrier, in this section I elaborate on the process of synchronization between image and sound, which is one of the most problematic and interesting aspects of the Tonbilder reconstruction. As already pointed out, both the records and films of the Tonbilder system did not have a standardized playback speed, since the motors of the camera and gramophone lacked a fixed rotation speed. Film speed was standardized to 24 images per second (fps, frame per second) only after the adoption of the optical soundtrack system at the end of the 1920s; before this time, the speed could vary from 14 to 22 frames per second. Similarly, gramophone records did not have a defined speed (rpm, revolutions per minute) at first, but ranged from 60 to 130 rpm; it was standardized to 78 rpm only around 1925 with the introduction of electrical recording systems.

These two unknown factors made synchronization problematic, since there is no established and technologically standardized reference point. The first challenge of Tonbilder synchronization was to find a disc speed that would make the music and human voices sound natural. The second challenge was to identify a film speed that would make the movement in the images seem natural as well (not too slow and not too fast). While the final challenge was final harmony between those two speeds.

The project team decided to use the sound recording as the guideline for playback speed, since the ear is more sensible to variations in sound speed than the eye is to

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164 As explained by Read and Meyer: “Sound film was standardized at 24 frames per second. [...] Twenty-four frames (equivalent to 456 mm/second) was the minimum length necessary for reproducing an optical sound track capable of recording and reproducing frequencies up to 5000 cycles per second, which was considered necessary to obtain realistic sound reproduction quality.” Paul Read and Mark-Paul Meyer, *Restoration of Motion Picture Film*, 26.

variations in image speed. This decision is supported by this consideration of Read and Meyer:

The characteristics of sight mean that film images shown at an incorrect speed are still intelligible, and even film run backwards is still intelligible as time running backwards. Sound cannot be heard in the same way and changes in speed mean profound changes in frequency, or tone, and a lack of perceived reality. A change in tone and harmony resulting from a change of just three frames per second in the speed of projection is unacceptable to the human ear. If the film direction is reversed the sound becomes unintelligible.\textsuperscript{166}

An additional argument towards using sound speed as a starting point lies in the fact that the Tonbilder projection dispositif was based on the principle that the image speed followed that of the sound. This brief account of the process already shows the great degree of variability that could occur in the operational work of preservation: how can the naturalness of sound or image speed be determined if there are no other parameters? There is no objective or universal answer, but the solution to such problems often comes out of interaction between the film carriers and the human actors (the preservationists and technicians) as well as the technologies at their disposal.

The first step was to digitize sound and image in order to bring both of them into the digital domain where they could be reassembled. The digitization of the image was carried out through the use of an Arriscan, which scanned each frame and converted it to a DPX file\textsuperscript{167} in 2K resolution. The images were then corrected using film restoration software, such as Da Vinci Revival, Diamant and Shake; the main phases consisted of stabilization, deflicking, manual and automatic retouch, and grading.\textsuperscript{168}

Christian Zwarg, the private collector and owner of various Tonbilder discs who carried out a search for such materials in the collectors’ world, requested to personally perform the sound digitization of the discs with his own equipment.\textsuperscript{169} To play the

\textsuperscript{166} Paul Read and Mark-Paul Meyer, \textit{Restoration of Motion Picture Film}, 26.
\textsuperscript{167} Digital Picture Exchange (DPX) is an image file format used in the workflow of Digital Intermediate (DI), postproduction and visual effects.
\textsuperscript{168} For more information about the restoration and reconstruction of the images, see Dirk Förstner, “Rekonstruktion von Tonbildern in modernen Wiedergabesystemen,” 22.
\textsuperscript{169} Since Zwarg performed the sound digitization at his own studio, it was not possible to document this process through personal observation. The following information about the apparatuses and techniques used for the digitization of the Tonbilder sound thus derives from Dirk Fröstner’s interview with Zwarg, see Dirk Förstner, “Rekonstruktion von Tonbildern in modernen Wiedergabesystemen,” 57.
records, Zwarg used a modern variable speed turntable with a special needle produced by the London-based company *Expert Stylus*; he did not use an original gramophone steel stylus because its weight (100-200 grams) would have worn the grooves of the disc.

The most important parameter to determine in sound digitization is the rotational speed, since early gramophone discs did not have a standardized speed and there were no indications on the discs. According to Zwarg, *Tonbilder* records usually have a speed of 75 revolutions per minute. The digitization of the sound information is obtained by connecting the record player to a computer with an acquisition software; the sound files were delivered as AIFF\(^{170}\) with a bit rate of 16 Bit and a frequency of 44,1 kHz. The record was digitized in stereo format with a stereo pickup cartridge, even if the gramophone track should be played as mono: this trick provides two equal tracks, so that the better quality track can be used. Moreover, it is possible to take a sample from the other track in the event of any damage. The frequency response\(^{171}\) of recorded sound on shellac discs is approximately between 100 and 4000/5000 Hz, which is very limited if compared to the sensitivity of the human ear (approximately 20 to 20000 Hz): this is why the sound recorded on early shellac discs, which lacks low and high frequencies and has a lot of noise, result as strange to contemporary ears, used to the improved sound quality of current recordings.

Sound and image were first reunited in *Avid Digital Suite (Avid DS)*, a platform capable of ingesting DPX files in 2K resolution and processing them in real time. With *Avid DS*, it is possible to change the speed of the image files and sound files through the *Retiming* function. The retiming of sound and image presented two issues. The first concerned the acquisition of the image files: the software, which was developed for new productions, can work only with an image frequency of 24 fps or higher, in accordance with contemporary standards. In order to work with early films, which have a speed of between 14 and 22 fps, it is then necessary to simulate the speed of 24 fps: this can be achieved with a plug-in that uses an algorithm to automatically double each image.

The next problem related to the presence of splices in the scanned copies: in many cases, the presence of splices marked the fact that frames were missing, causing a break in the synchronization between sound and image. To facilitate the synchronization

\(^{170}\) Audio Interchange File Format (AIFF) is an audio file format for digital postproduction and storage.

\(^{171}\) The frequency response in sound acoustic represents the measure of frequency range that is covered by the device output, in comparison to the sound input.
process, it was decided to try to establish, at least approximately, the number of missing frames in the different splices. This operation could be attempted since the Tonbilder films do not have editing cuts: they were filmed as a sequence shot and not edited in postproduction so that the duration of the shot and of the recorded sound would remain the same, and therefore synchronization could be maintained in projection. In order to determine the number of frames missing, the project team made use of the Avid software’s function that places a virtual grid on top of the frames. The grid helps to determine how many frames are missing by considering the steps and jumps in the movement of actors or objects. This method is not entirely accurate, but allows for an estimation of the number of missing frames. If the number was very low (one or two frames), no changes were needed; but when the number was high and the jump was discernible and disruptive, it was decided that a number of black frames correspondent to the number of supposed missing frames would be inserted.

Once the image timeline was adjusted by inserting the black frames, it was put in relation to the sound timeline (fig. 18). From this comparison, it was decided which frame speed should be attributed to the image files: 15 fps for Schutzmannlied, 16 fps for Liebes Männchen folge mir, 18 fps for Militärische Disziplin, and 20 fps for Am Elterngrab. After having determined the image speed rate, the sound was compared to the image again: it was much more synchronized, but still a bit off. Therefore, the sound files were slightly accelerated (between 101% and 123%) in order to create a better sync with the image. The decision to accelerate the sound speed was made also due to the fact that some soundtracks, particularly the one of Am Elterngrab, sounded too slow with regard to both music and human voice.

The description of the synchronization process shows the challenges of detecting a balanced speed of image and sound. The ideal combination of image and sound speed was found when the movement in the image flowed, the sound seemed natural, and the sync was acceptable without any disruptions. No principle or rule was determined; instead, human perception was the final judge. The resulting synchronization is not perfectly simultaneous, meaning that lip movement does not fully coincide with the sound. The loss of sync was only corrected if it resulted as very disturbing to the ear; again, the judgment was based on human perception. The analysis of this process shows the importance of the human actor, the restorer or the operator, in the process of preservation: in many phases his or her judgment, based on perception as well as
expertise and historical knowledge, determines how a film’s form is changed in the process.

The synchronization process, as interpreted in the analytical frame that I propose, demonstrates the importance of understanding the original dispositif situation in which the film was shown. The loose synchronization in the restored films is justified by the fact that the films were never perfectly synchronized in the first place, since synchronization depended on the capacity of the projectionist as well as technical factors. This loose synchronization is a characteristic of the original films that is allowed to be maintained in the reconstruction; a perfect sync would in fact deprive the public of a trace of the original separation of the image and sound carriers and the live sync performed by the projectionist. The reconstruction of synchronization took into account the performance aspect of Tonbilder exhibitions: similar to the Tonbilder’s projectionist, the preservationists and restorers used the technological means at their disposal to find the best possible accordance between image and sound in an attempt to remain faithful to how the film was displayed. The performance dimension of the exhibition phase is safeguarded to a certain extent by the preservation work; this dimension is also displaced from the presentation to the preservation phase.

As previously noted, it is not possible to keep the original form in its integrity; in the process of reconstruction there are basic changes on the level of the image (doubling of image, setting of a frame rate) and of the sound (changing the speed). These changes are nevertheless necessary to achieve the aim of the project, that is, the presentation of Tonbilder films in cinema theatres and to the contemporary public.

After finding a suitable sound speed for synchronization with Avid DS, the sound files were imported into the ProTools HD7 sound suite, so that they could be processed in a sound studio with an appropriate calibration of the amplification. Digital audio software allows an extensive processing of sound information through the control of many parameters and the use of multiple tools.

In the Tonbilder project, there were two main actions undertaken in the digital processing of sound. The first process was the retiming of the sound, an operation for changing the speed and length of the track, which was obtained through the use of the Pitch’n Time Pro plug-in. The second process consisted of denoising, which is the action taken to reduce noise. The iZotope RX Denoise plug-in was used for this task. It is important to note that both plug-ins have an effect on the overall sound signal and can generate so-called audio artifacts, which are unwanted distortions caused by the
malfunction of sound hardware or software. Therefore, different attempts were carried out to decide the parameters of the plug-ins, and which plug-in should be used first.\footnote{See Dirk Förstner, “Rekonstruktion von Tonbildern in modernen Wiedergabesystemen,” 66.} Upon hearing the results, it was concluded that the use of denoise, along with the least invasive parameters, changed the tone of the voices and music, sometimes creating a “pump” effect,\footnote{“Pumping” is an effect caused by a particular use of audio compressors that changes the levels making the signal sound unnatural.} and thus the reduction of noise was damaging the signal with artifacts. Therefore, it was decided to only work on the retiming and not intervene in the noise.

The analysis of the Tonbilder case thus points to the treatment of noise, which I already individuated as a fundamental issue in sound preservation. As noted in chapter one, early sound recordings contain a lot of noise, especially for ears used to modern high fidelity: these noises can be inherent to the carriers or to the devices that play them, or can be caused by the aging action of time or other factors. In the Tonbilder case, a certain amount of noise is inherent to the shellac disc carriers as well as the gramophone recording and playback devices. Digital software can substantially reduce the noise, but extensive action would corrupt the original recording and result as unnatural. Moreover, it would affect the sound trace to be recorded and stored for future access, canceling the noises that people associate with early sound recordings.

The treatment of noise in restoration practices can be interpreted in the light of the social and cultural dimensions of the noise associated with recording media, as described in chapter one. Following the considerations made on this topic, a principle for carrying out noise treatment in sound restoration can be formulated in this way: the noise inherent to the material carrier and the noise inherent to record and playback devices can be maintained and preserved, since they were already present in the initial exhibitions of the film. The noise produced due to time and use of the carrier can be reduced as much as possible.\footnote{For a discussion on the ethics of sound restoration in musical documents, see Sergio Canazza and Mauro Casadei Turroni Monti, eds., Ri-mediazione dei documenti sonori (Udine: Forum, 2006), 44. See also Angelo Orcalli, “Orientamenti ai documenti sonori,” in Ri-mediazione dei documenti sonori, 4-60.} It is very difficult to distinguish between these two kinds of noise, and even more difficult to treat them separately, since the frequencies of noises and recorded sound are all mixed together in the sound signal. Determining the quantity and quality of noise to be reduced therefore cannot be settled by a general rule or a formula, but, as with other preservation practices, mainly must depend on the judgment of the restorer or the technical operator and the possibilities offered by the technological devices involved in the process. The exchange between human and
technological actors plays a decisive role in determining how the noise will be treated, and reveals once more to be a determining factor in the result of preservation work.

An experiment in synchronization was conducted on the film *Militärische Disziplin*. The disc track almost matched up to the film, but not perfectly: in fact, the disc was recorded by Messter in 1903 with the title *Lustiges auf dem Kasernenhof*, while the film was produced by *Deutsche Bioscop GmbH* in 1910. This circumstance is not surprising; the investigation of the history of production and exhibition of these films showed that it was common practice for competing *Tonbilder* companies to use very similar sketches and remake the most successful ones. Since most of the dialogue of the disc seemed to fit to the image, it was decided to make an experimental reconstruction: the part of the dialogue that corresponded to the mimic of the character was synchronized, while the rest was left silent. This operation is considered questionable from a preservation perspective, because it matches sound and images that most likely belonged to two different films. Thus it does not preserve the original film text, but creates a completely new text. This kind of experimental operation is allowed in preservation under the condition of publicly documenting, declaring, and justifying the changes to the original film. The main justification for this experiment was that it allowed contemporary audiences to get an idea of the sketch, which would be incomprehensible without the sound. In the framework of my analysis, it can be stated that this forced synchronization betrays the fidelity to the text in order to show the potentialities of the historical *dispositif*. This experiment can be considered unacceptable according to the principles of the philology of the text: here a new film text is created, a text that has never existed in this form before. Yet if the preservation practice is guided by other principles than the philology of the text, such as the recovery of the *dispositif*, this experiment can be justified.

**The presentation of *Tonbilder* films**

I conclude the analysis of the *Tonbilder* project with a description of the presentation of this project to the public. Even if film preservation can exist also without presentation, as exemplified by the preservation work carried out by private collectors like Christian Zwarg, I consider that preservation and presentation are two activities necessarily interconnected and complementary in the work of film heritage institutions. The
mission of a public film heritage institution includes in fact making preserved material accessible to the public. The moments of presentation and exhibition are important factors to take into consideration when analyzing a film preservation project, because they measure the exposure of the project and the response of present-day audiences.

There are mainly two kinds of presentation of preservation projects. The first is the theatrical presentation for a general public, which can be accompanied by digital access and distribution. The second is the presentation for a professional audience, as for instance during conferences, symposia, or festivals dedicated to film archiving. In these situations the people that work in the field of film preservation interact, share their knowledge and expertise, discuss their experiences and results, and define their position in the field. These occasions play an important role in shaping the practices of preservation and also help to legitimize preservation work. Theatrical presentations for the general public and presentations for the professional public can also happen in contiguous situations, as for instance in dedicated festivals or conferences.

Considering the presentation to the professional public, the Tonbilder project was first presented at the Music and the Moving Image Conference (New York University, June 2012), with a presentation titled Tonbilder: Sound-On-Disc, Song-On-Film. A more technical event titled “The Possibilities of Digital Intermediate Process in Film Restoration” was held at the Third Arri Workshop (June 2012) and at the AMIA conference (Seattle, November 2012) for the archive public. These moments offered an occasion to share the considerations and practical issues concerning the Tonbilder film restoration with other professionals of the field.

The theatrical presentation of the five Tonbilder films to the general public occurred at the Il Cinema Ritrovato film festival in Bologna on the June 25, 2012, in the section Un secolo di clip musicali (fig. 19). Before the screening, a page with the translated texts of the films was distributed to help audience members understand the lyrics, and a brief presentation described the historical context and the reconstruction of the films. The introduction provided the public with information regarding the original form of Tonbilder films and their original exhibition as well as explained how preservationists worked on them. Thus the introduction offered contextual information that served for a better understanding of the films. The films were then presented to the German public at the Arsenal Kino during the Word Day for Audiovisual Heritage (27

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175 See Dan Nissen et al., eds., Preserve Then Show.
October 2012) and then at the Toute la mémoire du monde festival in Paris (28 November 2012).

3.6 The Phono-Cinéma-Théâtre and the Chronophone Systems

The Toute la mémoire du monde festival, held at the Cinémathèque Française in November 2012, presented a program titled The beginnings of sound - “You ain’t heard nothing yet!” which showed different early sound systems. This program exhibited, besides the restored Tonbilder films, other early sound films, which were produced with the Phono-Cinéma-Théâtre, the Chronophone and the Vitaphone systems. What these preservation projects have in common is their work on early sound systems in which sound and images are separated onto two carriers. For the analytical purpose of describing film sound preservation practices, it is relevant to briefly describe these other projects, since they allow for comparisons to be made regarding solutions for similar preservation problems. Moreover, the realization of these projects in the last few years at different institutions seems to suggest a new interest in and attention to early sound film forms in the international archive field. As the title of the festival program - “You ain’t heard nothing yet!” - suggests, the presentation of these projects can be interpreted as indicative of a tendency to rethink the beginning of film sound, which film history generally placed in the late 1920s, in the light of the initial sound systems of early 1900s.

In this section I describe the project of the reconstruction of the Phono-Cinéma-Théâtre repertoire and some Chronophone films, curated by Gaumont Pathé Archives and the Cinémathèque française. Following the analytical method of the Tonbilder case, I first illustrate the dispositif, carrier, and text dimensions of the two systems, as well as their exhibition history. Then I give some insights into the restoration, reconstruction, and presentation of the films.

Conceived by Clément Maurice Gratioulet and Henri Lioret in the end of 1890s, the Phono-Cinéma-Théâtre system can be considered the first film sound system. The first presentation of the Phono-Cinéma-Théâtre, on 28 April at L’exposition universelle de 1900 in Paris, is regarded as the first public presentation of film with synchronized
sound. It was presented as a “talking picture” attraction in the pavilion organized by the engineer Paul Decauville and the actress Marguerite Vrignault. The auditorium was located on Rue de Paris near the Pont des Invalides and was designed by the architect Dulong, who used the 1751 “Fresh Pavillon” as his model. After the Exposition, the attraction traveled throughout Switzerland, Germany, Austria, Sweden, Spain, England, and Italy. The Phono-Cinéma-Théâtre company ended in November 1901.

The Phono-Cinéma-Théâtre system is characterized for having the sound recorded on phonographic cylinders. This is the main difference in relation to other systems, which used discs as recording media. As for the carriers, the images were stored on nitrate 35 mm film prints with central and two lateral perforations (fig. 20), and many of the frames were also hand colored. The sound was recorded on phonographic cylinders (fig. 21 and 22) that measured 13 cm in diameter and 22 cm height and had a running time of about four minutes. Similar to the Tonbilder, the short scenes of the Phono-Cinéma-Théâtre films consisted of excerpts from stage plays and comedies as well as songs and dances from operas and music halls. The Phono-Cinéma-Théâtre program presented in fact the most famous artists, actors, musicians, dancers, and comedians of the Parisian theatres, from the Comédie Française to the vaudeville and boulevard theatres (fig. 23).

The production of the films followed the “playback method”: first, the sound was recorded through an Idéal phonograph on cylinders and the scene was then captured with an Ambroise-François Parnaland 35 mm camera while the actors tried to mimic the dialogue or song, or perform a dance to the music. During exhibition, the projectionist achieved synchronicity by manually accelerating or slowing down the speed of the projector, trying to remain in sync with the phonograph. This practice recalls the exhibition of Tonbilder films, in which the performance of the projectionist was fundamental in guaranteeing the synchronization effect.

The preservation project provided for the reconstruction of 30 out of the 35 shorts of the first Phono-Cinéma-Théâtre program. Of these films, only one cylinder disc survived and could be synchronized with the images. The other films were presented with live music accompaniment. Two aspects are particularly noteworthy in the preservation and presentation of the Phono-Cinéma-Théâtre films.

First, as in the case of the *Tonbilder* project, the digitization of the sound recorded on the cylinder disc was carried out by a private collector, Henry Chamoux. In 1998 Chamoux invented the *Archéophone*, a device that can digitize the sound information of all formats of phonographic cylinders in wax or celluloid produced between 1888 and 1929.\(^{177}\) The phonographic cylinders are installed through holders of different dimensions attached to the device, and a pick up head reads the trace of the sound signal and digitize it. Since the phonographic cylinders have a variable rotation speed, the motor has a speed range from 44 to 238 rpm that can be adjusted in relation to the recording. The digitization of phonographic cylinders is very difficult because the carriers are very fragile and can break under the pressure of the stylus; it is therefore important in this process to choose the right stylus and accurately center the cylinder in the device in order to recover the sound information. As in the *Tonbilder* case, the preservation practice is determined by the interrelation of human and technological actors.

The second interesting aspect of this project is that the presentation of the *Phono-Cinéma-Théâtre* program, held at the Cinémathèque française on 30 November 2012, aimed to simulate or evoke the experience of the first exhibition. In particular, a small orchestra composed of a piano (John Sweeney), an accordion (Romano Tedesco), and percussion (Frank Bockius), performed live music to accompany the majority of the films whose cylinders were not recovered. For the reconstruction of the music, the original scores of the musical pieces used in the cylinder recordings were sought after: in cases where the original scores were not found, the musicians tried to reconstruct a score as suitable as possible, especially for the dance numbers. Sometimes the percussionist provided a few sound effects for the action in the scene. Furthermore, the orchestra also played the music together with the sounds recorded on cylinder disc, creating an evocative mix of early sounds recorded on phonograph and live music. This happened in some shorts where the actor in the scene sang a popular song, and the singing voice was recorded on the cylinder without music. It is believed that the live orchestra accompanied the singers’ voice recordings also during the first exhibitions of the *Phono-Cinéma-Théâtre* in 1900; this element of film exhibition’s history contributes to defining presentation practices. The presentation of the *Phono-Cinéma-Théâtre* program illustrates not only the material and technological dimensions of film sound but

its performance dimension as well. The combination of the cylinder disc’s sound with the live performance during presentation can be interpreted as an attempt to reconstruct not only the soundtrack but also the original soundscape of exhibition.

The second part of this preservation project involved the Chronophone films, which Gaumont Pathé Archives aims to preserve in their entirety in the following years in collaboration with the Conservatoire des techniques of the Cinémathèque française, the Archives françaises du film, and the Fondation Jérôme Seydoux-Pathé. By November 2012, they had already digitized four hundred titles out of eight hundred, of which forty have been previously synchronized.

The Chronophone was the main competitor of Messter’s Biophon: they were the two main systems for exhibiting sound-on-disc films in Europe in the first decade of nineteenth century. Léon Gaumont was interested in pairing sound and image very early on, as demonstrated by this note made by him in 1881 and referenced by Laurent Mannoni: “If it were possible to photograph a play with an entire army of shots, for every second, it would be possible to have an entire series of the performers’ movements, which one could see at home while the phonograph or the telephone plays back the voice.”

The Chronophone device was composed of a cinematograph combined with a gramophone (fig. 24). The motors of the cinematograph and gramophone were linked electrically, with the motor of the phonograph driving the speed. The image carrier was 35 mm film with lateral perforations, while sound was recorded on gramophone discs (fig. 25). Gaumont patented the Chronophone in 1902, but it was publicly presented and commercialized only years later, in 1906. The main problem that Gaumont aimed to resolve before public screenings was amplification, since it was difficult for the public to hear the sound when far from the horn. Therefore, Gaumont perfected the system in 1905 and released the Chronomégaphone, which was an amplified phonograph that strengthened the sound volume in the theatre with the help of compressed air. The main exhibition space was Gaumont-Palace in Paris, where Gaumont was able to have control of the exhibition performance. The necessity to control the space and the performance recalls Messter’s decision to build his own theatre in Berlin.

178 My translation from the original: “Si l’on pouvait photographier avec tout un bataillon de clichés une pièce de théâtre, dans chaque seconde, on arriverait à avoir toute une série des mouvements des acteurs, que l’on pourrait voir chez soi même temps que le phonographe ou le téléphone qui en reproduirait la voix.” Maurice Gianati and Laurent Mannoni, eds., *Alice Guy, Léon Gaumont et les débuts du film sonore* (New Barnet: John Libbey Publishing, 2012), 53.
The *Chronophone* films are divided in two categories, interestingly enough, according to the use of the *dispositif* during production: the *phonoscènes*, where the artists performed the number in playback in front of the camera and tried to follow the pre-recorded disc, and the *filmparlant*, where sound and images were recorded synchronously using a microphone connected to the phonograph (fig. 26 and 27). The two forms were only different at the production level, since both could be screened with the same *Chronophone* equipment.

During the first period of the *phonoscènes*, Gaumont did not possess the technology and techniques to record sound with sufficient quality, so he used previously-recorded discs or discs that had been commercially released by music labels. Around 1907, when his troupe succeeded in recording sound together with the image, Gaumont began producing the *filmparlant*. As with the *Tonbilder* case, the relation between the technological devices and their human operators was fundamental in the development of the film form.

In the preservation of *Chronophone* films, it is interesting to note that a different transfer strategy was pursued, compared to the one chosen for the *Tonbilder* films. In the *Tonbilder* case the images were duplicated in order to be screened together with the sound using modern devices. In the *Chronophone* case, the films were scanned, and then the DCP digital copy was produced without duplicating or inserting images. The DCP file was then projected through a 3D digital projector, using “double or triple flashing:” the projector shows 24 frames per second, but each frame is flashed two or three times. This procedure, invented for showing 3D digital films, has been adapted for screening digitized versions of early films, which have a film speed slower than 24 fps; this is because present-day digital projectors cannot show films at rate slower than 24 fps. The trick consists of showing the DCP of a film recorded, for example, at 18 fps with a double or triple flashing, obtaining a final speed of 16 or 20 fps. The simulation of the original form of sound-on-disc films is obtained in the *Chronophone* case by working on the level of the device (the projector) and the *dispositif* (the way it is operated, and, in particular here, the use of a tool for a purpose different from its original function).

The *Tonbilder* and the *Chronophone* cases presented two different strategies for adapting the original form of early sound films to contemporary playback devices. The difference between these two procedures can be interpreted as follows, using the analytical concepts proposed. In the *Tonbilder* project, the duplication of images in the
recording phase affected the level of the carrier: the images were in fact recorded twice in the physical copy. In the *Chronophone* case, the speed of the images was changed using a projection technique, by intervening at the level of the device and *dispositif*. These two different procedures changed the original form of the film, to some extent, and how these films will be preserved and presented in the future. In the *Tonbilder* example, the fact that some images were duplicated on the carrier should be documented, so that if in the future a successive preservation is made, this element can be taken into account when choosing the copy to work on. In the *Chronophone* case, the way in which the restored films are to be projected is important in case of future exhibition. If the projection devices will be different from the ones used now, another projection strategy must be found in order to present the film at the right speed. These examples show once again that a record of the procedures and techniques adopted in preservation and presentation is important to document which aspects of the film form are changed in the process, and how the film trace survives for future access.

### 3.7 The Vitaphone System

To conclude this overview of sound-on-disc preservation projects, I will look at the preservation of *Vitaphone* films. The first reason for the analysis of this case is a temporal one: the project is older than the other two, beginning in the late 1980s. The analysis of the *Vitaphone* preservation project shows how the problems concerning sound and its synchronization in early films were solved twenty years before the *Tonbilder* and the *Chronophone* cases. I will highlight similarities and differences in preservation practices that treat similar materials but with different technologies and techniques. The second reason why it is interesting to include this case in the analysis lies in the development of the project: it started within an institutional framework that involved the UCLA Film Archive, the George Eastman House, the Library of Congress and the Museum of Modern Art Film Archive. However, it later developed outside the institution over the course of many years and was revitalized by the work of collectors, film experts, and film enthusiasts. This circumstance emphasizes the possible forms of participation of the public and the users in the cultural process of the preservation of
film heritage, and thus demonstrates to what extent the social and cultural context influences choices in film sound preservation.

The Vitaphone is a sound-on-disc system: the image is stored in 35 mm film, the sound in sixteen-inch electrical disc (fig. 28, 29 and 30). The Vitaphone projection system incorporates the film reproduction unit and the gramophone unit into a single device (fig. 31 and 32). The playback system is composed of a projector and a sound amplifier placed in the projection booth, horns situated behind the screen, and wires connecting the horns and the amplifier (fig. 33). The main difference with regards to the other two early sound systems concerns the carrier: in this case the sound is recorded on electrical disc, which means that the rotation speed is defined, while in the systems discussed above it was variable. Another difference is found in the playback device: instead of having two different devices linked together, in this case the playback of image and sound are integrated in a single device.

The Vitaphone system was developed by the Vitaphone Corporation, which was a subsidiary corporation of Warner Bros Picture Inc. and Western Electric, created on May 27th 1925 to produce and experiment with sound-on-disc films. Although the Vitaphone was conceived more than twenty years after the first film sound experiments, it is generally recognized in film histories as the first system that produced sound films. This assumption is inaccurate, considering the earlier commercialization of sound-on-disc systems such as the Biophon and Chronophone in Europe twenty years before.

It is, however, true that the Vitaphone brought sound to Hollywood productions by proving to be commercially exploitable in the US market, unlike previous systems. One reason for this success was that this system was conceived and launched by a studio and not by a private inventor or a commercial laboratory: Warner Bros. foresaw the possibility to emerge, expand, and enter the world of Hollywood majors through the production and distribution of sound films. Moreover, the choice of sound as a way to establish themselves within Hollywood was both aesthetically and economically motivated: the Warner brothers were planning to buy theatres for distributing their productions, and sound-on-disc was perceived as a solution to save on exhibition expenses for live music and orchestras. Additional economic conditions caused other Hollywood studios to convert to sound; among these, the most important was the

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involvement of the American Telephone and Telegraph Company and its two units, Western Electric Company and the Bell Telephone Laboratories.\textsuperscript{180}

Warner Bros. as well as Metro Goldwin Mayer and First National produced many \textit{Vitaphone} films between 1926 and 1939. Similar to the \textit{Chronophone} and \textit{Tonbilder} films, the \textit{Vitaphone} film narratives consisted of scenes from musical theatre, opera, and Broadway, as well as from comedy and vaudeville shows. These movies were a great success until the beginning of the 1930s when the definitive adoption of sound-on-film for production and distribution by the major studios resulted in the slow disappearance of the equipment for \textit{Vitaphone} projection from theatres.\textsuperscript{181} No longer commercially exploitable, the films and discs were stored in different places and forgotten, mirroring what transpired with the \textit{Biophon} and the \textit{Chronophone} systems.

The discovery of the discs in the Warner Bros. Archive and their subsequent donation to the UCLA Film and Television Archive led to the beginning of the \textit{Dawn of Sound} restoration project in 1987. Robert Gitt, the Preservation Officer of the UCLA archive at the time, provided a public description of the restoration,\textsuperscript{182} making it possible to learn about the practices they used even today.

According to Gitt’s report, synchronization was relatively unproblematic. This depended mainly on the fact that the speed parameters of image and sound playback were defined in this system: the 35 mm film was projected at 24 fps, while the sixteen inch records were played at 33 1/3 rpm. For synchronization, the sound of the disc was recorded on magnetic-striped 35 mm film. This intermediate soundtrack was lined up with a workprint copy of the picture on a Steenbeck flatbed. Discrepancies due to loss of frame were adjusted here, and disturbing clicks and pops were eliminated manually by scraping off portions of the magnetic oxide. The magnetic track was then recorded as optical soundtrack and printed together with the image in a combined print. In order to keep the original “full frame” and make space for the optical soundtrack, the frame was printed in a smaller format through the use of optical-reduction printing. Following this process, the images and sounds of the \textit{Vitaphone} films were reassembled in the analogue domain.


\textsuperscript{181} See Jean-Pierre Verscheure, “Les premiers systèmes Vitaphone, Movietone et Photophone,” in Alice Guy, Léon Gaumont et les débuts du film sonore-

This process can be described within the analytical framework described above, as I previously did for the *Chronophone* and *Tonbilder* projects. In this case synchronization is obtained operating on the level of the carrier: images and sounds are in fact physically worked on the analogue copy in order to obtain the synchronization. In contrast to the other cases, however, here there was no important intervention in the speed of images or sounds.

The records made by Gitt can be read in light of the influence of changing technologies on preservation work. The *Vitaphone* project was conducted in analogue workflow, which has limited possibilities to manipulate the audiovisual information in comparison to the possibilities of the digital workflow used in the *Tonbilder* and *Chronophone* projects. The different technological devices and techniques at the disposal of the preservationist necessarily influence the preservation practices. In general terms, it can be stated that in the analogue domain preservation practices regarded mainly the work on the material carrier, on the physical copy: the copy was physically cleaned and copied, and the intervention were made on the carrier. In the digital domain, preservation work concerns primarily the technological device and the *dispositif*: once the film images and sounds have been digitized, they can be worked on and manipulated using digital software, before eventually recording them back onto film or onto a digital carrier.

Gitt’s documentation can be used not only to highlight the differences in the use of technologies, but also to individuate the similarities. This report can in fact be read as supporting the idea that the guiding principle of preservation can remain the same, regardless of technological development. Considering the treatment of noise for instance, Gitt explains:

> We agreed with Richard [Dayton, working at YCM Laboratories] that it would be best to reproduce the sound in a simple, straightforward manner, without excessive filtering or extensive electronic processing. Unless used with restraint, modern noise-reduction techniques can drain the life of early recordings, and we wanted as much as possible to maintain the natural sound quality as recorded originally by the Vitaphone process.¹⁸³

This principle is also demonstrated by the *Tonbilder* and *Chronophone* projects, where the noise of the original recordings was preserved as well.

¹⁸³ Ibid., 12.
The relevance of Gitt’s documentation highlights once again the importance of documenting and publishing material on preservation practices. It is important to record descriptions of the preservation practices used to demonstrate the changes and modifications on the level of the text so that the restoration can be reversible in the future. Additionally, descriptions are necessary for documenting which devices were used and in which way, since operational techniques can disappear as fast as the technologies. Moreover, a description of preservation practices also provides insight into which agencies and social actors influenced the process.

The *Vitaphone* project concluded with the restoration of the most famous or important *Vitaphone* features, some shorts, and the first *Vitaphone* program presented at the Warner Theatre in New York on 6 August 1926, moreover believed to be the first synchronized sound film public screening in the United States.184 These films were presented together with an exhibit that opened at the Museum of Modern Art in New York in October 1989,185 which was produced by the MoMA and the AT&T Archives. The small exhibition, including screenings of the restored films, was constructed to travel and be installed in theatres or auditorium lobbies around the country.

Once the archival project came to an end, a public interest in *Vitaphone* films emerged, which was probably prompted by the traveling exhibition. A group of five private disc collectors (David Goldenberg, John Newton, Sherwin Dunner, Ron Hutchinson, and Vince Giordano) started the *Vitaphone Project* in 1991.186 The *Vitaphone Project* is an informal organization with the goal to set up a collective catalogue of their resources, 16-inch soundtrack recordings for *Vitaphone* movies, and find archives that hold the corresponding 35mm negatives. The major US film archives became interested and involved in the project, which led to collaboration between collectors and archives, including the UCLA Film Archive, the Library of Congress film archive, the George Eastman House, and the Warner Bros. Archive. The project’s website also became a networking opportunity for archive, museum, and studio professionals as well as collectors. The connections formed led to the development of joint restoration projects.

The archives decided to restore some of the films year by year with the sound provided by the collectors, produce theatrical copies, and release them in DVD. In more than twenty years of activity of the *Vitaphone Project*, 3,500 discs have been found, nearly 150 *Vitaphone* shorts have been restored, over 200 shorts were released on DVD, and nearly half a million dollars in funding was raised. The Warner Bros. Archive, which is the major rights owner of *Vitaphone* films, undertook fifty-three restorations between 2009 and 2010, releasing four DVDs afterwards. The restored *Vitaphone* films were presented in theatres at various film festivals (Capitolfest in Rome NY, Film Forum in New York, Cinefest in Syracuse NY, UCLA Festival of Preservation in Los Angeles), as well as in theatres across the USA. The *Vitaphone Project* also provided a number of items for the 2006 exhibition “From Horns To Hard Drives: The History of Sound Technology,” including discs, programs, stills, needles, a record duster, posters, lobby cards, and even an original 1928 Western Electric Projectionist’s manual.

The fact that the *Vitaphone* preservation project was animated not only by film heritage institutions but also by collectors, film experts, and film enthusiasts is particularly relevant: film preservation can in fact become an activity that involves more and more individual and social actors not necessarily belonging to the institutional field.

As a final example of the contribution of collectors to film preservation, I would like to mention the case of Jean-Pierre Verscheure since it is particularly relevant with regard to sound. Professor at the *Institut National Supérieur des Arts du Spectacle* in Brussels, Verscheure collected film sound devices, moved by the conviction that each film should be seen and heard in the *dispositif* for which it was intended. He started to collect equipment and devices in order to demonstrate the changes in the cinema spectacle, and in twenty years of research, he collected 750 devices and 700,000 pages of documentation, containing information about the techniques for using the devices. He also put the devices back into use whenever possible. Interestingly, Verscheure is a film collector who is not only interested in collecting film objects, but also engaged in rescuing the *dispositifs* and documenting how to operate the *dispositifs* in order to reproduce an original cinematic experience.

187 The exhibition opened in early September 2006 in the United Gallery F-2 North Connector in the San Francisco International Airport, and was organized by *The San Francisco Airport Museum* in conjunction with Dolby Laboratories.
Verscheure’s collection gained public acknowledgment: some devices were on public displayed in the *Des frères Lumière aux frères Dardenne* exhibition at the Mundaneum Museum in Mons, Belgium, in 2009. The collection was recently donated to the Cinémathèque française and an exhibition is planned for 2015. This last example reveals once again, as already noted in the previous cases, the great value of collaborations between institutional social actors, the public and private film archives or laboratories, and social actors external to institutions, such as private collectors and film experts, in the process of preserving audiovisual heritage.

### 3.8 Conclusion: Preserving Film Sound Traces

Until recent years, early sound systems have been neglected or underrepresented, both in film historiography and in film preservation. The recent preservation and presentation of early sound systems discussed in this chapter – the *Chronophone*, *Phono-Cinéma-Théâtre*, and *Vitaphone* – offer a chance to show early sound films to the general public, and also to rethink the historiography and categories of early cinema.

The rediscovery of early sound systems, some of which have been described in this chapter, can contribute to the process of rethinking and redefining the assumptions made about the historiography of early cinema. The fact that many pioneers, such as Edison, Gaumont, and Messter, tried to find solutions to synchronizing sound and images contradicts the assumption that cinema is a purely visual medium. Moreover, public appreciation of early sound films in contemporary presentations demonstrates the accomplishment of the combination of sound and images on a textual level. The achievement of synchronization already in the 1900s supports the idea that the introduction of synchronous sound in film exhibition only in the late 1920s was determined more by economic reasons than by technical constraints.\(^{188}\) The evolution of film technology is not just scientific, but also social and cultural: it depends on the economic and industrial conditions of production, distribution and exhibition, and on

\(^{188}\) For example, Jean-Pierre Verscheure interestingly traces the role of banks and telephone companies in the establishment of a standardized sound system in the United States of America. See Jean-Pierre Verscheure, “Les premiers systèmes Vitaphone, Movietone et Photophone.”
the expectations of the public, much more than on patents and the invention of devices.\textsuperscript{189}

The dating of the arrival of sound in film in the late 1920s, as well as the consideration of the previous period as characterized by silent cinema, is therefore questionable. In recent years film heritage institutions and scholars have made efforts to rediscover the sounds of early cinema in providing original music scores for live orchestras as well as reviving the function of the narrator and the stage rumorist. Starting from the assertion that cinema has never been silent, the category of “silent” cinema is slowly replaced by “early” cinema.

Considering the possible impact on the reconsideration of film historiography, early sound systems are indeed a relevant example of film sound traces. Nevertheless, forms of film sound have been varied throughout the history of cinema. Most have been underestimated and not taken much into account in the work of preservation. Also, in presentation, the sound of old films is often incorrectly played back in theatres; for example, playing a mono track as stereo or not applying the Academy filter to an Academy soundtrack.

The analysis of preservation practices in fact highlighted some crucial dimensions of film sound: the material carriers, the technological devices and human actors, the dispositif situation, the film text, the screening performance, and the history of exhibition. The consideration of these elements in early sound systems is beneficial to understanding how sound became a fundamental part of the cinematic experience through its synchronization with the film image. Moreover, the preservation practices applied to early sound systems can provide useful considerations for interpreting and preserving other types of film sound. These highlighted dimensions can in fact serve for describing film sound in general, as it will be further investigated in the following chapters.

\textsuperscript{189} See John Belton, “Technology and aesthetics of Film Sound,” in \textit{Film sound theory and practice}, 63.