38. *New York Times*, December 13, 1920, p. 19; June 20, 1921, p. 17; and April 24, 1925, p. 17.
39. See Siegfried Kracauer, *From Caligari to Hitler* (Princeton, N.J.: Princeton University Press, 1947), pp. 61–76; *New York Times*, March 20, 1921, VI:2; April 4, 1921, p. 18; *Current Opinion*, June 1921, p. 786; and *Moving Picture World*, April 23, 1921, pp. 785, 787.
40. See *Literary Digest*, September 26, 1925, pp. 27–28. For a summary of critical responses, see also, *New York Times*, August 24, 1925, p. 17; and *Nation*, September 16, 1925, p. 311.
41. *New York Times*, April 18, 1921, p. 8; December 7, 1926, p. 21; *New Republic*, July 28, 1926, p. 280; and *Nation*, March 23, 1927, p. 324.
42. *New Republic*, May 27, 1925, pp. 19–20. See also, *New Republic*, July 28, 1926, p. 280; *Nation*, September 16, 1925, p. 311; and *Moving Picture World*, July 31, 1926, p. 277.
43. *Literary Digest*, May 14, 1921, p. 28; *Moving Picture World*, May 7, 1921, p. 31; May 14, 1921, p. 119; April 23, 1921, p. 852; *Film Daily Yearbook 1927*, p. 22; and *Motion Picture Classic*, October 1925, p. 25.
44. *Moving Picture World*, April 23, 1927, p. 719; and March 26, 1927, p. 376.
45. *Film Daily Yearbook*, 1927, p. 741; *Moving Picture World*, April 2, 1927, p. 267; June 25, 1927, p. 589; "The Case of Mr. Fox," *Fortune* (May 1930): 49; and Allvine, *The Greatest Fox*, pp. 12, 105–112, 157.
46. Robert McLaughlin, *Broadway and Hollywood* (New York: Arno Press, 1974), pp. 52–80; *Moving Picture World*, January 2, 1926, p. 5; April 3, 1926, p. 332; May 21, 1927, p. 192; May 28, 1927, p. 289; and May 14, 1927, p. 92.
47. *New York Times*, December 7, 1926, p. 21; and *Moving Picture World*, July 23, 1927, p. 244.
48. *Moving Picture World*, January 2, 1926, p. 69; July 17, 1926, p. 151; *Photoplay*, November 1927, p. 27; and *Moving Picture World*, September 3, 1927.
49. See, for example, *Moving Picture World*, December 4, 1926. *Motion Picture Classic* quoted in Lipkin, *Sunrise*, pp. 342–43; *Moving Picture World*, March 5, 1927, p. 35; *Variety*, March 27, 1927, p. 4; and *Moving Picture World*, August 6, 1927, p. 402.
50. For discussion of the style of *Sunrise*, see Alexandre Astruc, "Fire and Ice," *Cahiers du Cinema in English* 1 (January 1966): 70; Robin Wood, "On *Sunrise*," *Film Comment* (May–June 1976): 10–19; Mary Ann Doane, "Desire in *Sunrise*," *Film Reader II* (1978); and Dudley Andrew, "The Gravity of *Sunrise*," *Quarterly Review of Film Studies* 2 (August 1977): 356–379.
51. *New York Times*, December 24, 1927, p. 15; *New Republic*, October 26, 1927, pp. 263–264; and *The Arts*, November 1927, p. 283. See also, *Literary Digest*, December 3, 1927, p. 29; and *Photoplay*, December 1927, p. 53.

5

Technological Film History

Cinema depends on machines. However, we forget the fundamental technological basis of the cinema as we sit in a darkened movie theater, engrossed in the story effortlessly unrolling before us on the screen. It is only when something goes wrong—the projector bulb burns out, the image loses focus, the volume is set too high or too low—that the technological complexity of the cinema is foregrounded. For a few moments (until the problem is corrected for us) we confront some of the difficulties encountered in the latter decades of the 1890s by the many American and European tinkerers, inventors, and scientists who sought a way of producing life-like projected images that gave the appearance of natural movement. By the early 1890s the three machines required for this task had been assembled: the motion picture camera, through which individual photographs could be taken in rapid succession; the printer, which converted the exposed film to positive images; and the projector, which, reversing the process of the camera, fed the positive print past a lens and light source, projecting the resulting image on a screen. To this basic triad has been added a vast array of devices, from special equipment to move the camera through space, to "special effects" printing, to new projection systems. With these subsequent technological developments have come new possibilities in filmmaking: sound, color, wide-screen, and "3-D," among others.

All art forms and communications media have a technological history. Western painting could hardly be discussed without reference to the development of oil paints, nor modern theater without reference to the development of electrical stage illumination. It is possible, however, to conceive of poetry, the-

ater, rhetoric, or painting with all or most of its technological augmentation stripped away and yet still be left with something recognizable as a poem or a play. In fact, some artists choose to dispense with the technological trappings of their medium—minimalist painters or performance artists, for example. The filmmaker, by comparison, cannot escape the relatively high degree of technological complexity that is a prerequisite to the production of any film. While the cinema is by no means unique in having a technological history, its inescapable dependence on a set of complex machines, themselves dependent on a particular formation in the history of optics, chemistry, and machine tooling, gives the study of technology a prominent place in film history.

The basic task of the historian of cinema technology is the examination of circumstances surrounding the initial development of the cinematic apparatus (camera, printer, projector) and those attending the subsequent alterations, modifications, and extensions. This does not mean merely cataloging inventions in historical sequence; machines do not invent themselves. The technological history of the cinema necessarily must also entail how particular pieces of technology came to be developed at a particular time, their relationship to the existing state of technology, the extent and nature of their use, and the consequence of that use—whether foreseen or unforeseen. Cinema has developed from a specific technological basis that has been changing since the 1890s. Not so obvious is how and why this original technology and the alterations to it came about. Answering these questions presupposes some theory of technological change. This chapter examines the major theories of technological change that have been applied to the history of the cinema, again emphasizing their application to the history of American cinema.

THE "GREAT MAN" THEORY AND TECHNOLOGICAL DETERMINATION

The first place one might think to look for the impetus behind technological change in cinema is in the laboratory itself, that is, the inventor who transforms an idea into apparatus. As we have seen in Chapter 3, the image of the solitary inventor crying "Eureka" in the wee hours of the morning has been a particularly appealing one, combining as it does an ethos of individual achievement with technological progress, relatable in terms of high drama, exciting enough to match the stories produced in Hollywood. Technological history is thus often portrayed as an evolutionary chain of technological success stories centering on the "breakthroughs" of individual inventors. The inventor supervises the birth of the appropriate technological change and nurtures it to maturity. This new technological state of affairs gives rise to new problems, needs, and/or opportunities, which provide the starting point for yet another technical genius. Such a schema carries with it its own criterion for historical significance: Only

those inventors and inventions that move the cinema onward toward its present state of technological sophistication are fit subjects for technological film history. History is constructed backwards from the present—tracing the evolutionary chain of events and great individuals that recede from today to the nineteenth century and beyond. With this chain in mind it becomes possible to recognize certain elements of technological change that cannot be accommodated by it as missteps and/or anachronisms—Smell-O-Vision in the 1950s or Edison's attempts at synchronous sound in 1912, for example.

We have deliberately outlined this "great man" theory of technological change in its most simplistic and least tenable form in order to carry its underlying precepts to their logical conclusions. "Great man" accounts of the technological history of the American cinema vary considerably in detail and complexity—from the rather simplistic (and in light of its method of publication, probably necessary) hero-worship of Grau, to the painstaking descriptions of the invention of early cinematic apparatus in Gordon Hendricks's work. However, so long as one holds that the ultimate "cause" of technological change is the genius of a few individuals, then there is not much else in the way of historical explanation that need be said. The task of the technological historian is limited to (1) separating the important technological advancements from the unimportant, (2) identifying the person(s) responsible for those advancements, (3) relating a narrative of their success, and, in doing so, (4) awarding them their proper place in the history of the cinema. Hence, for example, Hendricks's exhaustive examination of every scrap of documentation relating to the invention of the first working motion picture camera, the Kinetograph, is done in order to establish that it is not Thomas Edison who deserves credit for this achievement, but in fact his laboratory assistant, W. K. L. Dickson.

Certainly, the history of technological change in the cinema involves individuals whose training, skills, aptitudes, and, finally, achievements single them out for special consideration by the historian. To deny that Thomas Edison, W. K. L. Dickson, Lee de Forest, Theodore Case, or Herbert Kalmus played a part in the technological history of the cinema is not only shortsighted but historically unsupportable. However, by foregrounding the role of the individual in technological change, the "great man" theory excludes or greatly reduces consideration of other factors. The shortcomings of such a theory are, in fact, highlighted by the ongoing debate over who actually "invented" the movies. Since the 1920s claims of primacy have been made for inventors in the United States, England, France, Germany, and the Soviet Union: Thomas Edison, W. K. L. Dickson, Gray and Otway Latham, Jean LeRoy, William Friese-Green, Jules Marey, and Max Skladonowski, among others. What this historical hairsplitting ignores is the larger historical questions of what caused this flurry of research in the 1880s and 1890s, what is the context in which these inventors labored, and why a few machines received widespread commercial exploitation, while others—just as "technologically advanced"—were hardly

used outside the laboratory. The historical context of technological change in the cinema is not limited to the laboratory, and it is this larger context that the "great man" theory fails to take into account.

The "great man" approach to technological change concentrates on the steps leading to a major breakthrough and on the individual responsible for it. Other film historians have concentrated on what they see as the determining effect of these technical breakthroughs themselves on the future course of film history, shifting the focus from person to machine and from invention to the aesthetic consequence of that invention. Such historians might be called technological determinists, in that they presume, as Raymond Williams notes, that

> new technologies are discovered by an essentially internal process of research and development, which then sets the conditions for social change and progress. The effects of the technologies, whether direct or indirect, foreseen or unforeseen, are, as it were, the rest of history.[1]

According to this view, film history becomes (1) inventions, plus (2) the consequences that follow from their availability.

The thrust of technological determinism can be clearly seen in this forceful comment by an historian of film technology, Raymond Fielding

> All my work as an historian, at least in recent years, has proceeded from the premise that the history of the motion picture—as an art form, as a medium of communication, and as an industry—has been determined principally by technological innovations and considerations. . . . The contribution of a Porter, Ince, and Griffith followed as much from the availability of portable cameras, larger magazines, interchangeable lens, and improved emulsions as it did from their individual artistic vision and talent.[2]

To Fielding, then, each technological advancement contains within it a certain potential that is then realized by perceptive filmmakers, but what they can achieve artistically is already established by the technological parameters available to them. It is but a short step from this view to the assigning of artistic merit to those filmmakers perspicacious enough to understand the full implication of a new technology. Hence even in a nontechnologically oriented work such as Jacobs' *The Rise of the American Film*, one can see traces of technological determinism in, for example, his assessment of Walt Disney. Jacobs argues that during the 1930s Disney functioned as the consummate filmmaker because his studio completely exploited all the technological potential then available to the filmmaker, including color and sound. Disney possessed a "technical dexterity and remarkable command of the medium [that] gives all his efforts a brilliancy of rendition that makes even the least of them dazzling."[3]

To Jacobs and other film historians the "great man" theory and technological determinism coalesce. The great inventors are celebrated for contributing to technological advancement of the cinema, and then another set of great individuals take the stage of film history—those who saw the possibilities inherent in technological change and came closest to "fulfilling the promise" in that potential. The technological advancement itself determines the nature of that artistic fulfillment. Once the promise of a particular device has been fulfilled, history awaits yet another great individual to push film technology one step higher on the evolutionary ladder.

As with the "great man" theory of invention, technological determinism contains within it a kernel of unarguable fact: The state of technology at any given moment in film history imposes certain limits on film production. It marks out what is possible and feasible and thus makes more probable certain types of films and less probable or even impossible other types. Robert Altman's *Nashville* presupposes a state of sophistication in the field of sound recording and reproduction that had only been obtained by the 1960s. The difficulties of maintaining synchronous sound via the 1913 Edison Kinetophone system made it highly unlikely that it would be used to produce feature length films on a mass scale. However, the simple availability of technology does not in itself determine filmmaking practice, nor does it necessarily specify a general direction for artistic innovation. For example, lightweight, portable 16mm filmmaking equipment was "available" to Hollywood in the 1950s and 1960s, but did not find its way into use in Hollywood. Nothing inherent in basic film technology predisposes the cinema to the production of narrative films, or, indeed, to the use of editing to tell a story, and yet since 1908 the predominant form of commercial cinema in Europe and America has been a narrative form based in part on a particular style of editing.

THE ECONOMICS OF TECHNICAL CHANGE

The work of Hendricks and other "great man" historians (even Ramsaye) does help to provide a sense of the immediate context of technological change in the cinema. It is useful to know the specific technical obstacles that had to be overcome and the struggles among individual inventors to receive the acclaim we traditionally afford to the inventor who comes up with a solution "first." Similarly the research of more technological deterministic historians like Fielding provides invaluable information on the state of technical possibilities at a given moment, which nontechnically minded film historians ignore at their peril. However, the limitations of both approaches are apparent even at the pre-cinematic stage of film history (why had Edison put Dickson to work on the Kinetograph in the first place?), and become even more glaring as one moves into the industrial era of American film history.

By the 1920s technological change in the motion picture industry was by and large part of a much larger industrial process. Even when technological innovation in the cinema originated outside the Hollywood studio itself (as was the case with much of the early work on synchronous sound), it came from

companies in related industries (electronics, radio), not "lone wolf" individual inventors. In short, as the American cinema took on the characteristics of a mature capitalist industry—that is to say, a collection of firms, each trying to generate maximum long-run profits—technological change became largely a matter of economic decision making.

One approach to technological change that takes into account the larger economic context can be adapted to the technological history of the cinema from the field of industrial economics. Economic historians have developed a collection of sophisticated tools to analyze the behavior of corporations, one subset of which addresses questions of technological change. This approach, labeled the "theory of technological change," presumes that companies, over the long run, act in such a way as to make the highest possible profit (defined as the residual share after a firm has paid all costs of capital [interest], land [rent], and labor services [wages]). Technological change is one means of achieving that end. This chapter shall discuss this approach in some detail, as it is an important step in placing technological change in the cinema in a wider context.

The first steps in the economic analysis of a particular technological change involve establishing the basic structure of the industry under consideration, and the industry's closest competitors in the years prior to that technological change. In the case of the movies the latter might include vaudeville, popular music, phonograph records, live theater, television, and/or other leisure-time industries—depending on the time frame of the study. Having set forth this industrial context, the historian can move on to consider the three stages in the introduction of any new product or process, in other words, the technological change itself. The first of these stages is the *development of the invention* necessary for effecting the introduction of a new product or process. Economist Edwin Mansfield has defined an invention as "a prescription for a new product or process that was not obvious to one skilled in the relevant art at the time the idea was generated."[4] Usually the invention is not a single idea, but rather a system of concepts linked together. Certainly this was the case for most inventions in motion picture technology—color and sound being the most striking examples.

Once the system of inventions is initially adopted for practical use, it becomes an *innovation*. The innovation stage of technological change involves a firm altering its past methods of production, distribution, and/or marketing because it has determined that the adoption of the invention will result in greater long-term profits. Obviously, firms generate or are presented with many new inventions only a few of which ever reach the innovation stage. The decision to innovate is made only after the expected profits from the invention have been compared to those from alternative inventions and from continuing to employ existing products and processes. An invention does not have to be developed by the industry that ultimately adopts it. The inventor and innovator might be the same corporation (or individual), but in modern industrial practice they rarely are.

For any motion picture company, the process of innovation involves a large number of variables. The firm must have the necessary talent to organize and effect the change. The company must weigh the costs of acquiring new long-term debt, and making adjustments in production, distribution, and exhibition against anticipated revenue. It must also formulate marketing strategies to generate that revenue at the box office. Finally there is the factor of risk. Timing is crucial in innovation. A firm must decide to wait and gather more information about the technological potential and public acceptance of an innovation or gain the competitive leverage of being first on the market with the new product or process. Firms with a significant degree of economic power can afford to be cautious, for they possess the resources to make up for lost advantages.

The process of *diffusion* begins once the technology begins to receive widespread use within an industry. Again central to decision making during this stage is ranking all various investment policies open to the firm, including adopting the new technology. An investment rarely requires a quantum change in production, distribution, or exhibition. The firm continually must decide how and when to alter the speed of the transformation as new information is acquired. Simultaneously it can seek to alter and/or "improve" the invention to adapt it to the firm's particular needs. Early versions of an invention often possess serious technological and marketing disadvantages. Hence modifications at this stage may turn out to be more significant than the initial invention system itself. The diffusion process also involves a reallocation of resources. New plant, equipment, and labor replace those in current use. For example, workers with required new skills are hired. Since buildings and large-scale apparatus once in place become relatively inflexible, changes here take place largely through the construction of new plant and equipment.

The rate of diffusion is directly related to the perceived profitability of the new product or process. Three considerations are crucial. First, what is the nature of the potential profits relative to those earned by the next best investment possibility? The greater the difference, all other things being equal, the faster the rate of diffusion. Second, the greater the financial investment required, the slower the diffusion, unless potential profits loom very, very large. Finally, the rate of diffusion depends on the degree of success of the marketing strategy the firm adopts. The company's owners/managers must seek that avenue best able to convince customers to purchase the new product in large numbers.

CASE STUDY: THE COMING OF SOUND—AN ANALYSIS OF TECHNOLOGICAL CHANGE

The preceding framework—invention, innovation, and diffusion—provides the historian with a powerful, basic methodology by which to analyze the introduction of any technology. For the film industry, this would include any im-

provements in the camera, printer, or projector, as well as alterations in all three, such as the addition of a color, 3-D, or wide-screen process. One such fundamental benchmark in cinema history was the coming of sound to the American film industry during the late 1920s, and the resulting adoption of sound by all other film industries in the world.

Traditional accounts of the coming of sound to Hollywood stem from two sources: Benjamin Hampton's *History of the American Film Industry* and Lewis Jacobs' *The Rise of the American Film*.[5] Hampton presented the hypothesis that because the U.S. film industry had reached a steady-state, no-growth equilibrium, it was "ready" for sound. He offered no reasons why the industry was "ready" at that point and not before. Hampton then went on to describe how Warner Bros., alone, agreed to experiment with a sound system tendered by the American Telephone & Telegraph Corporation. Almost magically, the tiny Warners became a profit-making colossus on the strength of a single hit film, *The Jazz Singer* (1927), featuring America's most popular vaudeville/musical star, Al Jolson. But why Warner Bros.? Hampton provided no systematic answer. Lewis Jacobs did: Warner Bros. introduced talkies because it feared bankruptcy. The larger film industry concerns, Paramount and Loew's (parent company for MGM), shunned and at times actively opposed Warners' efforts. Again only because of *The Jazz Singer*, did Paramount and Loew's convert to sound. For Hampton and Jacobs the analysis is reduced to a David-and-Goliath narrative featuring the heroics of the Warner brothers.

Such an analysis fails to examine the complexity of the transformation. What firm or firms supplied the equipment and why? Didn't giants Paramount and Loew's eventually switch over to sound, and also generate huge profits? From our short local analysis of the changeover in Milwaukee, we are certainly skeptical about the ability of one film, *The Jazz Singer*, to alter the course of history. Were the vaudeville shorts, so popular in Milwaukee, used elsewhere? What was the timing of the sound transformation?

Using the theory of technological change, it is possible to analyze systematically the American film industry's conversion to sound in terms of the desire of the motion picture companies and the suppliers of the necessary inventions to maximize their long-run profits. The data for this study come from court records, motion picture trade papers, and corporate records.

The history of the invention phase of sound motion pictures begins even before the commercial introduction of the movies. In 1895 Edison's laboratory demonstrated a system for synchronous-sound motion pictures, but neither Edison nor his army of assistants could solve the vexing problems involved in the synchronization of sound and image. Ten years later, with the movies now a profitable and popular entertainment industry, dozens of would-be millionaires took up sound experimentation where Edison had left off. None, however, solved the fundamental problems of synchronization and amplification.[6] Typical was the experience of a French company headed by Leon Gaumont. In 1905, Gaumont recorded popular American vaudeville stars using his Chronophone

sound system and presented the resulting short films in U.S. vaudeville theaters. Technologically, the Chronophone was quite simple. A motion picture projector was linked by a series of cables to two phonographs positioned near the screen. Unfortunately the system frequently lapsed out of synchronization, and the primitive amplification system Gaumont employed emitted only muted and tinny approximations of the recorded performances. The Chronophone failed to attract large audiences on a sustained basis, and the scheme was finally dropped.[7]

In 1913 Edison boldly announced his laboratory had perfected a superior sound motion picture system. To its credit Edison's corporate laboratory had augmented the sensitivity of the recording microphone, increased power for amplification, and structurally improved the linkage between the phonograph and projector. Consequently the Edison Company was able to persuade the powerful Keith-Albee vaudeville circuit to try out the Kinetophone in four New York City theaters. On February 13, 1913, the premiere took place, with four entertaining shorts, including a lecturer smashing plates and "singing" (off-key) to demonstrate the tone and volume of the Edison device. However, after two week's run, it was clear to all involved that Edison Labs had not overcome problems of synchronization and amplification. Projectionists frequently failed to maintain the delicate balance necessary to preserve synchronized speech, nor could the Kinetophone eliminate the metallic sounds associated with the acoustical (pre-electronic) phonographs of that time. After several months of attempted innovation, Edison and the Keith-Albee vaudeville chain abandoned sound movies completely. Edison's withdrawal signaled the end to a decade of frustrated efforts by scores of other inventors/entrepreneurs.[8]

Work continued, however, among a handful of scientists who were attempting to develop a complete alternative to phonograph-linked systems through recording sounds directly on motion picture film, thus solving the problem of maintaining synchronization. In 1923 noted radio pioneer, Lee de Forest, demonstrated his Phonofilm system for the press. De Forest, not backed by a large corporation, tried to market his invention using only his own limited resources, and nearly went bankrupt funding a distribution network. Moreover, to raise backing he mortgaged his patents, and thus slowly lost control of that vital resource.[9] Technically, De Forest's system was hampered by an inadequate amplification apparatus.

Indeed it took the scientists and resources of the world's largest company, American Telephone & Telegraph (hereafter AT&T) more than ten years to perfect a satisfactory sound-on-film system. Working through its manufacturing subsidiary, Western Electric, AT&T engaged in sound-recording research because it desired sensitive apparatus by which to record and test the quality of long distance telephone transmission. Western Electric experimented with both traditional phonograph sound-on-disc and sound-on-film, and by 1922 they had developed a much improved loudspeaker, microphone, and turntable drive shaft. Labeled "electronic sound," these inventions produced a volume and tone

far superior to then conventional "acoustical" recording. In 1923 AT&T pondered how best to create a profit from these remarkable inventions. An electronic phonograph seemed an obvious possibility, but so did motion pictures with sound. To kick off a sales campaign, AT&T created several experimental short films, and began to approach members of the U.S. film industry.[10]

AT&T would eventually link up with Warner Bros., and later the Fox Film Corporation. In 1924 Warners was a small but growing motion picture enterprise that lacked the corporate muscle to challenge such industry giants as Paramount and Loew's. Warners sought help from Wall Street and eventually formed a liaison with a Wall Street investment banking house, Goldman Sachs. Quickly Warners and Goldman Sachs formulated a long-range plan to try to vault that movie company into a position equal to Paramount. Goldman Sachs established a $3 million-dollar revolving credit account with a consortium of banks to finance "prestige" big-budget feature films, and then floated a $4 million-dollar loan to improve studio facilities, acquire a small theater chain, and create a world-wide network for distribution. As part of the master design for expansion, Warners purchased a Los Angeles radio station. Through these radio dealings, Warners learned of AT&T's new sound recording technology. Needing all the comparative advantage it could muster, Warners incorporated the new technology into its plans for growth. The firm would continue to produce silent films, but, in addition, create more sales by recording the most popular vaudeville acts and offering them to exhibitors as low-priced substitutes for the stage shows then presented in all the best theaters in the United States. Moreover, recordings of the orchestral accompaniments for silent features would enable theater owners to save the considerable expense of paying a permanent group of 25 to 100 unionized musicians.[11]

It would take four years before Warners would reap substantial rewards from its scheme to market movies with sound. Paramount and Loew's expressed initial skepticism: "Talkies" had failed consistently for twenty years, why would they succeed now? Consequently, on June 25, 1925, AT&T gladly signed an agreement with "small-time" Warner Bros. calling for an undefined period of joint experimentation. Western Electric would supply the engineers and equipment, Warners the technicians and studio space. In the meantime Warners continued to supervise the other phases of expansion. By the end of the year the company had begun to produce its most expensive feature films to date, and had purchased a laboratory for film processing, more foreign distribution outlets, and a second radio station. Not surprisingly, Warners recorded a million-dollar loss in its annual report issued in March 1926. Historians have read this red ink as a sign of impending bankruptcy. In fact, Warner Bros., with Goldman Sachs' backing, had intentionally imposed a short-term loss to help construct the proper basis for greater profits in the future.[12]

By the spring of 1926 experiments with sound were going so well that all parties agreed to a permanent, long-term contract. Warners formed the Vitaphone Corporation to contract for and develop sound motion pictures. In turn

Western Electric granted Vitaphone an exclusive license, and agreed to manufacture the necessary apparatus. As the motion picture trade papers announced the new alliance, Warner shifted its strategy for innovation into high gear. It signed up stars from vaudeville, Broadway, and even the Metropolitan Opera. In addition, Vitaphone acquired the services of the New York Philharmonic to record the "incidental" musical music for silent films. Warner Bros. could now tender an exhibitor the most popular musical/vaudeville artists, albeit in the form of motion picture recordings.[13]

Warners opened the 1926–1927 movie season with its first Vitaphone show. Eight "Vitaphone preludes" replaced a typical theater's stage show. Initially, on that August evening in New York, the audience saw and heard film industry czar, Will Hays, congratulate Warners and AT&T for their pioneering achievement. The stage "illusion" was complete; Hays bowed at the end, anticipating the audience's applause. The New York Philharmonic followed with the "Overture" from Tannhauser. Conductor Henry Hadley also bowed as if "on stage." The six recordings that followed consisted of performances by op-

Jack Warner (right) with his less famous but more powerful older brother, Harry M. Warner, in 1945.

Quigley Photographic Archive, Georgetown University Library

eratic and concert stars. Only Roy Smeck, a vaudeville comic and musician, broke the serious tone of the evening. Warner Bros. remained cautious. No one could object to technological change that brought classical music to greater numbers of people. Vitaphone continued to make steady advances throughout the fall and winter months. The *Don Juan* program opened in Atlantic City, Chicago, and St. Louis. In October, Warners premiered a second package of shorts with the silent feature film, *The Better 'Ole*, at the Colony Theater in New York. These shorts, however, were directed at popular tastes. The five acts, which would have cost over $40,000 per week if presented live, included top vaudeville attractions, George Jessel and Al Jolson. The motion picture trade paper *Variety* predicted a bright future for an invention which could place that much high price vaudeville talent in a single theater.[14]

The central problem for Warners now became how best to develop the *long-run* profit potential for motion pictures with sound. As a first step in that direction Warner Bros. initiated an all-out sales campaign to convince exhibitors to install reproducing sound equipment. By April 1927 100 U.S. theaters could play Vitaphone shorts. However, AT&T, dissatisfied with what they perceived as slow progress on Warners' part, began to harass Vitaphone sales efforts at every turn. Eventually AT&T terminated the April 1926 agreement, paid Warners $1,300,000, and issued Vitaphone a *nonexclusive* license for sound. Warners had lost important leverage, but was now free to resume its slow and steady path for growth, including the innovation of motion pictures with sound. Vitaphone stepped up production of vaudeville shorts to five per week. A new package of a silent film with these shorts opened monthly, and previous packages, having completed initial long runs, moved to smaller markets and opened at popular prices.[15]

In addition, Vitaphone formulated plans for the following movie season, which began in September 1927. Feature films would contain "Vitaphoned" sequences. The initial effort, *The Jazz Singer*, filmed on Warners' newly completed Hollywood sound stage, premiered in October, but it was the inexpensive shorts (average cost about $15,000) that would provide Warners with a least cost method by which to experiment. Vitaphone first would try a new formula for motion pictures with sound as a short, and if response seemed positive, the programming innovation would become part of Warners' "Vitaphoned" features. For example, on December 4, 1928, Warners presented a ten-minute comedy short, *My Wife's Gone Away*, its first all-talkie story film. Later that month *Solomon's Children* opened; this all-talkie narrative film lasted nearly thirty minutes. (Both these shorts, usually ignored by the New York critical establishment, drew pointed praise in the *New York Times*.)[16]

Based on three years of growth and experimentation, financial success did come almost "overnight" during the spring of 1928. *The Jazz Singer* (and its accompanying sound shorts) gradually emerged as the 1927–1928 movie season's most popular box-office attraction. In medium-sized U.S. cities especially, where silent films rarely evoked enough drawing power to stay for more

than one week, *The Jazz Singer* package was held over for weeks, even months. In Charlotte, North Carolina; Columbus, Ohio; Reading, Pennsylvania; Seattle, Washington; and Baltimore, Maryland, *The Jazz Singer* continued to attract larger and larger crowds the longer it remained. Fortunately, Warners had the trained staff and sound stages to "instantly" react to this demand for talkies. Its experiments with vaudeville shorts guaranteed that. In fact, Warners' first all-talkie length film, *Lights of New York*, originated as a short subject, and was simply "stretched" to feature film length. Within one year, Warners' innovation of sound earned millions of dollars in profits. By 1930, the firm reached the zenith of the American film industry, in size and profitability, to rank along side Paramount and Loew's.[17]

This is the point at which most historical analyses of the introduction of sound cease. However, Warner Bros. was not the only innovator of sound, nor was AT&T the sole developer of a system for sound recording. Simultaneous

Left to right: Albert Warner (brother to Jack and Harry), exhibitor Moe Mark, Harry M. Warner, and exhibitor Moe Silvers pose before entering the premiere of *Lights of New York*, Warners' first all-talkie length film.

Quigley Photographic Archive, Georgetown University Library

with Warners' activities were the effects of the Fox Film Corporation, in particular its subsidiary Fox-Case. The inventions of the Fox system were based on the work of inventor Theodore W. Case and his laboratory. In 1917 this independently wealthy, Yale-trained physicist directed the creation of the Thalofide Cell, a highly improved vacuum tube. Spurred on by rival Lee de Forest's announcement of the Phonofilm, Case Labs turned all efforts to integrating the Thalofide Cell into a sound-on-film recording system. By 1923 Case could boast of an improved microphone, recording apparatus, and amplifier. Two years later, after learning of the AT&T–Warner Bros. alliance, Case tried to locate a motion picture concern to market Case Labs' sound system. Only by turning all rights over to Fox Film (predecessor to today's Twentieth Century-Fox) could Case contract an outlet. Fox, then a secondary member of the U.S. film industry behind Paramount and Loew's, was primarily interested in producing more "big-budget" silent films and expanding its chain of theaters. Moreover, initially, the movie company had to expend resources defending the fragile patent position inherited from Case, and contracting to use AT&T's superior amplification system.[18]

After the inauspicious beginning, Fox was at last ready to assault the marketplace. At first Fox tried to imitate Warners, and created popular vaudeville performances. Vitaphone commenced operations in June 1926; four months later, Fox recorded its first sound short. Production continued on an irregular basis throughout the winter. Then on February 24, 1927, in an attempt to seize the public relations rostrum from Warners, Fox staged a widely publicized press demonstration of the newly christened Movietone system. At 10:00 A.M. fifty reporters and photographers entered the Fox studio near New York's Times Square, and were filmed using the miracle of Movietone. Four hours later these representatives of the U.S. and foreign press corps saw and heard themselves as part of a special private screening. In addition, Fox presented several vaudeville sound shorts: a banjo and piano act, a comedy sketch, and three songs by a popular cabaret performer.

The demonstration worked! Favorable commentary flowed in from all sides. By then, however, Warners had cornered the market for vaudeville shorts by signing exclusive contracts with the most popular performers. Fox needed an alternative cost-effective marketing strategy. Fox reconsidered an earlier plan: newsreels with sound. Then it could provide a unique, economically viable alternative to Warners' presentations. Fox could cheaply move into a heretofore unoccupied portion of the market for motion picture entertainment. Furthermore, sound newsreels would provide a logical method by which Fox could gradually perfect necessary new techniques of camerawork and editing, and test the market at minimal cost.[19]

Fox moved quickly. On April 30, 1927, Fox Movietone News premiered at New York City's largest theater, the Roxy. Lasting only four minutes, patrons saw and heard cadets march at the United States Military Academy. Despite limited publicity compared to the February press showing, this earliest Movietone newsreel drew an enthusiastic response from motion picture trade papers and New York-based motion picture reviewers. Soon after, Fox seized on one of the most important symbolic news events of the 1920s. At 8:00 A.M. on May 20, 1927, Charles Lindbergh departed for Paris. That evening Fox Movietone News presented footage of the takeoff, with sound, to a packed house (6200 persons) at the Roxy theater. The throng stood and cheered for nearly ten minutes. The press saluted this new motion picture marvel and noted how it had brought alive the heroics of the "Lone Eagle." In June, Lindbergh returned to a tumultuous welcome in New York City and Washington, D.C. Again Movietone News camera operators recorded portions of those celebrations on film, and Fox Film distributed a ten-minute Movietone newsfilm to the few theaters equipped for sound.

The Fox system seemed to be heading down a propitious path. Quickly Fox Film wired all theaters in its growing chain. Movietone camera operators scattered to all parts of the globe. They recorded heroics of other aviators, harmonica contests, beauty pageants, and sporting events, as well as the earliest sound film statements by public figures such as Italian dictator Benuto Mussolini and Arctic explorer Admiral Richard Byrd. Newspaper columnists, educators, and other opinion leaders hailed these latter short subjects for their educational value. In addition Fox established a regular pattern for release of Movietone newsreels: one ten-minute reel per week. It also hired on a permanent staff of camera operators and laboratory employees, and developed a world-wide network of stringers.[20]

Warners was still ahead of Fox when the spring of 1928 arrived and talkies became the newest fad of the 1920s, but Fox continued to move quickly. Before 1928 Fox-Case had released only one silent feature film with a recorded score, *Sunrise*. Boldly, Fox declared that *all* future products would be completely "Movietoned." Fox could film and record out-of-doors where Warners' disc system required studio conditions. Fox even made enough money from its sound newsreels to offer Warners a challenge in the arena of vaudeville shorts. By 1929, based on its successful innovation of sound through newsreels, and its expanded network of distribution and exhibition outlets, Fox Film neared the peak of the U.S. film industry, a climb only rivaled by the other innovator of sound, Warner Bros. The innovation stage for sound was now finished.[21]

Here the analysis of technological change should proceed to the diffusion phase. For brevity's sake, we will provide only a summary of that analysis. At first the largest firms, Paramount and Loew's, were very skeptical. They had the most to lose. Quietly they studied the efforts of Warners and Fox. When long-run profits seemed assured, both signed with Western Electric (on May 11, 1928). Once the decision was made, the actual switchover occurred rapidly and smoothly. The giant firms had learned a great deal from Warners and Fox, and had formulated elaborate contingency plans. Moreover, profits proved so much greater than expected that no time was lost fueling a maximum effort. Within fifteen months (by September 1929) the full transformation to sound

had been completed. Hollywood would subsequently only produce talkies. The result was greater profits than any time in industry history. AT&T prospered because of royalties; the large theater circuits (which were wired for sound first) grew stronger; and Paramount and Loew's, joined by Warner Bros., Fox, and the Radio Corporation of America-sponsored Radio-Keith Orpheum, now formed the U.S. film industry's "Big-Five" companies. This corporate structure, shaped by technological change, would remain intact until the 1950s.

RETHINKING THE ECONOMICS OF TECHNOLOGICAL CHANGE

This brief case study illustrates the cogency of the economic theory of technological change in specifying some of the most important factors involved in technological change in the capitalist film industries. The primacy given long-term profitability as a determining factor by this approach seems justified in light of (1) the size and complexity of the American film industry by the 1920s, and (2) the relative cost of even the most basic film technology.

Individuals still have a role to play in the historical analyses generated by this approach, but the great men of previous accounts (Edison, Gaumont, Case, de Forest, the Warners and others) should be seen as operating within constraints defined by economic forces. De Forest's failure to innovate the phonophone sound system was based to some degree on unsatisfactory amplification but also his inability to compete in a technological marketplace dominated by powerful corporations. The Warner brothers emerged not as free-wheeling moguls heroically saving their company from bankruptcy, but as able administrators of a corporate enterprise, obeying the demands of a pregiven economic system. By defining technological change as a tripartite process—invention, innovation, and diffusion—the economic theory of technological change broadens the scope of historical analysis to include not just the historical moment of technological discovery but the events leading up to and following from it as well.

The effectiveness of the economic theory of technological change is greatest when applied to commercial filmmaking in capitalist economies. It is here that the fundamental axiom of the approach—that firms take whatever measures necessary to assure the greatest long-term profitability—is most clearly in operation. However, if the danger of reductionism is to be avoided, even in such "classic" cases as the advent of sound, several complicating factors must be kept in mind.

First, some technological change originates in institutions for which profitability (in a strictly economic sense) is not a motivation; the primary modern example being the state. As we shall see in the case study in Chapter 9, the invention and innovation of certain pieces of technology necessary for what was to become cinema verité filmmaking resulted from certain military needs during

and immediately following World War II. This is not to say that the technological interests of the government and those of private industry are necessarily distinct. One of the primary justifications for the American space program has been the adoption of many of its inventions by private corporations—from the silicon chip to freeze-dried food. In fact, the historian of technological change must always keep in mind that the introduction of a new product or process can have uses and consequences not intended or foreseen by those responsible for it. For example, the original Edison phonograph, patented in 1878, was developed as a business dictating device, and it took nearly a decade for it to be used for popular entertainment.

Furthermore, economic decision making does not occur in a vacuum; corporations operate within societies, and are subject to accepted norms and values when making any decision, including those having to do with technological change. Thus interacting with the economics of technological change is what we might call a sociology of technological change. In the realm of consumer goods and services (of which the movies are a part) in capitalist societies, the "marketability" of a new product or process is another way of describing the perceived social utility of that product or process. Would people in 1927 spend their money and time attending sound films rather than or in addition to listening to the radio, attending sporting events, or buying phonograph records? In other words, is there a social need for the new technology? Some would argue that technological change in capitalist economies is not only a response to a perceived social need, but is also the manufacture of a perceived need through advertising, which can then be conveniently "met" by the new product or service. It is in this context that the more general discourse on technology at any particular historical moment becomes important.

As pointed out in Chapter 3, the American fascination with technology around the turn of the century certainly conditioned the public response to the movies, not to mention subsequent historical discourse on the movies. If part of technological change is the production of ideas (recalling Mansfield's definition of invention), then we need to include in the notion of technological change the production of ideas about technology and technological change itself.

A French scholar, Jean-Louis Comolli, has tried to do this. Writing from an avowedly Marxist perspective, Comolli calls for analysis of technological change in a broad context.[22] For his wider perspective Comolli identifies the interaction of two types of social forces—the ideological and economic. Cinema is the mutual reinforcement of an ideological demand "to see life as it is" with the economic forces of profit maximization. For the ideological component Comolli argues that machines of cinema (projectors, lens, cameras, and so on) are not neutral objects meant to reflect a true view of the world. No, inventors and innovators of all forms of technology, including the cinema, have created machines in terms of how they knew and understood the world. That is, technology change was (and is) influenced by the ideas and beliefs about the world and how it works.

For Comolli technological film history (indeed all types of film history) is dialectical in form. Rather than a single linear progression, history is a plural series with neither origin nor end. An ongoing process, history has a plurality of beginnings, a series of points which may even be contradictory. It is not possible to single out one event or one "invention." For example, Comolli "deconstructs" the origin of the cinema into a scattered series of events that go back many centuries. According to him, all necessary knowledge for cinema was available some fifty years before the actual films were presented The pressure to display cinema in the 1890s came about because of the confluence of ideological demands to (1) represent life in a certain way, and (2) economically exploit that power of vision. The knowledge of technology was available before capitalists found a social demand to convert that knowledge into profits.

For Comolli change in capitalist cultures is measured in the Marxist terms of an unrelenting class struggle. This includes technological innovation and diffusion. Comolli rejects analysis based on evolutionary change, but instead seizes on those breaks or discontinuities in the innovation of new technologies. Such a view sees gaps, not the stages of a smooth evolution. For example, certain lens provide the ability to capture several planes of action, the arena of deep space. Filmmakers during the first decade of this century made use of this technique. With the coming of the factory-line Hollywood style, little deep space was utilized in films of the 1920s and 1930s. Only later were *Citizen Kane*, and other films of the early 1940s, hailed for their vibrant use of deep space. It is such gaps in the use of technology which Comolli finds at the core of technical change.

Comolli also downplays the role of the individual in the process of technical change. Individuals exist only in relation to ideology. Ideology is complex, coherent, and logical systems of images, ideas, beliefs, and actions by which and through which people live their daily lives. Cinema plays an important role in this representational system through which people encounter and deal with the material reality of their existence. For Comolli technology functions along with other institutions to link members of a society in a particular set of relationships. Technology is produced by and functions in an ideology. Consequently it has not ever been "neutral"—but neither is it determined forever by its past or present functions, for as social relations change, so do peoples' relationship with technology.

Comolli argues that cinema came about as people attempted to compensate for limitation of the human eye. The camera—first through still photography and then cinema—can be more objective and scientific. In the late nineteenth century cinema seemed to be human vision perfected. This belief was part of a larger system of beliefs that shaped the technological development of the cinema. The rhetoric by which great men were credited with the invention of the cinema lays bare this system of belief. For example, Edison was a wizard who created modern miracles. He was able to use science to "improve" the way we

could see. This scientific rendering was argued to be far superior to drawing, painting, sculpture, or human sight. The late nineteenth century belief was that science (here invention) had improved the human condition, but "science" for Comolli has always been part of the web of ideas and beliefs of how people know the world. Science adapted to capitalist needs. It didn't make the world necessarily better, only different. Historians should seek to understand this difference.

Edward Branigan provides a useful example of how Comolli, the historian, might deal with one particular "chunk" of the history of one particular technological change, the coming of color. With improvements in the camera, lighting equipment, and laboratory processing, it became possible in 1936 to make color films using lighting levels extremely close to the common black and white standards. Three years later, the Technicolor Corporation introduced a faster film stock that made possible further improvements. This meant that color could finally achieve techniques which until then were the province of black and white photography. Images could be softer, shadows better retained, and close-ups could be more precise. In sum, the result was that color became less garish and more natural.[23]

For Comolli this change would be seen as an illustration of technology acting to reinvest "realism" into color cinematography. Technological change, in this case, was responding to an ideological demand for "realism." The film industry could now achieve effects that black and white had built up as a preferable set of conventions. Technological change was pursued in order to achieve a certain use of visual codes. Color was not only more scientifically accurate, but it also was able to "repeat" the dominant forms of the culture. In this sense ideological historians argue the coming of color does not begin with the Technicolor Corporation or even hand tinting of early silent films. The coming of color begins with the Renaissance's interest in color and linear perspective. One must understand the use of color in other forms of communication and art before one can study the coming of color to film.

In sum, for Comolli technological transformation is important in the writing of film history only insofar as it can be related to ideological and economic change. Despite its importance and considerable explanatory power, however, Comolli's work, still in progress we should note, does contain several weaknesses in its present form. He seems to want to make "ideology" do more than it can. In its somewhat vague, undefined state, Comolli uses ideology to sweep all Western civilization into one concept. There are few specific classes or institutions to be analyzed. There are even fewer examples of specific historical analysis. Technology and ideology, unfortunately, seem to have become abstract, ahistorical concepts. Furthermore, Comolli's work, so far, suffers from inadequate evidence. He constantly criticizes the work of others, yet he takes up their terms, concepts, and even historical data. If Comolli is to truly overhaul technological film history, he cannot let others set the agenda, since the acceptance

of concepts and data necessarily leads to acceptance of fundamental assumptions. Comolli has provided a strong beginning for the reexamination of technological film; however, much fundamental work remains to be done.

NOTES

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3. Lewis Jacobs, *The Rise of the American Film* (New York: Teachers College Press, 1939), p. 505.
4. Edwin Mansfield, *The Economics of Technological Change* (New York: W. W. Norton, 1968), p. 50.
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10. *General Talking Pictures Corporation et al.* v. *American Telephone and Telegraph Company et al.*, 18 F. Supp. 650 (1937), Record, pp. 2488–2508; and Frank H. Lovette and Stanley Watkins, "Twenty Years of Talking Movies," *Bell Telephone Magazine* (Summer 1946): 84–95.

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14. *Variety*, August 11, 1926, p. 11; *Moving Picture World*, August 14, 1926, p. 1; *New York Times*, August 8, 1926, II, p. 6; *Koplar*, 19 F. Supp. 650, Record, pp. 1128–1130; *Moving Picture World*, September 18, 1926, p. 4; *Variety*, September 8, 1926, p. 1; *Moving Picture World*, September 25, 1926, p. 200; *New York Times*, October 8, 1926, p. 23; and *Moving Picture World*, October 16, 1926, p. 1.
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17. *Variety*, October 12, 1927, pp. 7, 11, 16; *Variety*, October 19, 1927, pp. 21, 25; *Variety*, November 30, 1927, p. 5; *Variety*, December 7, 1927, p. 36; *Variety*, March 21, 1928, p. 44; *Variety*, February 1, 1928, p. 18; *Variety*, April 4, 1928, p. 40; and *Variety*, April 18, 1928, p. 46.
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6

Economic Film History

As seen in the last chapter, questions of technical change in movie history have been inexorably intertwined with economic forces. When anyone raises the issue of business arrangements in film's past, the image of Hollywood and its riches quickly comes to mind: swimming pools, starlets, and multimillion dollar deals. Certainly few doubt that the American film industry has functioned as a business—albeit a nontraditional one with its production of value from sight, sound, and story. Consumers paid for, and then hopefully received, a pleasurable experience. Somehow the movie was created; somehow it got to one's local moviehouse or television screen. But who owned the movie companies? How were films distributed—then exhibited? And what effect did all this have on the development of motion picture history? This chapter will seek to develop ways to better understand how motion pictures—as a business and economic institution—operated in the history of cinema.

First, some definitions must be laid out. The movie business has always included three basic sectors: (1) production, (2) distribution, and (3) exhibition. Initially a motion picture must be created. Production has taken place in Hollywood proper as well as other southern California hamlets: Culver City (MGM), Universal City (Universal), and Burbank (Warner Bros.), all suburbs of Los Angeles. Indeed, during the 1930s few feature films made in the United States were shot outside a "Hollywood" studio. In recent years American filmmakers have created films throughout the world, but usually for Hollywood-based companies. These giant corporations (Warners, Twentieth Century-Fox, Paramount, Columbia et al.) have also handled the distribution (wholesaling) of