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**Silent cinema as a technological system: Infrastructure, innovation, and
institutialization (1890–1930)**

***Abstract.** This article examines the period from the 1890s to the late 1920s as the stage in which cinema became a stable technological and social institution through the interaction of five key developments: the system introduced by the Lumière brothers, the emergence of permanent movie theaters, the formation of the first film studios, the*



introduction of early special effects, and the appearance of recognizable film genres. The study applies a historical-technological approach combining the analysis of primary technical documentation, architectural evidence, studio infrastructure records and recent international scholarship to identify how concrete innovations in mechanics, optics, illumination, chemical processing and exhibition design reshaped moving-image production and spectatorship. The results show that the Lumière system established reproducible projection standards and enabled the international circulation of moving images; that permanent movie theaters created controlled visual environments, standardized viewing schedules and supported longer narrative formats; and that early studios introduced regulated lighting, set construction and division of labor, transforming filmmaking into an industrial process. The analysis also demonstrates that special effects expanded representational capacity through multi-exposure, miniature models, masking techniques and color processes, and that genres emerged in relation to technological conditions, with comedy tied to variable cranking, melodrama to controlled lighting, epic and adventure films to large-scale staging and horror to manipulated architectural space and shadow. These developments collectively contributed to the global diffusion of cinema, the formation of shared cultural reference systems and new modes of social interaction grounded in collective spectatorship. The conclusion suggests that further research should investigate how these foundations supported the later adoption of synchronized sound and influenced the long-term evolution of audiovisual media.

Keywords: *visual arts; cinematography; history of cinema; technological modernization; visual effects*

Introduction.

The period from the 1890s to the late 1920s marks the stage in which cinema moved from a short-lived novelty to a stabilized technological and social institution. This transformation was driven by a set of developments that occurred in sequence yet interacted with one another: the work of the Lumière brothers as the first large-scale system for producing and exhibiting moving images; the emergence of permanent movie theaters that standardized projection conditions and spectatorship; the formation of the first film studios, which organized production through controlled lighting, architectural design and division of labor; the introduction of the first special effects, which expanded what could be represented on screen; and the appearance of recognizable film genres, which structured production methods, distribution strategies and audience expectations. Recent research shows that these developments were closely linked to advances in mechanics, optics, electrical illumination, chemical processes, architectural planning and equipment standardization (Beugnet, 2022; Strickland, 2024; Toporivska, Dyadyukh-Bogatko, Belinska, Balan, & Patsaliuk, 2025).

The technological contributions of the Lumière brothers established cinema as a reproducible system rather than a demonstration device, enabling films to circulate internationally. The spread of permanent theaters in cities such as Paris (1895), Berlin (1895), London (1896), and later New York, Chicago and Tokyo created new public environments in which moving images were presented under controlled visual conditions. The establishment of studios in Paris (Pathé, Gaumont), New York and later Los Angeles (Biograph, early Hollywood facilities), Berlin (UFA complexes), Moscow and St. Petersburg, and Tokyo (Nikkatsu) introduced continuous production workflows supported by lighting systems, mechanical staging and laboratory processing. Early special effects in France, Britain, the United States and Germany demonstrated that cinema could depict transformation, space, scale and motion beyond direct photography (Abel, 1996; Brownlow, 1984; Kobel, 2007). Genre differentiation emerged when these technical capacities aligned with production specialization and audience familiarity, resulting in identifiable forms such as slapstick comedy, melodrama, adventure epics, horror and early science fiction (Schuchman, 2004; Withall, 2014; Frymus, 2023).

These developments did not merely shape film style – they altered patterns of spectatorship, labor organization, cultural circulation and public space (Zhu, 2021; Lewis, 2024; Peng, 2024). Cinemas contributed to new habits of collective viewing, evening leisure and urban social mixing. Studios created new professions linked to modern technical work. Special effects supported changing perceptions of science, technology and imagination. Genres standardized viewing expectations across different regions and markets. By the end of the silent era, cinema had become the first globally circulating medium supported by shared technological specifications and synchronized audience practices, laying the groundwork for the later introduction of synchronized sound.

This article analyzes these developments through a technological and social lens, drawing on research that reassesses early cinema not only as an artistic formation but as a system shaped by material innovation, industrial organization and societal transformation. The aim is to clarify how the key milestones, – the Lumière system, the first movie theaters, the first film studios, the first special effects, and the emergence of genre cinema, – collectively reshaped the medium and contributed to wider changes in modern societies during the late nineteenth and early twentieth centuries.

Methodology.

This study approaches the development of cinema from the 1890s to the late 1920s by examining how concrete technological changes shaped the ways films were produced, distributed and viewed. The research is based on the principle that cameras, projectors, lighting systems, film stock, studio design and exhibition environments were not secondary to film history but were central factors influencing the evolution of the medium. The methodology therefore focuses on material evidence, technical

documentation and historical analyses that describe how equipment functioned, how production practices were organized and how viewing conditions were constructed during the silent era.

The source base consists of recent academic publications that analyze early cinema through technological, industrial and societal perspectives. These studies provide information about the development of projection mechanisms, the formation of permanent movie theaters, the establishment of studio infrastructure, the refinement of special effects techniques and the emergence of film genres linked to equipment capabilities and production workflows.

Comparative analysis plays an important role in the methodology. The study examines how cinema developed in different regions, including Western Europe, the United States, the Russian Empire and Soviet Union, Japan, India, Australia and parts of South America and North Africa, and considers how variations in electrification, industrial manufacturing, urbanization and access to imported technology resulted in distinct trajectories. This comparative approach makes it possible to distinguish between developments driven by global technological standardization and those arising from local social, economic or infrastructural conditions.

The methodology also investigates how cinema intersected with broader societal transformations, such as changes in labor organization, urban leisure patterns, public gathering practices and new modes of visual perception. By analyzing the Lumière system, permanent theaters, early studios, special effects and genre formation as interconnected developments, the study treats the silent era as a technologically consolidated phase rather than a preliminary stage overshadowed by the later introduction of synchronized sound.

Overall, this methodological framework enables the article to interpret early cinema as a technological system embedded in the modernization processes of the early twentieth century. It supports an understanding of cinema as both a technical and social institution whose influence extended beyond entertainment into communication, cultural circulation and everyday life.

Results and Discussion.

The Lumière Brothers as a Technological Starting.

The Lumière brothers occupy a central position in the early development of cinema because they introduced not only a recording device but a complete, technically unified system for producing, duplicating and projecting moving images. Recent research (Lipton, 2021a; Vaniuha, Kyreia, Lemishka, Spolska, & Patron, 2024; Toporivska, Dyadyukh-Bogatko, Belinska, Balan, & Patsaliuk, 2025) emphasizes that the cinematograph represented a significant technological integration: it combined camera, printer and projector into a single mechanism that used perforated 35 mm film stock and an intermittent movement system that ensured stable image registration. This configuration allowed films to be manufactured in multiple copies, transported across

long distances and projected repeatedly without recalibration. The Lumière company's existing industrial infrastructure for photographic materials enabled large-scale production of both equipment and film stock, which facilitated the rapid spread of screenings beyond France.

The first public screenings in Paris in December 1895 were followed within months by presentations in London, Brussels, Vienna, Madrid, St. Petersburg and New York. Studies (Lipton, 2021a; Gibson, 2022; Strickland, 2024) show that Lumière operators traveled with standardized projection units, screens and printed programs, creating consistent viewing conditions in cafés, theaters, exhibition halls and other enclosed environments. These screenings introduced a new form of collective spectatorship structured around fixed seating, controlled illumination and synchronized attention. Strickland (2024) links this mode of presentation to broader changes in urban social life, including emerging leisure patterns, regulated public time and new forms of visual concentration associated with industrial modernity. The subjects of Lumière films (factory workers, city streets, transportation systems, domestic routines) reflected contemporary technological transformation and framed cinema as a medium that documented everyday life shaped by mechanization. The appeal of these films lay in their ability to visualize processes that audiences recognized from their own surroundings, reinforcing cinema's association with modern labor, mobility and urban scale. At the same time, the limitations of the cinematograph (short reel length, absence of synchronized sound and reliance on hand-cranked motion) stimulated subsequent innovation, encouraging filmmakers to develop editing practices, longer narrative formats and improved projection systems.

The international circulation of Lumière equipment also influenced the emergence of local film cultures (Şerban, 2016; Gibson, 2022; Toporivska, Dyadyukh-Bogatko, Belinska, Balan, & Patsaliuk, 2025). Screenings in Asia, North Africa and Latin America between 1896 and 1900 introduced moving images in regions where electrification, urban architecture and entertainment infrastructure were unevenly developed. In several cities, Lumière screenings preceded the installation of permanent theaters and contributed to public interest in modern technologies more broadly. In some areas, these screenings intersected with existing performance traditions, shaping distinct paths of cinematic adoption.

The significance of the Lumière brothers therefore lies not only in their chronological priority but in their role in establishing cinema as a reproducible and distributable technological system. Their work created expectations regarding image stability, projection conditions, audience arrangement and commercial circulation. It also linked cinema to the broader technological and social transformations of the late nineteenth century, positioning moving images within the dynamics of industrial production, urbanization and global communication. As later developments (permanent movie theaters, studio production, special effects and genre formation)

took shape, they did so within a framework first defined by the Lumière system and its rapid international diffusion.

The First Movie Theaters and the Technological Stabilization of Exhibition.

The transition from temporary screening spaces to permanent movie theaters began within a few years of the Lumière screenings and played a central role in transforming cinema into a regular and technically standardized form of public entertainment. The first permanent cinema generally identified in Europe, the “Salon Indien” at the Grand Café in Paris, began operating regular paid screenings in late 1895, but it was soon followed by dedicated venues adapted specifically for projected moving images. In 1896, the Alhambra and the Empire Theatres (Figure 1) in London incorporated fixed projection equipment (Hirsch & O'Rourke, 2017; Raisbeck, 2018), and by 1901 the Warwick Bioscope Theatre in London was operating as a year-round cinema. In Germany, the first purpose-built venue, the Wintergarten in Berlin, adapted its stage for ongoing projection in 1896 (Narath & Guttman, 1966), while fixed cinemas began to proliferate after 1905, particularly in industrial cities such as Hamburg and Munich (Bergfelder, Carter, Göktürk, & Sandberg, 2020). Research Brockmann (2010) show that by 1910 Germany had more than 1,000 registered cinemas, many operating with standardized projection booths and regulated seating environments.



Figure 1. The grand and sumptuous Empire Leicester Square (Raisbeck, 2018).

In the United States, permanent movie theaters emerged slightly later but expanded more rapidly. The Vitascope Hall in New Orleans (1896) and the Nickelodeon in Pittsburgh (1905) are frequently cited as early examples (Labosier, 2004), but that nickelodeons operating between 1905 and 1907 created the first nationwide exhibition system. By 1910, more than 10,000 nickelodeons were operating across the country, supported by improved carbon-arc illumination, enclosed projection booths and standardized rental distribution (Allen, 1979). The introduction of electrically driven projectors allowed larger auditorium sizes, and by the 1910s urban centers such as New York, Chicago and San Francisco saw the rise of “movie palaces,” whose architectural scale reflected cinema’s integration into commercial entertainment infrastructure.

Outside Europe and North America, the development of permanent cinemas followed different timelines shaped by colonial, economic and technological conditions. In Japan, fixed cinemas appeared in Tokyo and Osaka by 1903, initially combining projected images with live benshi narration, reflecting the coexistence of imported technology and established theatrical culture (Standish, 2006; Bernardi & Ogawa, 2021). The Japanese cinemas adopted standardized projection speeds later than Western venues because of the persistence of manual cranking techniques. In the Russian Empire, permanent cinemas emerged in major cities such as St. Petersburg and Moscow around 1907, spreading more slowly into provincial regions due to limited electrification (Stites, 1992; Pryt, 2022). After 1917, state priorities influenced cinema distribution, and by the early 1920s urban centers operated fixed projection facilities while rural exhibition relied on portable setups.

On other continents, cinema infrastructure developed unevenly. In Australia, permanent cinemas appeared in Sydney and Melbourne by 1906 (Allen, 2025), and by 1911 the continent had a circuit-based exhibition system supported by imported projectors and film stock. In Mexico, Buenos Aires and Rio de Janeiro saw permanent cinemas by 1907–1908, reflecting strong urban commercial sectors (Burns, 2013; Navitski, 2013). In Africa, fixed cinemas emerged first in colonial port cities such as Cairo, Alexandria and Algiers, mainly between 1906 and 1912, while in sub-Saharan regions cinema often remained itinerant until the 1920s. In India, Calcutta and Bombay hosted permanent cinemas by 1907, with Burns (2013) linking their growth to electrified commercial districts and railway connectivity.

The spread of permanent theaters had several technological consequences. Standardized projection booths reduced fire risk associated with nitrate stock; regulated illumination allowed films to be shown consistently regardless of time of day; and fixed seating and sightline arrangements encouraged longer films and more complex narratives. Cinemas also facilitated the adoption of consistent frame rates, reducing flicker and stabilizing image rhythm. These developments contributed directly to changes in production: studios began making films of predictable length because

theaters required regular programming. Distribution practices also evolved, since permanent cinemas demanded continuous supply rather than occasional novelty.

The societal impact of these venues was equally significant. Cinemas became central urban meeting places, offering inexpensive leisure accessible to women, workers and young people. The theaters contributed to new public behaviors, including evening socializing, mixed-class gathering and collective spectatorship (Burns, 2013; Hirsch & O'Rourke, 2017; Peng, 2024). The darkened auditorium and synchronized viewing experience shaped patterns of attention associated with modernity and mechanized time. As cinemas spread geographically, they linked diverse populations through shared visual content, contributing to the early globalization of cultural experience.

By establishing stable exhibition conditions, permanent movie theaters transformed cinema into a predictable and repeatable social practice. They provided the infrastructure needed for longer films, narrative coherence and industrial expansion. This stabilization shifted the center of innovation toward production, where the emergence of the first film studios introduced systematic methods of creating moving images and further consolidated cinema as a technological and cultural system.

The First Film Studios and the Industrialization of Production.

The emergence of the first film studios between the early 1900s and the early 1920s marked a decisive transformation in how moving images were created. While early films were shot outdoors using available light, the establishment of dedicated studio spaces made it possible to regulate illumination, control exposure and organize production as a continuous, predictable process. The first glass-enclosed studios appeared in France around 1902–1903, with the Pathé and Gaumont facilities in Paris often cited as early examples (Ghertman & Hadida, 2005; Jacobson, 2015). These studios used large glass roofs and adjustable shutters to diffuse natural light and reduce harsh contrast, and that this architectural innovation enabled longer shooting days and improved image consistency. By 1907, Pathé operated what historians consider the first vertically integrated studio system, complete with its own film laboratories, set construction workshops, and distribution arm, allowing the company to produce hundreds of films annually for international markets.

In the United States, the Biograph studio in New York constructed a rooftop glasshouse stage in 1906, and by 1910 studio production was shifting to California, where more consistent sunlight complemented expanding artificial lighting systems (Jacobson, 2015). The establishment of studios in Los Angeles, including the early facilities in Edendale and later in Hollywood, reflected both technical and economic considerations. By the mid-1910s, American studios had adopted electric arc and incandescent illumination, allowing interior shooting independent of weather conditions. This drove the expansion of feature-length films and more elaborate staging, supported by the division of labor among camera operators, lighting technicians, set builders and laboratory specialists.

In Germany, the development of studio infrastructure followed a different trajectory (Kreimeier, 1999; Brockmann, 2010). The early Berlin studios of companies such as Deutsche Mutoskope & Biograph and Messter-Film experimented with artificial lighting earlier than many of their European counterparts (Blom, 1995). After the formation of Universum Film AG (UFA) in 1917, Germany built some of the most advanced studio complexes of the era, including the Tempelhof and Neubabelsberg facilities (Kreimeier, 1999). These studios incorporated sophisticated lighting grids, large-scale stage architecture and precision optical equipment, enabling the stylized visual environments associated with German Expressionist cinema (Bergfelder, Carter, Göktürk, & Sandberg, 2020). The technical capabilities of these studios (particularly their ability to control shadow, scale and architectural distortion) had a direct influence on cinematic aesthetics and helped define a national style recognized internationally.

In the Russian Empire, early studio activity began in St. Petersburg and Moscow around 1908, but expansion accelerated after 1917 when the Soviet state nationalized production (Stites, 1992; Nebesio, 2009). While resources were more limited than in Western Europe or the United States, Soviet studios emphasized editing and montage because they lacked extensive lighting and set-construction capacity. The material conditions of production (shortages of stock, limited artificial lighting and restricted access to imported equipment) shaped the development of montage theory and the technical experimentation of the 1920s. As a result, Soviet innovation occurred less in scenic construction and more in mechanical manipulation of filmed material.

In Japan, the first permanent studios appeared in Tokyo and Yokohama by 1909–1910, operated by companies such as Yoshizawa and later Nikkatsu after its consolidation in 1912 (Ruot, 1932; Bernardi & Ogawa, 2021). These studios adapted imported cameras and projectors but retained staging practices rooted in kabuki and shinpa theater, leading to hybrid production methods. Research Standish (2006) shows that Japanese studio development was shaped by limited access to imported lighting equipment, resulting in slower adoption of electrically lit interiors and continued reliance on natural light well into the 1910s.

The industrialization of film production had several broad consequences. First, it increased the scale and speed of filmmaking, allowing companies to produce films continuously rather than sporadically. Second, it created new professions, including lighting engineers, lab technicians, carpenters, costume specialists and camera assistants. Third, it contributed to the emergence of standard narrative structures, since continuous production required predictable story formats suited to distribution schedules. Finally, it transformed cinema into an exportable industrial product, contributing to early global media circulation.

The establishment of the first film studios therefore marked a shift from artisanal experimentation to industrial organization. It provided the technical and logistical framework within which longer films, narrative clarity, repeatable performance styles

and recognizable genres could emerge. With production aligned to industrial principles, filmmakers began to explore new visual possibilities, leading directly to the invention and refinement of the first special effects, which expanded the representational capacity of the medium and reshaped audience expectations.

The First Special Effects and the Expansion of Screen Possibilities.

The development of the first special effects between the late 1890s and the 1920s expanded what cinema could represent and played a crucial role in shifting moving images from simple visual records to a medium capable of depicting transformation, fantasy and phenomena that could not be captured directly. While Georges Méliès is frequently associated with the origins of screen illusion, recent researches (Coleclough, 2022; Ioan, 2023; Kim, 2025) shows that early special effects emerged from a wider set of technological practices including stop-camera substitution, reverse motion, double exposure, matte blocking and scale miniatures. Méliès began using substitution splicing after 1896 at the Théâtre Robert-Houdin studio in Paris, where controlled lighting and fixed camera placement made it possible to align multiple exposures accurately. These effects depended on stable tripod-mounted cameras and perforated film stock that allowed multiple passes without frame drift. His later productions, such as *Le Voyage dans la Lune* (1902), used painted sets, smoke effects and mechanical stage devices, illustrating how theatrical stagecraft merged with emerging cinematic optics (Figure 2).



Figure 2. Georges Méliès, image from *Le Voyage dans la Lune* (1902 as cited in Ioan, 2023).

In Britain, special effects developed through different technical conditions. Filmmakers associated with Hepworth and G. A. Smith experimented with reverse motion and masking techniques between 1898 and 1903, producing films in which objects assembled themselves or figures appeared and disappeared. Research Lipton (2021b) notes that these effects relied on precise camera registration and laboratory techniques that ensured consistent exposure across multiple passes. In the United States, Edwin S. Porter used matte work and miniature models in films such as *The Life of an American Fireman* (1903) and *The Great Train Robbery* (1903), combining staged and documentary footage. The American effects development was accelerated by the availability of industrial optical equipment and the emergence of professional film laboratories by the 1910s.

German cinema developed a distinctive approach to effects based on architectural distortion, lighting manipulation and optical filters. Films associated with German Expressionism (including works produced at the UFA studios after 1917) used painted perspectives, angled constructions and controlled shadow to create environments that appeared psychologically charged rather than physically realistic. Research (Kreimeier, 1999; Brockmann, 2010; Bergfelder, Carter, Göktürk, & Sandberg, 2020) attributes these effects to the advanced lighting grids and precision lenses available in Berlin studio complexes, which made it possible to shape contrast and depth deliberately. These techniques influenced not only fictional cinema but also stage design, advertising graphics and visual culture more broadly, demonstrating the permeability between cinematic technology and other fields.

Color manipulation formed another dimension of early effects (Burns, 2013; Lipton, 2021b). Tinting and toning became widespread by the 1910s, with blue signifying night, amber for interiors and red for fire or danger. The practices to chemical processes that altered the film emulsion rather than the image content, allowing color to be applied after editing. More advanced systems followed: Kinemacolor appeared in Britain in 1908, using alternating red and green frames projected with a synchronized filter wheel, while Technicolor introduced subtractive dye-transfer methods in the United States beginning in 1916. The systems required precise mechanical alignment and laboratory calibration, making color not only an aesthetic choice but a technical achievement that depended on engineering accuracy and industrial capacity.

Special effects also appeared in scientific, educational and military films. High-speed photography, microcinematography and time-lapse imaging were used in laboratories to document chemical reactions, mechanical stress, biological growth and ballistic trajectories (Blom, 1995; Ioan, 2023). The applications contributed to cinema's legitimacy as a research tool and linked the medium to scientific modernity. These uses demonstrate that effects were not restricted to fantasy but helped visualize processes otherwise invisible to the human eye.

The societal impact of special effects was substantial. Audiences were introduced to representations of flight, outer space, microscopic life, industrial power and supernatural transformation – subjects aligned with technological aspiration and cultural fascination with progress (Bergfelder, Carter, Göktürk, & Sandberg, 2020; Kim, 2025). The early effects contributed to new ways of imagining modernity, reinforcing public interest in science, exploration and mechanical innovation (Coleclough, 2022; Ioan, 2023). Furthermore, effects-driven films supported the emergence of screen genres such as fantasy, science fiction and adventure, encouraging distribution strategies based on spectacle and novelty.

By the late 1920s, special effects had become integrated into studio practice, supported by dedicated technicians, laboratory specialists and optical units. Their technical requirements shaped camera design, lighting systems, film stock composition and projection standards. As a result, effects work contributed directly to cinema's industrialization and to the expansion of its expressive and commercial potential. With representational capacity widened, cinema could support more differentiated narrative forms, leading to the development of recognizable genres that organized production, distribution and audience expectations.

The Emergence of Genre Cinema as a Technological Outcome.

The appearance of recognizable film genres between the 1910s and the late 1920s was closely connected to the technological conditions under which films were produced, edited and exhibited. Although genres are often described as narrative or cultural classifications, studies (Kobel, 2007; Jacobson, 2015; Bergfelder, Carter, Göktürk, & Sandberg, 2020) emphasize that the formation of genre categories was driven by mechanical constraints, equipment capabilities and production workflows. Films came to be identified as comedy, melodrama, adventure, horror, historical epic or science fiction not simply because they shared themes, but because specific technologies enabled distinctive visual rhythms, staging practices and performance styles that audiences learned to recognize and anticipate.

Comedy provides one of the clearest examples of how technology shaped genre identity. Variable cranking speeds and uneven projection rates produced accelerated motion, contributing to the characteristic kinetic exaggeration associated with slapstick. This effect depended on standardized projection speeds adopted in permanent theaters after 1908, which made under-cranked footage appear comically fast (Montgomery & Wisdom, 2022). Physical stunt work relied on wide-angle lenses and deep focus, enabling action to be captured clearly without rapid cutting. In the United States, studios in Los Angeles and later Hollywood developed dedicated stunt teams and reinforced sets, reflecting the growing technical demands of comedic filmmaking.

Melodrama developed in parallel with advances in lighting, lenses and set construction. The introduction of artificial studio illumination around 1907–1912 made

it possible to control contrast, highlight facial expression and shoot interior scenes consistently. This close-up shots depended on improved lens precision and faster emulsions, which allowed emotional emphasis and contributed to melodrama's characteristic intensity. Tinting and toning further reinforced emotional coding, with colors applied to signal mood and narrative transitions. These technical factors made melodrama one of the dominant genres in Europe and North America during the 1910s.

Adventure films and historical epics emerged where production infrastructure could sustain large-scale staging. In the United States, the growth of studio backlots and outdoor sets after 1912 enabled crowd scenes, battles and expansive landscapes. Research (Allen, 1979) links the rise of these genres to logistical capacity, including costume manufacturing, transport coordination and camera mobility. In Italy, early epics such as *Quo Vadis?* (1913) and *Cabiria* (1914) drew on large studio complexes in Turin and Rome, supported by architectural resources and mechanically operated tracking systems (Schenk, 2024). In Germany, UFA's studio facilities enabled monumental set construction, contributing to historically themed spectacles that circulated internationally.

Horror and Expressionist cinema developed largely in Germany during the 1910s and 1920s, shaped by controlled lighting systems, optical filters and stylized architectural design (Kreimeier, 1999; Brockmann, 2010; Bergfelder, Carter, Göktürk, & Sandberg, 2020). These films relied on precise shadow shaping and perspective distortion, techniques made possible by advanced lighting grids and lens manufacturing. The result was a distinctive genre defined by visual deformation rather than narrative violence. These stylistic effects influenced international cinema and contributed to later sound-era horror conventions.

Science fiction and fantasy emerged where special effects capabilities had matured. Films that depicted flight, space travel, futuristic cities or supernatural transformation depended on double exposure, miniature models, matte compositing and early color systems. Studies (Burns, 2013; Coleclough, 2022; Ioan, 2023) note that these genres appeared in France, the United States and Germany first because these industries possessed laboratories capable of precise optical alignment. The expansion of these genres reflected both technical skill and public fascination with technology, aviation, astronomy and industrial modernity.

Genre development differed across global regions due to local technological conditions. In Japan, the coexistence of imported cameras and traditional theater influenced jidaigeki (period drama), which relied on stylized acting and slower cutting rhythms. In the Soviet Union, limited studio resources and strong editorial practices fostered genres defined by montage, collective struggle and industrial themes, rather than spectacle or fantasy. In India, early studios combined mythological narratives with simple effects and outdoor shooting, reflecting both cultural continuity and constrained infrastructure. The genre differences reflected disparities in electrification, film stock supply, projection standards and labor organization.

By the late 1920s, genres had become essential to production planning, distribution scheduling and audience expectations. Theaters programmed films according to genre because projection conditions (illumination, auditorium size and musical accompaniment) varied with different types of content (Anderson, 1987; Carli, 1995). Distribution companies marketed films internationally using genre labels that required minimal translation, facilitating global circulation. Genre cinema thus emerged as a technological and industrial system that structured how films were made, circulated and understood. With genre formation established, cinema became a medium capable of standardization and worldwide dissemination. The next stage of development involved the integration of these industrial and stylistic systems into a global network of production, distribution and exhibition, laying the groundwork for cinema to become the first mass medium with internationally coordinated technological standards.

Integrated Impact on the Global Development of Cinema.

By the 1910s and especially by the 1920s, the combined effects of the Lumière system, permanent movie theaters, industrialized studio production, special effects techniques and genre differentiation produced a technological and organizational framework that enabled cinema to develop as the first globally circulating mass medium. The decisive factor in this transformation was the standardization of equipment, formats and exhibition conditions. The widespread adoption of 35 mm perforated film stock, consistent projection apertures and increasingly regulated frame rates meant that films could be shipped between countries and projected without mechanical modification. This compatibility preceded similar international harmonization in radio transmission, sound recording or household electrical systems, positioning cinema as a technological forerunner in global media integration.

Distribution networks expanded in parallel with these standards. By 1915, American distributors were circulating films across Latin America and parts of Asia, while European companies such as Pathé supplied prints to North Africa, the Middle East and Eastern Europe. This film rental systems, introduced first in the United States and then adopted elsewhere, allowed theaters to program new material weekly, creating synchronized viewing rhythms across regions. The result was a coordinated flow of visual content that linked geographically distant populations through shared imagery and narrative forms.

At the same time, cinema influenced and was shaped by different socioeconomic environments. In industrial centers such as Berlin, Chicago and Tokyo, theaters became focal points of urban culture, supporting nightlife economies and influencing commercial advertising, fashion and behavioral norms. In colonial contexts such as India, Egypt and West Africa, cinema functioned both as a tool of cultural importation and as a catalyst for emerging local production. In the Soviet Union, cinema was designated a strategic instrument of communication after 1917, and its distribution

networks expanded accordingly, though unevenly across rural territories. These variations demonstrate that while cinema's technological base was increasingly standardized, its social functions were shaped by political and infrastructural conditions.

The expansion of cinema also altered patterns of literacy and perception. Whereas printed texts required reading proficiency, film communicated visually, enabling mass audiences (including children, recent urban migrants and populations with limited formal education) to engage with complex narratives. This accessibility reshaped cultural participation, contributed to new modes of collective spectatorship and accelerated the formation of shared visual reference points across different social groups. At the same time, the technological conditions of projection (darkened auditoriums, fixed seating and synchronized attention) encouraged forms of concentrated perception associated with modern industrial time.

By the end of the silent era, cinema had become a globally coordinated technological system supported by standardized materials, mechanical specifications, distribution logistics and audience expectations. These developments created the platform upon which synchronized sound could later be introduced. Electrical amplification, optical soundtracks and new architectural acoustics built directly on the infrastructure established during the silent period. Thus, the integrated impact of the foundational developments discussed in earlier sections positioned cinema not only as a cultural form, but as a technological network that reshaped communication, leisure, industrial organization and social life on an international scale.

Long-Term Societal Consequences.

By the close of the 1920s, the technological, industrial and cultural transformations that had shaped silent cinema had already begun to alter broader patterns of social life, communication and collective experience. The cinema influenced society not only through narratives and stars, but through the technological structures that organized spectatorship, labor, memory and public space. The spread of permanent movie theaters created new forms of urban gathering and standardized leisure schedules tied to fixed screening times, reinforcing rhythms associated with industrial working hours. Cinemas also functioned as mixed social environments in which women, young workers and recent migrants participated in public cultural activity, contributing to changing norms of visibility, mobility and social interaction.

The industrialization of film production introduced new professions and reorganized labor practices. Camera operators, lighting technicians, set designers, laboratory workers and projectionists formed specialized workforces whose skills paralleled developments in electrical engineering, optics and chemical processing. These occupations reflected the increasing technical complexity of modern industry and contributed to the professionalization of media work. Furthermore, the international circulation of films linked distant audiences through shared reference

points, contributing to early forms of global cultural familiarity long before broadcast radio or television.

Cinema also reshaped perception and visual literacy. The concentration required in darkened auditoriums, the sequencing of images and the synchronization of collective attention encouraged new habits of focused looking. The expansion of special effects and imaginative visual representation contributed to new conceptions of scientific possibility, exploration and technological progress, influencing popular understandings of aviation, astronomy and mechanization.

In political and educational contexts, cinema became a tool for shaping public opinion and transmitting information. The governments, reform movements and industrial organizations used film to communicate reforms, promote public health initiatives and document infrastructure projects. The ability to display moving images to large audiences made cinema an early instrument of mass communication, predating the widespread adoption of sound reproduction and radio broadcasting.

With the emergence of recognizable genres, audiences developed expectations and interpretive skills that facilitated shared cultural frameworks. Comedy, melodrama, adventure, historical epics and horror became reference systems that structured emotional response and social meaning. As these genres circulated globally, they contributed to early forms of cultural standardization, even as local variations persisted. Meanwhile, the stability of projection systems, film stock formats and distribution networks made cinema one of the first technologies to synchronize cultural experience across continents.

By creating new forms of spectatorship, labor organization, communication and shared visual reference, silent-era cinema helped establish the foundations upon which later audiovisual media developed. The introduction of synchronized sound in the late 1920s built directly on the technological infrastructure and audience habits formed during the silent period. These long-term consequences suggest that the history of early cinema is inseparable from the history of modernization, urbanization and global communication. Understanding the silent era as a technologically driven phase clarifies its enduring impact on media systems, cultural practices and social life, and points to future research directions in archival reconstruction, material analysis and digital restoration that continue to reveal how early cinema shaped the modern world.

Conclusions.

The analysis of cinema's development from the 1890s to the late 1920s confirms that the silent era should be understood as a period in which moving images became a coherent technological, industrial and social system. Rather than viewing early cinema as a preliminary stage awaiting later refinement, the study shows that this era produced the fundamental structures that determined how film would operate as a medium throughout the twentieth century. The Lumière system established the technical conditions for reproducibility and circulation; permanent movie theaters created stable

environments for collective spectatorship; early studios introduced organized production based on controlled lighting, architectural planning and division of labor; the first special effects expanded the visual and conceptual boundaries of screen representation; and genre formation linked production practices with audience expectations and distribution mechanisms. These developments did not occur independently but reinforced one another, resulting in cinema's integration into urban culture, labor organization, patterns of leisure and emerging forms of mass communication. By the end of the 1920s, cinema functioned as a standardized international medium capable of synchronizing cultural experience across geographically and socially diverse populations. The findings therefore indicate that the silent era represents a decisive phase in the history of technology, during which film became both a modern industrial product and a shared cultural institution, shaping the foundations upon which sound cinema and later audiovisual media were built.

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References

- Abel, R. (Ed.). (1996). *Silent film*. London: A&C Black.
- Allen, R. C. (1979). Motion picture exhibition in Manhattan 1906–1912: Beyond the Nickelodeon. *Cinema Journal*, 18(2), 2–15. <https://doi.org/10.2307/1225438>
- Allen, J. K. (2025). 'A window of the world': itinerant silent cinemas in rural Australia. *Early Popular Visual Culture*, 23(1–2), 192–208. <https://doi.org/10.1080/17460654.2024.2408219>
- Anderson, G. B. (1987). The presentation of silent films, or, music as anaesthesia. *The Journal of Musicology*, 5(2), 257–295. <https://doi.org/10.2307/763853>
- Bergfelder, T., Carter, E., Göktürk, D., & Sandberg, C. (Eds.). (2020). *The German cinema book*. London: Bloomsbury Publishing.
- Bernardi, J., & Ogawa, S. T. (Eds.). (2021). *Routledge handbook of Japanese cinema*. New York: Routledge.
- Beugnet, M. (2022). The Gulliver effect: Screen size, scale and frame, from cinema to mobile phones. *New Review of Film and Television Studies*, 20(3), 303–328. <https://doi.org/10.1080/17400309.2022.2081461>
- Blom, I. (1995). Filmvertrieb in Europa 1910–1915. *Jean Desmet und die Messter-Film GmbH*. Retrieved from <https://mediarep.org/server/api/core/bitstreams/70edaeae-df97-4cdd-a3b8-51d91fd64369/content>

- Brockmann, S. (2010). *A critical history of German film*. Rochester, New York: Camden House.
- Brownlow, K. (1984). An Introduction to Silent Film. *Journal of the Royal Society of Arts*, 132(5332), 261–270. Retrieved from <http://www.jstor.org/stable/41373724>
- Burns, J. (2013). The birth of the cinema age. In *Cinema and Society in the British Empire, 1895–1940* (pp. 13–54). London: Palgrave Macmillan. https://doi.org/10.1057/9781137308023_2
- Carli, P. C. (1995). Musicology and the presentation of silent film. *Film History*, 7(3), 298–321. Retrieved from <http://www.jstor.org/stable/3815096>
- Coleclough, S. (2022). Méliès–léger d’écran. *Early Popular Visual Culture*, 20(1), 34–59. <https://doi.org/10.1080/17460654.2022.2076357>
- Frymus, A. (2023). Silent film era and marginalised spectatorship. *Early Popular Visual Culture*, 21(2), 183–188. <https://doi.org/10.1080/17460654.2023.2209938>
- Ghertman, M., & Hadida, A. L. (2005). Institutional assets and competitive advantages of French over US cinema, 1895–1914. *International Studies of Management & Organization*, 35(3), 50–81. <https://doi.org/10.1080/00208825.2005.11043737>
- Gibson, J. (2022). The Man behind the Curtain. *Intellectual Property and the Law of Nations, 1860–1920*, 58, 207–41. https://doi.org/10.1163/9789004511439_008
- Hirsch, P., & O'Rourke, C. (Eds.). (2017). *London on film*. Cham: Palgrave Macmillan.
- Ioan, D. (2023). Spectral Bodies and Superimposition in Photography and Film. *Studia Universitatis Babeş-Bolyai – Dramatica*, 68(1), 43–70. Retrieved from <https://dramatica.ro/index.php/j/article/view/270>
- Jacobson, B. R. (2015). *Studios before the system: architecture, technology, and the emergence of cinematic space*. New York: Columbia University Press.
- Kim, H. (2025). The transhumanist and animated bodies of Georges Méliès. *Early Popular Visual Culture*, 1–14. <https://doi.org/10.1080/17460654.2025.2530428>
- Kobel, P. (2007). *Silent movies: The birth of film and the triumph of movie culture*. New York: Little, Brown and Co.
- Kreimeier, K. (1999). *The UFA story: A history of Germany's greatest film company, 1918–1945*. Berkeley: University of California.
- Labosier, J. (2004). From the Kinetoscope to the Nickelodeon: Motion Picture Presentation and Production in Portland, Oregon from 1894 to 1906. *Film History*, 16(3), 286–323. Retrieved from <http://www.jstor.org/stable/3815539>
- Lewis, M. (2024). Silent Films and Augmented Reality. *The Journal of e-Media Studies*, 7(1), 11. <https://doi.org/10.1349/PS1.1938-6060.A.496>
- Lipton, L. (2021a). The Lumières and the Europeans. In *The Cinema in Flux: The Evolution of Motion Picture Technology from the Magic Lantern to the Digital Era* (pp. 161–169). New York: Springer. https://doi.org/10.1007/978-1-0716-0951-4_17

- Lipton, L. (2021b). Urban and the origins of Kinemacolor. In *The Cinema in Flux: The Evolution of Motion Picture Technology from the Magic Lantern to the Digital Era* (pp. 371–378). New York: Springer. https://doi.org/10.1007/978-1-0716-0951-4_43
- Marks, M. M. (1997). *Music and the silent film: Contexts and case studies, 1895-1924*. New York: Oxford University Press.
- Montgomery, J., & Wisdom, N. (2022). *Comedy Films 1894–1954*. London: Routledge. <https://doi.org/10.4324/9781003267669>
- Narath, A., & Guttman, E. I. (1966). The work of film pioneer Max Skladanowsky. *Journal of the SMPTE*, 75(12), 1168–1174.
- Navitski, R. E. (2013). *Sensationalism, Cinema and the Popular Press in Mexico and Brazil, 1905–1930*. Berkeley: University of California.
- Nebesio, B. Y. (2009). Competition from Ukraine: VUFKU and the Soviet Film Industry in the 1920s. *Historical Journal of Film, Radio and Television*, 29(2), 159–180. <https://doi.org/10.1080/01439680902890654>
- Peng, A. I. (2024). Social Changes in America: The Silent Cinema Frontier and Women Pioneers. *Humanities*, 13(1), 3. <https://doi.org/10.3390/h13010003>
- Pryt, K. (2022). Mapping cinemas in the Russian-governed Warsaw. *Studia Geohistorica*, 10, 138–151. <https://doi.org/10.12775/SG.2022.08>
- Raisbeck, A. (2018). Extinguishing Spotlights: the Uncertain Future of Cinematic Heritage in London's Leicester Square. *Apuntes: Revista de estudios sobre patrimonio cultural*, 31(1), 66–83. Retrieved from <https://revistas.javeriana.edu.co/index.php/revApuntesArq/article/download/23480/20837>
- Ruot, M. (1932). The Motion Picture Industry in Japan. *Journal of the Society of Motion Picture Engineers*, 18(5), 628–642.
- Schenk, I. (2024). *A History of Italian Cinema. Cinema Paradiso?* Wiesbaden: Springer VS. <https://doi.org/10.1007/978-3-658-44821-9>
- Schuchman, J. S. (2004). The silent film era: Silent films, NAD films, and the Deaf community's response. *Sign Language Studies*, 4(3), 231–238. <https://doi.org/10.1353/sls.2004.0013>
- Șerban, S. (2016). Lumière's cinématographe—The starting point of the history of cinematography? *Analele Universității Spiru Haret. Seria Jurnalism*, 17(2), 49–52.
- Standish, I. (2006). *A new history of Japanese cinema*. London: Bloomsbury Publishing. Retrieved from <https://digital.casalini.it/9781441161543>
- Stites, R. (1992). *Russian popular culture: Entertainment and society since 1900*. New York: Cambridge University Press.
- Strickland, J. (2024). A cinematic soap opera: The development of cinematography as an advertising and promotional tool in Lever Brothers Limited. *Business History*, 66(1), 136–156. <https://doi.org/10.1080/00076791.2021.1909573>

- Toporivska, Y., Dyadyukh-Bogatko, N., Belinska, L., Balan, N., & Patsaliuk, L. (2025). The movement into cinema as a stage in the cinema development. *History of Science and Technology*, 15(1), 239–275. <https://doi.org/10.32703/2415-7422-2025-15-1-239-275>
- Vaniuha, L., Kyreia, M., Lemishka, N., Spolska, O., & Patron, I. (2024). History of the evolution of cinema in the context of considering the stages of development of science and technology. The first steps to the birth of cinema. *History of Science and Technology*, 14(2), 513–538. <https://doi.org/10.32703/2415-7422-2024-14-2-513-538>
- Withall, K. (2014). *Studying Early and Silent Cinema*. Liverpool: Liverpool Scholarship Online. <https://doi.org/10.3828/liverpool/9781906733704.001.0001>
- Zhu, J. (2021). Changing Women Social Status and Roles in Silent Film During the 1910s to 1930s. *Frontiers in Art Research*, 3(4). <https://doi.org/10.25236/FAR.2021.030401>

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Німе кіно як технологічна система: Інфраструктура, інновації та інституціоналізація (1890–1930)

Анотація. У цій статті розглядається період з 1890-х до кінця 1920-х років як етап, на якому кінематограф став стабільним технологічним та соціальним інститутом завдяки взаємодії п'яти ключових подій: системи, створеної

братами Люм'єром; появи стаціонарних кінотеатрів; утворення перших кіностудій; впровадження ранніх спецефектів; появи кіножанрів. У дослідженні застосовується історичний підхід, що поєднує аналіз первинної технічної документації, архітектурних свідчень, документації про студійну інфраструктуру та сучасні міжнародні дослідження, щоб виявити, як конкретні інновації в механіці, оптиці, освітленні, хімічній обробці та дизайні кінопоказу перетворили виробництво та глядацьку аудиторію. Результати показують, що система Люм'єр встановила відтворювані стандарти проєкції і сприяла міжнародному поширенню зображень, що рухаються. Стаціонарні кінотеатри створювали контрольоване візуальне середовище, стандартизували розклад переглядів та підтримували більш довгі оповідальні формати. Перші студії впровадили регульоване освітлення, конструкцію декорацій та поділ праці, перетворивши кіновиробництво на промисловий процес. Аналіз також показує, що спецефекти розширили можливості репрезентації завдяки мультиекспозиції, мініатюрним моделям, технікам маскування та кольорним процесам, а жанри виникали залежно від технологічних умов: комедія була пов'язана зі змінним звучанням, мелодрама – з керованим освітленням, епічні та пригодницькі фільми маніпуляцією архітектурним простором та тінями. Ці досягнення в сукупності сприяли глобальному поширенню кінематографу, формуванню загальних культурних систем відліку та нових способів соціальної взаємодії, що ґрунтуються на колективному глядацькому сприйнятті. На закінчення слід зазначити, що подальші дослідження повинні вивчити, як ці основи сприяли подальшому впровадженню синхронізованого звуку та вплинули на довгострокову еволюцію аудіовізуальних медіа.

Ключові слова: візуальні мистецтва; кіномистецтво; історія розвитку кінематографу; технологічна модернізація; візуальні ефекти

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