

# The Last Great Innovation: The Stereoscopic Cinema



Lipton

By Lenny Lipton

In February 2007, a sea change in perception took place. A full-page article in *Variety* magazine extolled the virtues of 3-D movies, and a few days later, an editorial in the *L.A. Times* stated that 3-D had to be taken seriously by the studios. Since then, a number of articles in the trades have discussed the stereoscopic cinema in positive terms. It has become the great hope of the industry after languishing for a century, primarily because recent 3-D movies are producing about three times the revenue of the simultaneously released 2-D version of films such as *Chicken Little*, *Monster House*, and *Meet the Robinsons*. In addition, Disney's *The Nightmare Before Christmas*, a 14-year-old film that had been in home release, was converted to 3-D and profitably theatrically re-released. Before February, in the trades and the popular press, the stereoscopic cinema was referred to with derision; it was a joke, to be dismissed. That is no longer the case. What has changed in addition to the better box office? In this article, I will attempt to provide a historical perspective with regard to technology introductions to the cinema, and explore the reasons for this recent change in attitude, with regard to the stereoscopic cinema.








The impact of technological change on the business and creative aspects of the motion picture medium is a huge topic and I can only skim the surface here (Table 1). In this article, I am trying to help the industry plan for the transition from the planar to the stereoscopic cinema. I've been designing stereoscopic display systems for over 30 years, and 5 years ago I wrote an article that appeared in the *SMPTE Journal*, "The Stereoscopic Cinema: From Film to Digital Projection,"<sup>1</sup> which described, in some detail, the system that is now being deployed internationally. The article described a projection process that used the ZScreen\* electro-optical modulator. It had to be improved to work to the high standards of the theatrical motion picture business, but it is more or less the same as that which had been shipping (for industrial virtual reality applications) by StereoGraphics, Real D's predecessor, for more than 15 years.

The motion picture medium is one of continual technology evolution. Television is an outgrowth of the movies and is the basis for digital cinema as it has developed—a curious looping-back on itself. From the earliest days of the movies, sound, color, widescreen, and 3-D were the subject of inventors' efforts and were explored for decades before coming to fruition and commercial acceptance. Edison's first experiments were with sound movies and attempts to achieve synchronized sound using a phonograph cylinder-like device. His assistant, William Kennedy Laurie Dickson, developed a stereoscopic movie camera, after he broke off from Edison.

Some of the earliest movies were hand-colored using stencils, or tinted and toned, and there is a long history of people attempting to develop color motion picture

\*The ZScreen is a registered trademark.

### Impact of Technological Innovation in Cinema

Technology	Major Intro.	Practical Impact	Artistic Impact
 Motion	1895	Required entirely new infrastructure to exhibit	Involved creation of new visual narrative techniques
 Sound	1927	Made both production and exhibition more complex and expensive	Shifted emphasis to dialog for storytelling
 Color	1935	Increased production costs, but did not affect exhibition	Extended palette for emotional expression
 Widescreen	1952	Increased both production and exhibition costs	Increased immersive nature of movie viewing experience
 3-D	1952	Imposed practical limitations during production and was difficult to exhibit properly	Was not sufficiently successful to significantly impact the nature of film narrative
 Digital Projection	2000	Requires initial investment, but is more reliable and simpler to use than film projection	Presents no obvious subjective difference to the viewer
 Digital 3-D Projection	2005	Requires initial investment, but is reliable and entails no special operator training	Increases immersive nature of viewing experience and expands emotional palette

*Illustrated table by David Kuntz and Ray Zone*

*Table 1. Major technology additions to the theatrical cinema. The history of the cinema is one of the visible jumps in technology while engineering effort in the background ceaselessly grinds on. Such improvements often provide the justification for a ticket price increase.*

systems. In fact, many of the people who worked on color, worked on stereoscopic cinema technology. It is a similar problem, because a number of channels of information require combining by the mind to produce the desired physical sensation.

The Lumières experimented with widescreen or giant-format movies in the early days, and the Fox Grandeur system in the 1930s is an example of a large-format widescreen process that was commercialized briefly. From its inception, inventors experimented with the improvements that are now commonplace, but the technology that has yet to become ubiquitous is the stereoscopic cinema.

Next, I'll draw parallels between the present introduction of the stereoscopic cinema and prior technology transitions.

### Sound

There are striking similarities between the introduction of sound and the introduction of the stereoscopic cinema. Both required decades of technology development initially requiring two synchronize machines; both required studio and exhibitor investment; both used similar business models for exhibition; both were introduced to the studios and exhibitors by outside business interests; both justified an increase in ticket prices; and both required a rethinking of creative filmmaking techniques such as production design, cinematography, production pipeline issues, and acting style.

The creation of a sound cinema required efforts by many inventors over a period of many years before commercial acceptance. It was eventually made practical by the

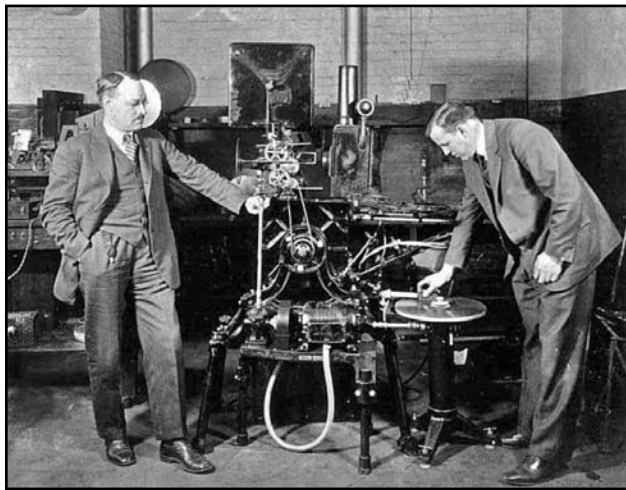


Figure 1. The Vitaphone system. Introduced in 1927, the Warner Bros. system used a phonograph synchronized to the projector. This is obviously a publicity still, because projectionists did not often wear three-piece suits.

combination of the vacuum tube amplifier and optical sound-on-film technologies. An early sound feature, *The Jazz Singer*, in Warner's Vitaphone system (Fig. 1) used a phonograph mechanically interlocked with a projector. The film had about two minutes of ad lib dialog and a number of synchronized songs and is often given credit for popularizing the medium. Its dialog came as a revelation and changed people's thinking about the potential of the medium.

When sound movies were introduced, ticket prices increased because exhibitors had to invest in a sound system. At the time, studios owned many theaters, so there was a linkage of business interests. It is reported from various sources that the cost of adding sound equipment was between \$10,000 and \$25,000 in the late 1920s—a lot of money at that time. In his book *The Speed of Sound*,<sup>2</sup> Scott Eyman writes: "To make the investment more palatable, Warners and ERPI (Electrical Research Products, Inc., a new subsidiary of Western Electric) offered to finance the investment if the theater put 25% down, with the balance to be paid over the next year, in addition to a 10-cents-a-seat tax each and every week."<sup>2</sup>

After the introduction of sound, some of what had been the basis of the silent cinema needed to be rethought. This reevaluation is a typical pattern that occurred with cinema technology introductions. Initially, there is a disruption in the artistic expression of the medium. In part, there are technical reasons for this disruption; artists, filmmakers, marketing people, and exhibitors also have to learn how to deal with the changes. It is the job of the actors, filmmakers, and creative technicians to shape and exploit each technological improvement. The silent cinema included pantomime, montage, and reading—reading

the title cards. It grew into its own stylized world of expression—as stylized as the Japanese No Theater.

At first, people in the industry believed that the new technology would be used for sound effects and musical soundtracks, because the silent cinema, never truly silent, used live musical accompaniment. Although it may be hard to believe from today's perspective, initially, filmmakers did not grasp that the medium belonged to filmed dialog for screenplays. Bosley Crowther, in his book *The Lion's Share*,<sup>3</sup> credits that insight to Irving Thalberg at Metro-Goldwyn-Mayer (MGM). Be that as it may, the potential of lip sync sound took time to absorb. It took time before the cinema returned to montage, because the need to film dialog taxed the capability of early equipment and, for one thing, limited camera movement. Cinema regressed momentarily to the proscenium arch composition of the early silent days, and the length of shots increased, pulling away from montage. In only a few years, from 1927 to 1930, a tremendous change took place. The crude first sound films are of interest mainly to historians of the medium, but the films of the early 1930s can be appreciated by a modern audience, because of their creative and technical proficiency.

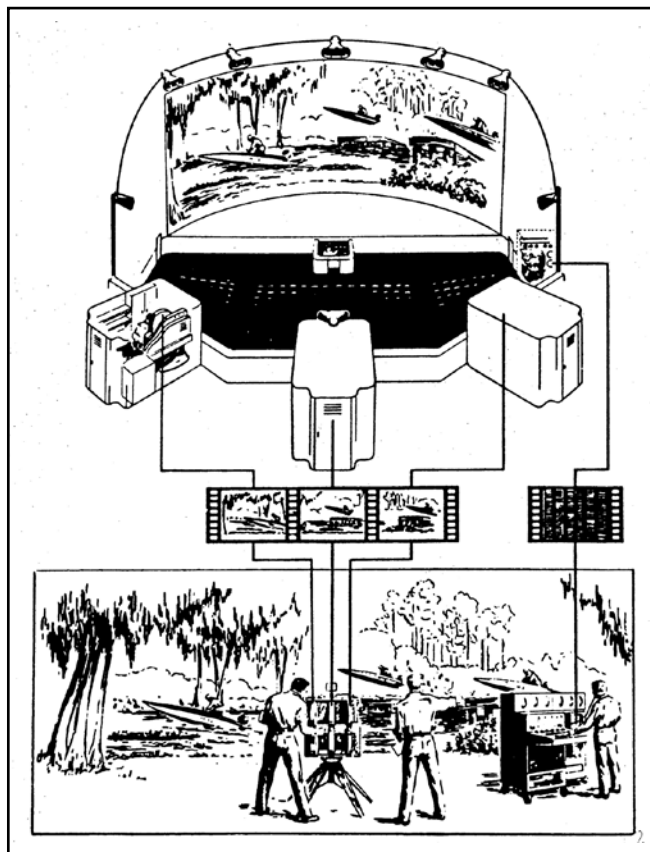


Figure 2. The classic Cinerama diagram. This graphic conveys the essence of the process from cameras to curved screen. Three projectionists, a soundman, and a technician were required to run the show.

## Theater Attendance and Stakeholders

Before World War II, the movie business grew in revenue as attendance climbed; however, after the War, and especially in 1948, there was a drastic reduction in attendance that has been attributed to the consent decree that divested the studios of their theater ownership, increased disposable income with additional entertainment opportunities after the end of the war, and the advent of television. Despite the decline in attendance that began in 1948, theater revenue has more or less climbed, because ticket prices have increased. This increase in price is attributable to inflation, special attractions, and the introduction of new technology.

What are the effects on the stakeholders in cinema technology changes? If we take a look at the introduction of sound, there was great risk on the part of the studios and the exhibitors because they had to invest heavily. The exhibitors, as mentioned, had to add sound playback, and the studios had to build soundstages. They had to buy new equipment and create a new production pipeline for producing sound films. As far as the public was concerned, the price of the tickets increased to defray costs.

The motion imaging industry has historically sought technology innovation to keep people going to the movies (along with star power, blockbuster productions, prizes, and double features). In the early 1950s, several technologies were tested on the public. One approach was to change the shape and size of the screen, and another was an attempt to introduce the 3-D movie.

## Scope and Widescreen

The competing technologies in the early 1950s were wide aspect ratio projection, giant screens, and 3-D. For example, Cinerama used three projectors and a sound playback machine to project on a 150° arc screen with stereophonic sound and was installed in a limited number of theaters (Fig. 2). 3-D was added to neighborhood theaters by using the two projectors that had been required for changeover, now repurposed to be used as right and left machines. About 50 films were shot in the early 1950s, but many were never released in 3-D because of projection problems. It was too hard to synchronize the two machines.

CinemaScope prevailed in the 1950s, because its movies could be projected by adding a new lens to the projector (and a bigger screen), rather than the multiple machines required for Cinerama or 3-D. The introduction of CinemaScope initially halted motion picture fluidity. Suddenly, cutting slowed down and film

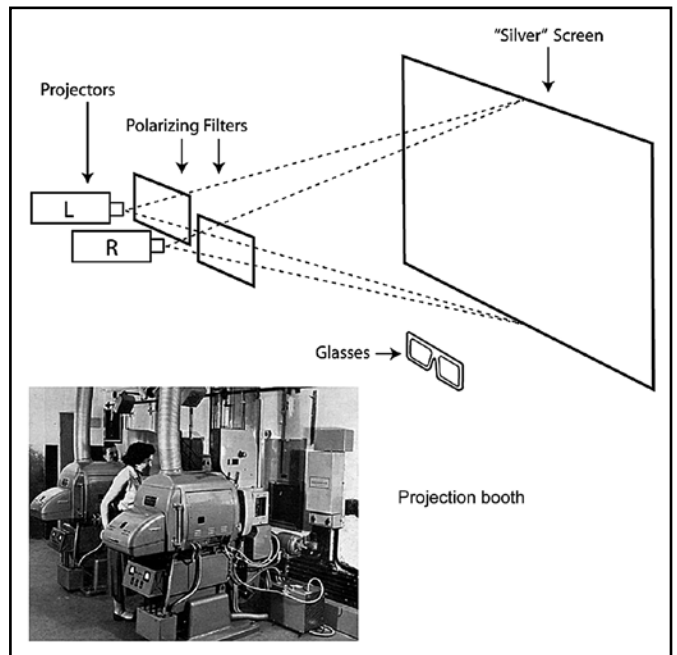


Figure 3. 3-D projection circa 1952-1953. The polarized light method was used with filters over the left and right projectors. A so-called "silver" screen was required. Projectors used for changeover were pressed into service for 3-D.

composition became locked to the proscenium arch. The dynamism of the cinema was lost for a short period of time until filmmakers adjusted to the wide aspect ratio. CinemaScope's introduction required additional cost in production and in release prints because they had, at least in the beginning, magnetic soundtracks. Exhibitors also had to put in new screens, buy new lenses, and install a new stereophonic sound system. In addition, the audience had to pay more because all Cinerama and many CinemaScope movies commanded roadshow prices. 3-D glasses cost about a dime, and this added to the ticket price for these movies at a time when matinees were a quarter.

Today, all movies are shot in a wide aspect ratio. The Edison aspect ratio of 1.33:1 is dead (except for analog TV and IMAX). Whether it's 1.85:1 or 2.4:1, films in theaters are projected wide, and just about all movies are in color and have sound. When a new technology is successfully added, there is no going back. Will this be true for the stereoscopic cinema?

## Color

Color had a long gestation period and an interesting history. It took a long time for color to prevail; however, seeing a movie today that is not in color is the exception. Just to scratch the surface, there were early two-color systems that had multiple-lens projectors and also duplitzed prints that sandwiched two pieces of film

together, but these were not practical solutions. A two-pronged problem had to be solved: How to capture good quality and pleasing full-color images, and how to make relatively low-cost good quality prints for distribution.

For the studios, color was a significant investment, especially when the Technicolor photographic and printmaking process had a virtual monopoly on the technology for three decades. In passing, I can tell you that in doing research for this paper, I discovered that at one point in the 1920s, the Technicolor brand had a pejorative connotation. It wasn't "glorious Technicolor;" it was, "Hey, that's lousy color." It's fascinating, the way the perception of color as a quality medium and the connotation of the word "Technicolor" have turned around. Perhaps there is something to be learned from this experience with regard to the present change in perception of the stereoscopic digital cinema.

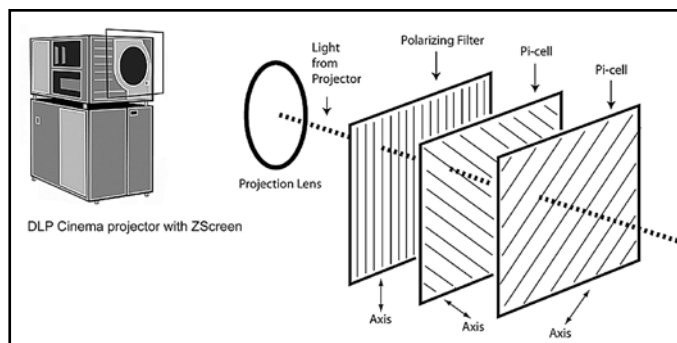
Now that color technology is, as they say, perfected, Eastman Kodak or Fuji film will run through a camera that's the same as one that can be used for black-and-white film, and the prints will run through any unmodified projector. Color is interesting because exhibitors have been able to use the same projectors and screens that were already being used, with no upgrade expense. But the studios and distributors made a major investment in color photography and prints. Color films often commanded a premium at the box office in the early days of its successful introduction. Interestingly, there is no difference today in the cost of making a color movie, compared with that of black-and-white.

### Two Machines in the Booth

Although not a perfect comparison, there is a pattern with regard to the introduction of new motion picture technology and that of the current stereoscopic medium. At first there is more than one machine in the projection booth. For example, the first sound system offered by Warner Bros. used a phonograph record that had to be synchronized with the motion picture projector. Cinerama used four machines, all of which had to be kept in interlock. The stereoscopic cinema in the early 1950s used two projectors, but none of these systems prevailed (Fig. 3). As long as more than one machine is required, we don't have a product that is suited to the realities in the projection booth.

### The Digital Cinema

For the past several years, the cinema has been undergoing a change from the silver-based 35mm infrastructure to a digital technology infrastructure. The digital infrastructure, an outgrowth of television and



*Figure 4. Digital 3-D projection. For the case of the Real D process (and most other modern 3-D projection systems) a single projector is required. Here, a ZScreen modulator switches the characteristics of polarized light at field rate. The ZScreen is made up of a linear polarizer and two pi-cells in optical series. The pi-cells switch on and off to create left- and right-handed circularly polarized light in synchrony with the left and right images.*

computer technology, falls into three areas: image capture or generation, post-production, and projection. Digital projection is in the early days of its introduction, and of about 135,000 theater screens worldwide, by some estimates, 4,000 use digital machines for the projection of feature films, practically all of which are based on the digital micro-mirror device (DMD) by Texas Instruments, as embodied in projectors made by Christie, Barco, and NEC-Ballantyne. As of this writing, 720 of these digital projectors, in 14 countries, are equipped to show 3-D using the Real D field-sequential polarization process. It is expected that this number will increase to more than 1,000 installations by November 2007, with the majority of installations in the U.S. It is reported that a small number of stereoscopic digital theaters in Europe use shuttering eyewear made by MacNaughton, and an unspecified number of systems using the Dolby wavelength selection process, an advanced form of anaglyph, are expected to be installed in time for the release of Paramount's *Beowulf*, directed by Robert Zemeckis. One could make the case that 3-D is the "killer app" for digital projection.

### The Stereoscopic Digital Cinema

Like all prior two-machine technologies, two-projector stereoscopic projection is problematical. It is difficult to project stereo using two projectors, even in theme parks. A successful outcome requires a dedicated staff, and it is best to have someone in the booth watching the movie while it is running. Based on my sample, after having visited most of the theme parks in Southern California, half of the time, the two-projector stereoscopic solution, whether film or digital, had significant projection errors—enough to spoil the enjoyment of the show.

The single-digital-projector system, based on the ZScreen, has made the projection of stereoscopic movies more dependable (Fig. 4). The exhibitor is required to make an

investment in a new aluminum-coated so-called “silver” projection screen, as well as new equipment in the booth. It also means that studios have to invest in the additional cost of stereoscopic production. Cost can decrease, however, with experience and new developments, just as it did for color, sound, and widescreen.

The audience, which is the most important stakeholder, is paying more—another dollar or two to see a stereoscopic movie. What must be defrayed, or can become a profit center, are the costs of the upgrades to the theater and the 3-D eyewear. The audience can now see the highest quality stereoscopic projection in a neighborhood cinema, rather than a theme park. ZScreen projection, for example, is a repeatable single-projector process, and the same quality image in the laboratory screening room is what is seen in the theater.

### The Filmmakers

The future direction of the stereoscopic medium belongs to filmmakers, who have always been actively interested in adding the third dimension. Three-dimensional vision depends on what psychologists call depth cues, and most of these actually have to do with seeing the world with one, rather than two eyes. Cinematographers are experts at applying these cues to make the single-eyed cinema look deep. They do it with lighting, the moving camera, depth of field, proper choice of lenses, mist and fog, and other techniques. For them, the challenge has always been how to make the planar image look three-dimensional using extra-stereoscopic depth cues. The stereoscopic cinema—the cinema of two eyes—adds power to the cinematographers’ quest to create a three-dimensional world.

Stereoscopic filmmaking remains in its infancy, despite the fact that there have been attempts to perfect it for a century. What has been missing until now is the continuity of experience with which the talented cinematographers, directors, film crews, post-production supervisors, and other creative people in the industry will be able to explore the medium—an exploration that is happening at this moment. The disruptions that accompanied new technology introductions do not have to reoccur, because of the visual literacy of modern filmmakers. Part of my job is to work with filmmakers to help them make the transition, and the filmmakers are learning fast and teaching their teacher.

### Conclusion

The goal of this article was to show that major changes to motion picture technology create an economic opportunity for the studios and the exhibitors and a creative one for

the filmmakers. My motive for digging into this history is based on the fact that we are at another crucial inflexion point in the history of the cinema. Based on recent history and technology advances, there is reason to believe that the stereoscopic cinema may at last be accepted as part of the filmmaking armamentarium. It is my hope that by paying attention to historical precedents, people in the industry will be able to work together to make this transition both minimally disruptive and one of creative growth.

As always, we await the unknowable future, but I will make a prediction: It is my expectation that the stereoscopic medium will help re-invent the cinema. My hope is that this is not just a renaissance of the stereoscopic cinema, but also a renaissance of the cinema. Ultimately, it is the filmmakers who will explore the three-dimensional cinema’s potential and shape it in ways we cannot now predict or envision.

### Acknowledgments

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### The Author

Lenny Lipton, the father of the electronic stereoscopic display industry, has been granted more than 30 patents in the field. He received an award from the Smithsonian for this invention of CrystalEyes, the dominant product for desktop stereoscopic displays for 20 years. He invented the ZScreen, which is the basis of the Real D cinema system deployed in 14 countries. Lipton is currently the CTO of Real D. He has written four books, including *Independent Filmmaking* and *Foundations of the Stereoscopic Cinema*. He wrote the words of the song “Puff the Magic Dragon;” the picture book version is the number one selling children’s book in the U.S. Lipton has traveled on behalf of the U.S. Department of State as a cultural liaison. His film work has been exhibited at the Tate Liverpool Museum and the Whitney Museum of American Art and is collected in the Pacific Film Archive of the University of California. Lipton resides in Los Angeles with his family.