Film-Tech

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FILM NOTES FOR THE REEL PEOPLE

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A TECHNICAL SERVICE FOR FILMHANDLERS FROM EASTMAN KODAK COMPANY

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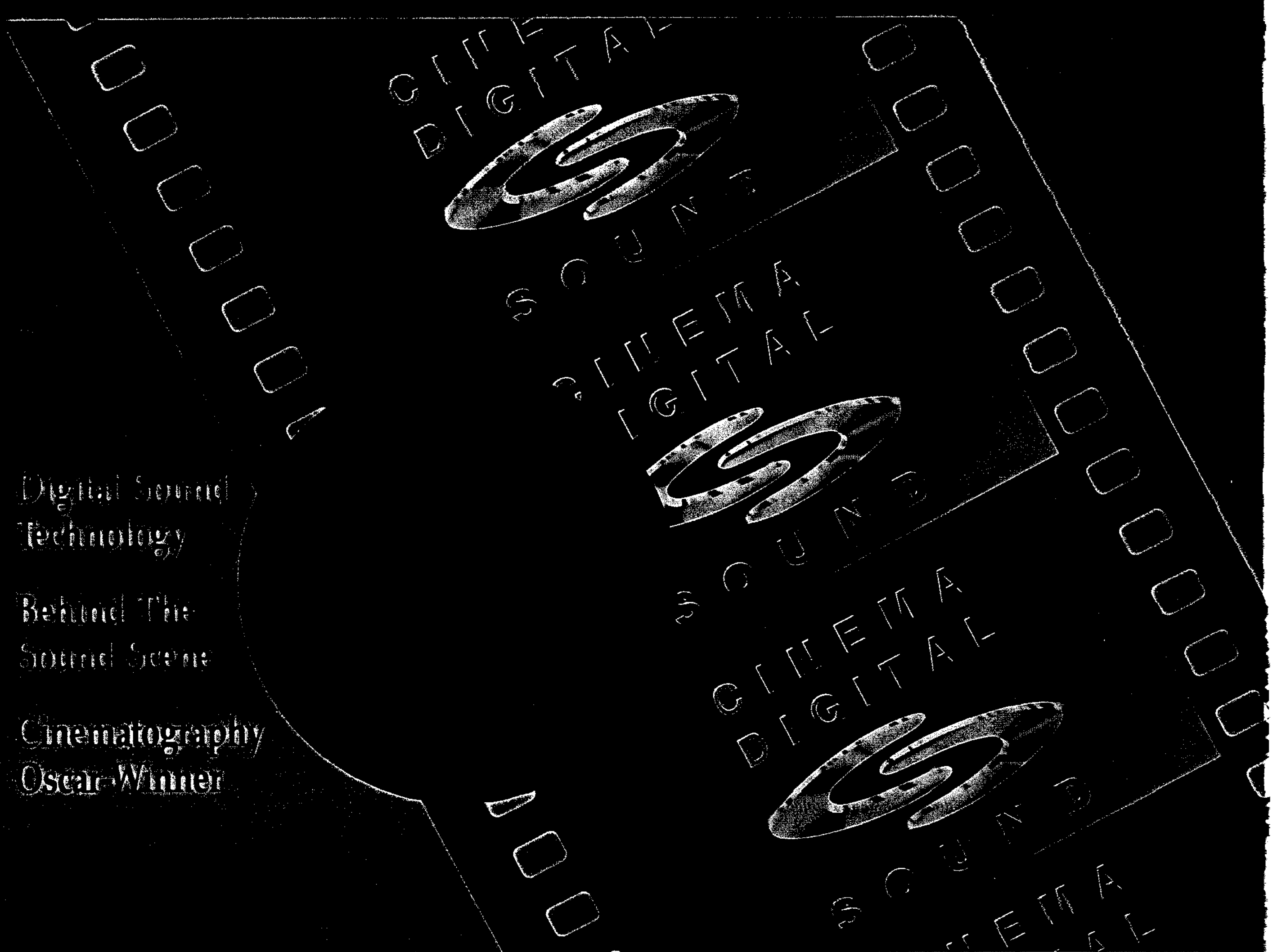

CINEMA DIGITAL SOUND

Digital Sound Technology

Behind The Sound Scene

Cinematography Oscar Winner

FILM NOTES FOR THE
REEL PEOPLE
A TECHNICAL SERVICE FOR FILMHANDLERS FROM EASTMAN KODAK COMPANY

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EDITOR'S MAILBOX

I worked for many years as chief projectionist at the Montecito Theatre in San Rafael. As it has happened to many single-screen theatres across the nation, it was closed and demolished. The plex's have taken their place.

As Business Agent for Local 811 over the years, I have found your "Reel People" publication so very helpful for the old pros and the new upcoming professional projectionists we have in training to keep up with our manpower demand.

I would like to continue to receive "Reel People," so as to have a complete and ongoing library for our members. How would you suggest that we might obtain back copies for the last three or four years plus being put on your current mailing list for future issues?

I personally would appreciate hearing from you. Thank you for your time and interest in improving film presentation.

Sincerely,
George B. Allan, Business Agent
Local 811, Marin County

As a projectionist with 20 years of experience, I would like to make a suggestion for a better presentation in theatres that use 6000 ft. reels and the platter system. The use of blooping tape on all splices will stop the pops that come through the sound system on all snipes and trailers.

I enjoy Reel People very much.

Very truly yours,
Robert W. Keene

I read with great interest the article that described the evolution of the film platter and the xenon technology that makes this device possible. While the xenon lamp is the current pinnacle reached in projection lighting, I would hesitate to call it actually *better* than carbon arc lighting. Mr. Shubert cites problems with carbon arcs such as flickering and color change. Any modern arc lamp which is properly maintained does not do this. In terms of the carbon arcs needing constant attention, we never had to adjust the lamps while they were in operation; we simply followed the manufacturer's instruction book. Mr. Robert Endres, director of projection at Radio City Music Hall, once told me that the only reason that the Music Hall retired their arc lamps was because replacement condensers were no longer available. He praised the extremely flat field that only a condenser style lamp could provide.

I cannot recall the "good old days"; I'm 32 years old and realize that companies are run on dollars and cents, not sentiment. But I do think that sometimes our industry fails to recognize that often what we call improvements are just steps to economize. There *is* a difference. If a Strong Super Trouper Xenon is the state of the art, for example, but my Hall & Connolly spotlight built in 1936 is brighter, better balanced, and provides more features, then I ask what is really the state of our art?

Peter Askin

Editor: Our supply of back-issues is mostly exhausted because we disseminate our over-runs at the major exhibitor conventions. Kodak is planning to reprint the popular Film Notes for the Reel People Collection *within the next few months. We will announce its availability in an upcoming issue of* Film Notes for the Reel People. *Stay tuned!*

If you have a ***Letter to the Editor*** please send to:
Editor
Film Notes for the Reel People
6700 Santa Monica Boulevard
Hollywood, CA 90038

BEHIND THE SCENES WITH CINEMA DIGITAL SOUND

Eastman Kodak Company and Optical Radiation Corporation have co-developed a multiple-channel digital sound system for theatrical films. The system features six discrete channels of digital sound, plus a control channel for automating numerous aspects of in-theatre operation. The new sound system was introduced to hundreds of Hollywood insiders May 3rd at the Screen Directors Guild.

The following are excerpts of an interview with Joerg D. Agin, Vice-President and General Manager of Kodak's Motion Picture and Television Products Division, and Richard D. Wood, President of Optical Radiation Corporation, providing a behind-the-scenes look into the evolution and potential ramifications of this co-venture.

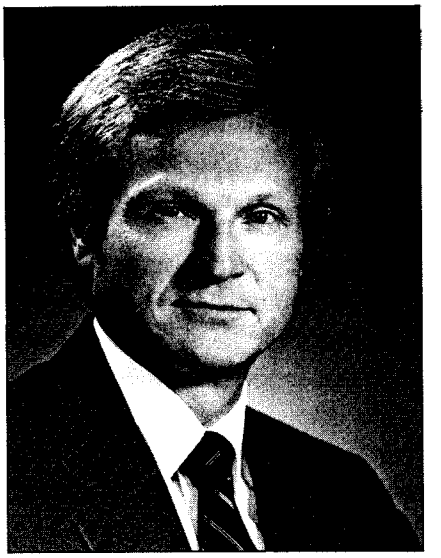
Q: How did Kodak and Optical Radiation become involved in the co-development of a new audio technology for theatres?

AGIN: Kodak has been involved in research and development for enhancing theatrical sound since 1928. The company's first office in Hollywood was staffed with engineers and scientists who resolved technical problems related to ushering in the age of "talkies."

In 1932, we made the first high-quality sound film especially designed to optimize audio quality. Since then, we have always had active research and development programs designed to improve the theatrical experience by improving sound. During the early 1970s, Kodak scientists adapted the Dolby noise reduction system for stereo sound applications with movies. It has been evident for some time that analog sound was reaching a point where it would only be possible to make incremental improvements. Digital sound, however, offers unlimited possibilities for dramatically improving sound quality. It also provides many options for computerizing control of theatres.

Several years ago, we presented a technical paper at a conference of the Society of Motion Picture and Television Engineers describing the research we were doing with digital sound. Soon afterwards, we were contacted by Optical Radiation, which made us aware of research it was doing which would accelerate the development of Cinema Digital Sound (CDS). It was a natural synergy.

WOOD: Optical Radiation has a division which manufactures and sells Century projectors as well as various specialized lenses and Xenon light sources for theatres. We received a technical achievement award from the Academy of Motion Picture Arts and Sciences in 1972 for work we did to enhance the brightness of images projected on theatrical screens. That's the equivalent of an Oscar for film industry vendors. Today we have thousands of projectors installed in every part of the world. We aren't the kind of company that waits for things to happen. There hadn't been any significant progress in theatrical sound for decades. We conducted an extensive study before deciding that multichannel digital sound was the wave of the future. Naturally, we were very interested when we learned that Kodak was working on the same technology. By combining our efforts, we have undoubtedly brought a better product to the marketplace faster.



Joerg Agin

Q: What were the biggest technical obstacles?

AGIN: There have been several previous attempts to use digital sound in theatres, and artistically, some of these have proven to be excellent. However, the approach that has previously been taken was to use double system sound. The digital sound was recorded and played on a separate medium, either a compact disc player or a digital video cassette recorder. A variety of techniques have been used to interlock sound with the projection of film. We felt that this method had great potential for special venue theatres, and perhaps for selected theatres for major theatrical releases. However, we didn't think it was practical for the vast majority of theatres because of the added costs and the potential for mechanical failure in synchronizing the sound source to the projector. The obvious solution was to see if it was

feasible to record the digital sound directly on the film. For practical reasons, we wanted to do this in the same place where sound tracks are currently recorded, because that would require the least amount of change in film production, postproduction and display.

However, that would require an ability to record and read a vast amount of information. By our calculations, we would need to read and decode approximately 5.5 million bits of information per second. You record digital sound by translating the analog voltage, representing the mixed audio tracks with composite dialog, effects and music, into binary format. Then you use light to write these columns of numbers onto the sound track area of the film while it is being printed.

The question we had to answer was whether our print films had sufficient resolution to hold that much information in the sound track area. We built experimental equipment for recording and playing back sound, and found that the error rate was within ranges that could be corrected with modern error detection and correction techniques.

WOOD: The integrated circuits that Cyclotomics, a part of Kodak's Federal Systems Division, has designed for this application are a key to reliability, since they replace many hundreds of parts which otherwise would have been required. The sound recorder and projector reader were designed around these integrated circuits. The custom electronics detect and correct errors caused by such anomalies as scratches and dirt on the print. They also eliminate flutter, which comes from slight variations in the speed of the film being transported through the projector.

Q: Why is Cinema Digital Sound being made available first in 70 mm format?

AGIN: It just makes good sense. The most discerning audiences already tend to go to these theatres because they are interested in superior image quality and an enhanced theatrical experience. The best first-run 70 mm theatres are already equipped with superior surround sound speaker systems which are compatible with Cinema Digital Sound. It will be a fairly simple and fast retrofit at an affordable price for those exhibitors. It is also a good way for us to showcase Cinema Digital Sound. The audio quality is equivalent to that of compact discs (CDs). I think that once audiences hear Cinema Digital Sound, they will look for it on marquees.

Q: What will Cinema Digital Sound cost exhibitors?

WOOD: For 70 mm theatres already equipped with high-quality surround sound speakers, the investment will be between $18,000 and $22,000. What this involves is retrofitting projectors with a sound head that can "read" the digital information encoded on the film, and a digital processor that is easily installed in the equipment rack. Incidentally, this will just be an added capability. They will still be able to use projectors to show conventional films.

Q: What kind of return can they envision for their investment?

AGIN: This is difficult to quantify, but there is good empirical evidence that when you enrich the movie-going experience, you increase admissions at the box office. We know that theatres equipped to project 70 mm prints typically draw larger audiences than those showing the same films in 35mm format. Many people feel that Dolby sound is an added attraction. We believe that Cinema Digital Sound is the next logical evolution in enhancing the theatrical experience. This is the ultimate in audio quality. It addresses the total range of our ability to distinguish between the softest and loudest sounds. The ability to direct sound to six different channels is complete, and distortion of sound caused by dirt or scratches on the film, or just by slight variations in the speed of the projector, is eliminated.

WOOD: There are other aspects that you have to consider. The control channel and time-code that we can digitally encode on the film present opportunities for automating projection booth and theatre operations. It also provides significant opportunities for enhancing the movie-going experience and for integrating special effects in the theatre with scenes in the movie. There are possibilities for synchronizing strobe lights in theatres with storm or disco scenes, for instance, and for using hydraulic controls to move seats in concert with images on the screen. The sensation of movement could be tremendously enhanced.

There are other economies. Currently, 70 mm stereo sound films have the audio recorded on a magnetic track. The sound is "read" by magnetic heads on the projector which come into close contact with the media. Eventually, these heads wear out and need to be replaced. There is no contact with the digital sound head, therefore we anticipate reduced head replacement and maintenance costs. In fact, both the digital sound head and the digital processor should be virtually maintenance free, especially compared to other equipment used in the theatre.

Q: How will this equipment be sold and installed?

WOOD: Optical Radiation has a network of dealers, worldwide. They will sell and install equipment. Many of them have already been trained to do so.

Q: When will Cinema Digital Sound be in theatres?

Richard Wood

WOOD: *Dick Tracy* is currently in release. We anticipate that several, maybe as many as three or four more films will be distributed in Cinema Digital Sound format at selected 70 mm theatres in major markets this year.

Q: How will the quality of sound differ from 70 mm Dolby sound?

AGIN: In every way that you can measure a sound system, Cinema Digital Sound is superior. It has a superior dynamic and frequency range, and there is virtually no noticeable harmonic distortion, flutter, hisses, pops or other noise introduced by the media or projection system.

We have measured the audio quality of a Cinema Digital Sound print after 1,000 runs through a projector, and there is no discernible difference compared to the first run. This guarantees that audiences will enjoy a superior performance even if they see and hear a movie at the end of its run. However, the most dramatic advances in sound quality will occur in 35 mm theatres.

Q: Why?

WOOD: There are significant improvements in every aspect of sound, including dynamic range, frequency range, harmonic distortion and channel separation. Current analog stereo systems only offer two discrete channels, plus two matrixed channels, which, in essence, are sharing the same sound. It will be like comparing the sound quality of a record player to that of a compact disc player. Then, there is the whole new dimension of using the control channel to automate theatre operations and to integrate visual effects created in the theatre with scenes in the film.

Q: When will Cinema Digital Sound be available in 35 mm format?

AGIN: This could happen as early as the summer of 1991. There is no reason why we couldn't deliver on the technology now. But, the question is when will there be enough titles available in this format for sufficient numbers of 35 mm theatres to invest in upgrading to Cinema Digital Sound. In order to realize the full advantages of Cinema Digital Sound, many 35 mm theatres will have to upgrade audio systems.

Q: What kind of costs will be involved?

WOOD: It is impossible to answer that this far in advance, because there could be advances in technology that will affect the answer between now and then. Also, we are looking at significant opportunities for economies of scale. There are some 90,000 motion picture screens worldwide. All of them are currently equipped to project 35 mm prints.

AGIN: When you combine the dramatic advances that have been made in motion picture film imaging technology with the availability of Cinema Digital Sound in 35 mm format, you can see where there could be tremendous breakthroughs in the dramatic intensity and entertainment values of movies. Advances in audio technology are just part of the picture. Last year, Kodak introduced the first members of a new family of "extended range" negative films that are sharper, finer grained and much more sensitive to light. These films are giving cinematographers more creative freedom for artistic interpretation. There also is noticeable improvement in image quality. When you combine that with superior sound, in terms of both audio quality and design, there are real opportunities for redefining the art form. Furthermore, you can do this from the perspective of both the filmmaker and the exhibitor.

Q: How will filmmakers be affected?

AGIN: There is an opportunity for them to rethink the way they design and use sound. The ability to have total silence in a theatre has awesome dramatic potential. That's a terrific way, for example, to focus the audiences' complete attention on the images without distracting hissing and popping noises. There are also opportunities to separate sounds coming from different speakers in ways that amplify the images. These are things that the creative community will interpret better than we ever will. You can also be more subtle in your use of sound, so you make the audience really listen. Then, there is the overall quality of sound which compares to CDs. We think that is essential today because of the way audiences are being conditioned. You don't want people to hear better movie sound on their laser disc players—as is the case today—than they can hear in the theatre. The theatre should provide the ultimate experience in seeing and hearing movies.

Q: How about the exhibitor?

WOOD: Cinema Digital Sound can be interpreted in all kinds of ways by exhibitors.

The industry has been thinking in terms of larger theatres with bigger screens and superior audio systems as the ultimate way to improve the movie-going experience. John Bonner, one of the industry's top audio experts, has suggested that we think in terms of much smaller, very posh theatres, equipped with outstanding projection systems, augmented by Cinema Digital Sound in an environment where all ambient noise is filtered out. There could be plush seats and gourmet food. Exhibitors following this route could offer a very intense movie-going experience at premium prices.

Q: How will the creative community be affected?

AGIN: We have been very careful not to impose any changes in the way movies are produced or edited. In fact, you could take any film that has been released and redistribute it in Cinema Digital Sound format. Audio quality can never be better than the master

recording, but in almost every case, the quality of theatrical sound will be closer to the master and far superior to anything we've heard in the past. I do think that directors and sound designers will find ways to take advantage of the capabilities that Cinema Digital Sound provides. It could be a powerful new creative tool. Even so, right through the sound mixing stage during postproduction, no changes or adjustments are required.

Q: Then what happens?

WOOD: We'll set up a special facility in Hollywood where the analog sound that has been mixed is converted to digital format and encoded to take advantage of the error detection and correction capabilities of the system. Control channel data will also be laid down on the sound film at this time.

Q: Who will operate this facility?

WOOD: Optical Radiation Corporation will probably do it, at least initially.

Q: How about capacity?

WOOD: That's no problem. Conversions are made in real-time, and you'll probably only need one or two sound films for the laboratory per picture. In fact, there is significant potential for saving time in the release of 70 mm prints. It is possible for us to break a bottleneck that occasionally restricts the number of 70 mm release prints that can be made on tight deadlines.

Q: How?

AGIN: Currently, 70 mm stereo prints have the sound recorded on magnetic tracks. It is a fairly cumbersome process. First, images are printed on the film. Then, the magnetic oxide is coated on the track area. That is done at a special facility, one print at a time. You have to wait 48 hours for the oxide to cure before sound is recorded, typically two prints at a time. Then, you have to listen to each print in real-time to verify quality. With Cinema Digital Sound, the sound film is used to encode the audio and control channel while prints are being made at high speeds. Quality assurance can be done visually, which means it can be mechanized. This will increase the capacity of laboratories to turn out more 70 mm prints faster.

Q: Will it affect the price of 70 mm prints?

WOOD: That will be up to the labs to decide. They are going to have to make some investment in upgrading film printers to lay down the digital sound and control channels.

Q: How does all of this mesh with high-definition television?

AGIN: Cinema Digital Sound bodes very well for the future of exhibitors. Sooner or later, there will be some type of high-definition television in homes which will allow people to see better quality images and hear higher quality sound. It is incumbent on the motion picture industry, including exhibitors, to enhance the movie-going experience. This is happening in many ways, including the advances we are making in motion picture imaging technology. When you combine that with the potential that Cinema Digital Sound provides for enhancing the theatrical experience, movies should have a bright and extended future. Even with HDTV in homes, I don't see the quality gap between the home-viewing and movie-going experiences narrowing in any meaningful way.

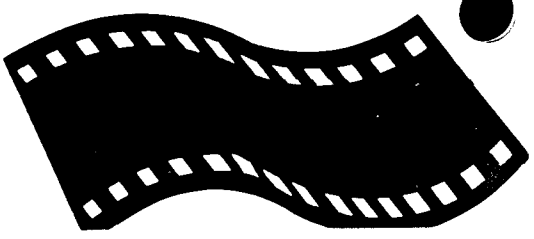
Q: How about electronic theatres?

AGIN: That's an interesting notion that Sony introduced nearly 10 years ago. Sony's idea was that savings could be realized by distributing electronic movies to theatres via satellite for video projection. This concept hasn't made much headway because it requires a tremendous capital investment on the part of the exhibitor, in the range of $250,000 to $300,000 per screen, and up to $800,000 for optimized video projection systems. Also, there is a tremendous difference in image quality. The introduction for movie theatres of a vastly improved stereo digital sound system, with additional digital control functions, opens an even wider gap. For a small fraction of the price of gearing up for satellite reception and video projection of electronic movies, exhibitors will be able to make dramatic improvements in audio capabilities, which will appeal to audiences. At the same time, they'll be able to automate many theatre operations.

Q: What's the outlook for exhibitors for this decade?

AGIN: During the 1990s, we will continue to enhance and improve film technology. By the end of the decade, we anticipate that an electronic intermediate system for motion pictures will be put into place. Kodak introduced that technology last fall. It will allow producers to convert analog images recorded on film into digital format for visual effects and other postproduction work. The output of that system will be high-resolution prints. At the same time, I'm sure that Richard Wood's company will continue advancing the state of the art of theatrical projection. And, we believe that Cinema Digital Sound will establish the standard for excellence in theatrical sound.

I'd say that the picture for exhibitors is very bright.



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RICHARD W. COOK: CINEMA DIGITAL SOUND AND THE FUTURE OF MOVIES

Just a few weeks after Cinema Digital Sound was introduced, *Dick Tracy* became the first theatrical feature released in the new audio format. Initial release was to just seven theatres in New York and Los Angeles. Following are excerpts of an interview with Richard W. Cook, president of Buena Vista Pictures Distribution, Inc., talking about the new digital sound technology and what he thinks it portends for the future of the industry.

"Before you ask, I think digital sound will revolutionize the moviegoing experience."

Q: How do you feel that Cinema Digital Sound enhances the theatrical experience?

A: Cinema Digital Sound provides another way for exhibitors to differentiate their theatres from other forms of entertainment. As home TV improves, we need theatres with bigger screens, brighter pictures, and the best sound—all of these elements contribute to enhancing the moviegoing experience.

Q: With improvements in home video technology, do you think people will eventually decide to stay home and watch movies?

A: I think the popularity of home video has done more to help the theatrical industry than anything else that happened during the 1980s. It made exhibitors more conscious of the need to improve the theatrical environment. At the same time, it has renewed the appetite for movies among people who had gotten out of the moviegoing habit. However, it has also made our patrons more demanding. When a movie comes along that provides a great theatrical experience they want to see it in a great environment. I don't see that scenario changing. As long as producers, distributors and exhibitors give the public a reason to go to theatres, they will go.

Q: That's not a bad segue into *Dick Tracy.*

A: Visually it is a dazzling movie. Digital sound adds to that experience. There is something special and unique about the way images and sound complement each other in this film.

Q: Was *Dick Tracy* produced with CDS in mind?

A: No. *Dick Tracy* had a unique sound track from the outset. But, CDS does add a new dimension. You can hear every individual sound clearly and distinctly. Since the digital sound track is much more durable than the magnetic sound currently used with 70 mm prints, the quality of sound will be consistent during the life of each print. That is important because we want every audience to enjoy the maximum theatrical experience, so they will want to come back to see the next movie.

Richard W. Cook

Q: What do you think will happen with Cinema Digital Sound during the 1990s?

A: I think it will become the standard. Once an audience hears it, they won't be satisfied with less. CDS will be comparable to the effect of CD's on the vinyl LP market.

Q: Can superior sound draw people to movie theatres?

A: In the beginning, Dolby sound attracted audiences. People are even more conscious of sound today because of the popularity of CD players. Our demanding theatrical audiences perceive sound to be an integral part of the moviegoing experience.

Q: It now seems fairly certain that some time during the next decade we will see some form of high-definition TV in homes with better image quality, wider screens and digital sound. What does that imply for the theatrical film industry?

A: Each advance creates more competition and therefore more incentive for producers and exhibitors to improve the theatrical experience. As high-definition TV comes on line in homes, I am sure we'll find ways to make the theatrical experience even more sensational. But, we don't have to wait for HDTV. Until recently home entertainment was a TV set. It wasn't large, and it didn't have great sound. Today, you can get digital sound with laser players in the home. We need to improve sound quality in theatres now, and it has to be better than the sound people can hear at home.

Q: Why are you confident about the future of the theatre?

A: When television came out, an exhibitor was asked if it would be the ruination of the industry. His answer? Every home has a kitchen, but people still go out to eat. I think there will always be something unique about being in a darkened theatre with other people, and sharing a communal experience that you can't get at home. As long as we preserve and advance the uniqueness of the theatrical experience, I will remain confident about the future of the industry.

Q: It will be interesting to see how the use of CDS evolves in the creative community.

A: Now that we can hear movies in digital sound, I think we'll see more and better use of digital sound recording, and more and better use of music. It will inspire the creative community to do some things differently. Script writers have to give some serious thought to this issue. CDS gives them a new dimension for storytelling. I am confident they will figure out how to use it to the utmost.

Q: With all of the competition for leisure time dollars, does the movie industry have any room to grow during the 1990s and beyond?

A: Box office admissions have not kept up with population growth in this country. They fluctuate around 1.1 to 1.2 billion tickets from year to year. Admissions depend on the quality of the product and the presentation environment. I'm very optimistic about the future and impressed by the many outstanding innovative filmmakers today. They have a vision of what movie could and should be like, and they are enjoying wonderful advances in technology to help them achieve their vision. However, production is only half the battle. The other half is a great environment for presenting films. By concentrating on high production and high presentation values, we'll draw audiences from a much larger demographic base. People who haven't gone to movies for years are coming back. Why? Because those things that drove them away are being eliminated. I think exhibitors are paying more attention to their audiences. Theatres overall are becoming comfortable. Patrons' feet aren't sticking to the floor anymore. Theatres are enhancing presentation values as they feel the competition from home video/audio technology. I believe during the 1990s we will see the audience come back to theatres in a major way. If we do things right, I believe we will see a major increase in the size of audiences.

Q: What about other parts of the world?

A: As the multiplex concept catches on overseas I expect to see an increase in admissions. If you see one picture you want to see another picture. It's contagious. That's the wonderful part of our business. If people like what you do, they want to see more. The size of the audience is elastic. It will expand to accommodate good movies. Of course, there are limitations imposed by the number of screens available, but I'm not sure if there is an outer limit in terms of how many good movies can succeed at one given time. If there are four or five pictures that people want to see, they'll go to the movies four or five times. If there is only one picture that appeals to them, they'll go once. I do not think foreign moviegoers differ from Americans in this regard.

Q: Let's get back to Cinema Digital Sound. Do you recall your reaction when you first heard it?

A: Having followed its development for some time, we felt a lot of anticipation. From experience, we also knew the difference between CD sound and analog sound. The first time I actually heard it was a demonstration at the Directors Guild of America. The clarity was spectacular. Every note, every sound, every piece of dialogue was individually distinguishable. The realistic sound made everything more true to life. CDS puts you in a great moviegoing environment.

Q: Different people notice different aspects of CDS. Many people are amazed by the absolute silence you can create by eliminating ambient noises caused by anomolies on the print or by the projection system.

A: The absence of sound can have as great an effect as sound itself. Absolute quiet creates a sense of anticipation. It is a great new tool for writers and directors.

Q: Other people talke about the ability CDS provides for traveling sound around a theatre.

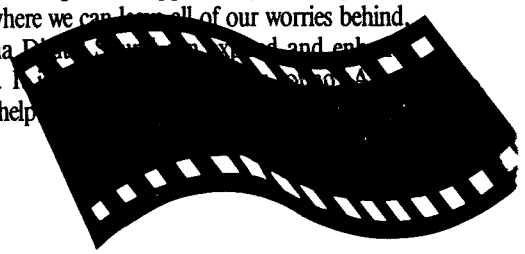
A: If you can control the direction of sound, it can change everything...the script, the kinds of movies you make, camera work, sound recording, everything.

Q: Do you see a creative renaissance going on?

A: There are some marvelous filmmakers out there. Bob Zemeckis, Martin Scorsese, Steven Spielberg and Warren Beatty, to name just a few of the people who are bringing a new vision to movies. All of these people are willing to take some real chances. That is the only way you can stretch the art form. Otherwise, they would all be making the same movie the same way.

Q: It seems like we need movies now more than ever.

A: Absolutely true. Movies give the opportunity to escape and temporarily enter a world where we can leave all of our worries behind. A development like Cinema D[illegible] and enhance the moviegoing experience. [illegible] with other advances, it will help



CINEMA DIGITAL SOUND BUILT ON FOUNDATION OF PROVEN TECHNOLOGIES

Cinema Digital Sound is built upon a foundation of proven technologies which have been customized and optimized to create an ultimate audio experience for motion picture audiences.

Perhaps the most impressive features of the new format may be appreciated when comparing digital sound with its analog and magnetic predecessors.

The most important improvement of digital sound is the expanded frequency range from 20-20,000 Hz on digital. The low frequency adds a reality and power to the sound sensation and the expanded high frequency creates a more natural reproduction for realism in the movie.

Howard J. Flemming, program manager for Optical Radiation, and Ronald E. Uhlig, group leader in electronic development for Kodak's Motion Picture and Television Products Division, discuss the technologies of Cinema Digital Sound. Cinema Digital Sound requires

Continued on Page 10

The following chart compares the major system specifications.

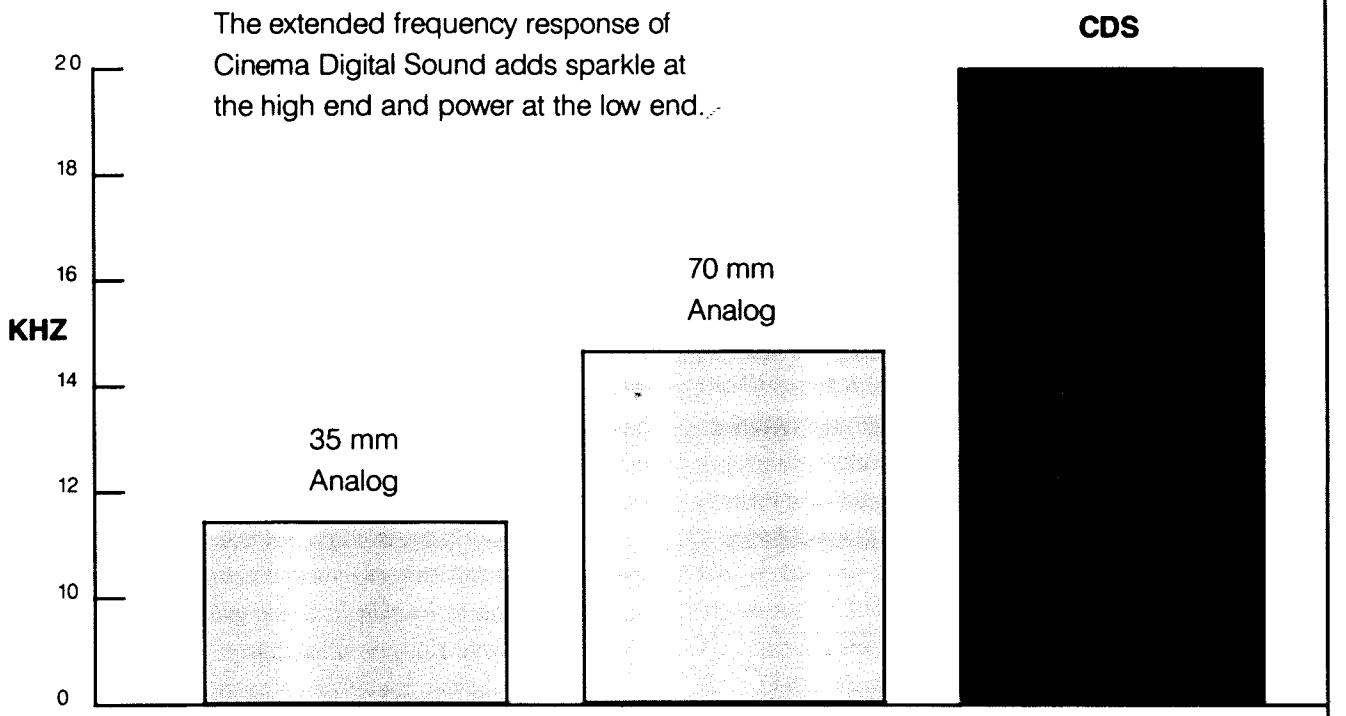
MOTION PICTURE SOUND SPECIFICATION COMPARISON

FEATURE	35 mm "ACADEMY" OPTICAL SOUND	35 mm *DOLBY* STEREO OPTICAL SOUND	70 mm *DOLBY* MAGNETIC SOUND	**70 mm CINEMA DIGITAL SOUND**
Number of Channels	1	2 matrixed to 4	4 full-bandwidth 1 subwoofer	5 full-bandwidth 1 subwoofer
Dynamic Range New Print Worn Print	 52 dB 44 dB	 59 dB 51 dB	 78-80 dB	 96 dB 96 dB
Channel Separation	NA*	12-49 dB	50 dB	100 dB
Frequency Range	30-6,300 Hz	40-12,500 Hz	30-14,500 Hz	20-20,000 Hz
Total Harmonic Distortion	1-7%	1-7%	3%	0.01%
Control Channel	None	None	None	MIDI
Synchronization Track	None	None	None	SMPTE Time Code
Film ID Information	None	None	None	ID Data Fields

*Note: NA = not applicable

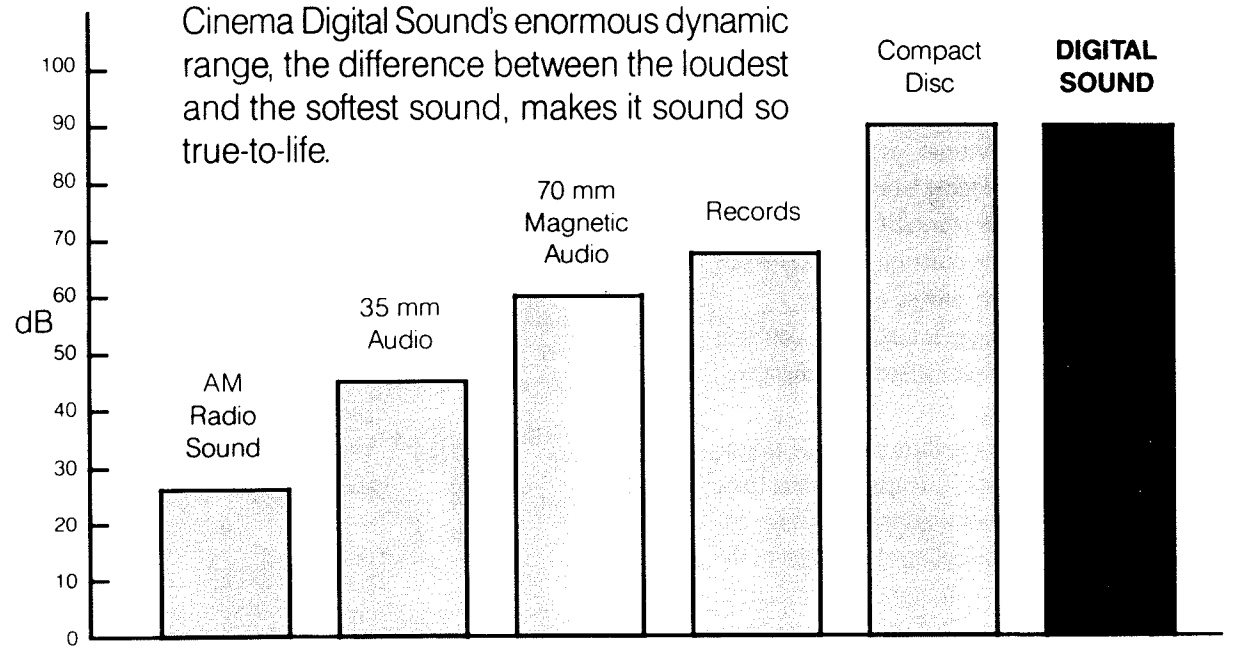
FREQUENCY RANGE COMPARISON

The extended frequency response of Cinema Digital Sound adds sparkle at the high end and power at the low end.



DYNAMIC RANGE COMPARISON

Cinema Digital Sound's enormous dynamic range, the difference between the loudest and the softest sound, makes it sound so true-to-life.



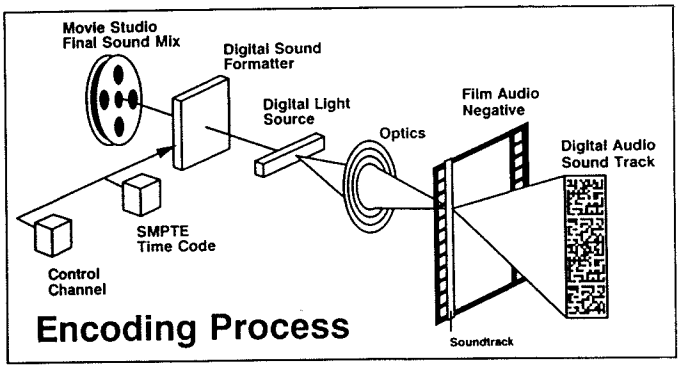
no significant changes in current techniques for producing and presenting movies.

"We don't anticipate any resistance to change, because very little is needed," said Ronald E. Uhlig. "There are no changes required during either production or postproduction."

Uhlig explained that movie dialogue is typically recorded in synchronization with the images on a quarter-inch magnetic tape. Sound effects, music and additional dialogue are recorded separately. In postproduction, it isn't unusual for a sound editor to composite 40 or more different sources of sound.

With Cinema Digital Sound, these different sources of sound can be divided into five full bandwidth channels and a sub-woofer channel. The latter is primarily used for low-frequency bass tones. In contrast, current 35 mm stereo sound systems provide two discrete and two matrixed channels.

After the various sources of sound are "mixed" and recorded on sound film, the latter is sent to a specialized facility for analog-to-digital conversion. There, the analog data is sampled—the voltage is measured many times per second—and converted to digital format.



The digital data goes through an electronic encoder, which formats it into rows and columns. An encoding technique, called interleaving, is used. The numbers which represent sound information can be placed anywhere and in any order on the film. When decoded, the data is played back in its proper sequence.

"The advantage of physical interleaving is that lost or damaged data can be easily reconstructed using simple mathematical averages," explained ORC's Howard J. Flemming.

In addition to the six discrete channels, there is a MIDI (Music Industry Digital Interface) control channel, a synchronization track containing SMPTE time-code (which puts a machine-readable address on each frame), and various identification fields, such as the film name, the date sound was recorded and similar information. The control channel can be used for booth and theatre automation and for synchronizing in-theatre special effects.

The audio samples and control channel are packaged into error correction blocks—which provide redundancy—to help ensure that any data obscured due to dirt or scratches on the print, or other reasons, can be recovered.

"You construct these blocks and string them together when you encode them onto film," Flemming said. "This burst error correction acts like a protective package around each chunk of data."

Burst error correction codes were selected because the kinds of flaws that can occur on film, such as scratches and dirt, are localized in nature, he said.

"This family of codes is uniquely designed to address this kind of problem," Flemming said. "However, it is thoroughly tested and proven—since it is related to error detection and correction codes built into many computer peripherals and large computer systems."

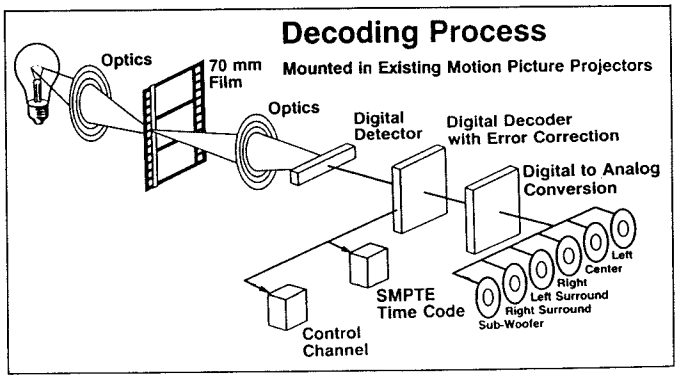
Digital sound and control channel data are recorded optically by writing with light on film. The Digital Sound film is exposed in real-time, using a proprietary light-emitting diode array. After it is encoded, the digital film is sent to a film lab, where the developed digital data and images are simultaneously printed with high-speed equipment onto color print film.

"The major change that labs will make is in retrofitting high-speed printers with high-resolution optical heads for encoding digital information onto print film," Uhlig said. "DeLuxe, CFI and Technicolor labs in Hollywood have already run successful tests."

In 35 mm format, the current area used to record the optical sound track print is wide enough to contain the digital sound track. However, the digital sound track on a 70 mm print is slightly larger than the magnetic track which is currently used.

"We considered a number of possibilities, such as putting the track inside the perfs, changing the picture area or moving it," Uhlig said. "We came to the conclusion that the highest reliability and the least disruption in existing practices in 70 mm was to put the track in the position of the No. 4 mag track, located inside the perfs on one side of the film.

"The reduction in frame area is about 1 percent on each side," he said. "That should have no impact on the way films are composed. Cinematographers very rarely use the extreme edges of the frame in their composition, since most exhibitors use a mask with 70 mm projectors in order to create a black frame around the edges of the picture area."



The pickup head, which will retrofit to any projector, scans the film and 'reads' the digital information. The convertor decodes or unpacks the digital information and translates it back into analog format. The analog signal is almost simultaneously sent to the appropriate speakers as bursts of voltage which accurately represent the dialog, sound effects and music that were originally recorded.

"One big advantage of digital sound is the mathematical techniques that can be applied for an error detection and error correction system in the processor," Flemming said.

Utilizing proven digital technology, such as concealment algorithms, the processor automatically provides an accurate audio signal despite splices, dirt or scratches on the film, he said. Fast audio fade-outs and fade-ins are used if large gaps of data are damaged or missing, causing that signal loss to be virtually undetectable to the human ear.

More than 5.5 million bits of data are read and recovered per second.

"One of the major questions we had in the beginning was whether it was feasible to accurately write and read that much data," Uhlig said. "In order to pack that much data into that small an area, each bit, representing a zero or a one, has to be minute in size. We built prototype equipment to physically test and measure our ability to accurately record and read information. The project was made feasible by the extremely high resolution characteristics of modern motion picture films."

Part of the error correction and error detection system was designed and built exclusively for the Cinema Digital Sound system by Cyclotomics, part of Kodak's Federal Systems Division. Although similar to other data recording and playback devices, the Cyclotomics unit is customized to satisfy the unique needs of the motion picture industry, such as the imaging characteristics of film, the number of channels, etc.

Cyclotomics developed proprietary integrated circuits (ICs) optimized for this application. The ICs, which replace thousands of electronic components, were designed to enhance the reliability of the system.

One other side benefit is that the audio track is literally read with light. In contrast, current 70 mm magnetic projectors have heads which make physical contact with the audio track. With time, the heads wear, resulting in a slow but steady loss of performance, possible damage to the film, and a requirement for maintenance and replacement.

System Specifications

Dynamic range describes the range of loudness in decibels. The higher the decibel, the broader the range from soft to loud.

Conventional 35 mm monaural optical sound typically ranges from 44 dB to 52 dB depending on the condition of the print. Dolby stereo optical sound in 35 mm format ranges from 51 to 59 dB depending on the condition of the print. Dolby in 70 mm magnetic format ranges from 78 to 80 dB. Cinema Digital Sound retains a level of around 96 dB for the life of the print. The difference between 70 mm magnetic and 70 mm digital optical sound is most noticeable in theatres with low background noise levels. The difference between both 35 mm monaural and Dolby stereo optical sound and Cinema Digital Sound in 35 mm format is dramatic.

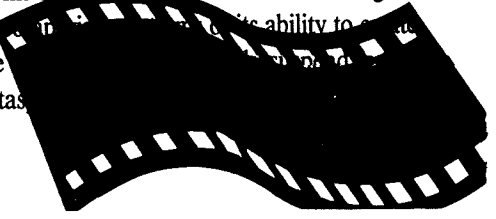
Channel separation is the system's ability to isolate sounds coming from specific directions or speakers. Conventional 35 mm optical sound is not stereo, so there is no separation. Dolby stereo optical sound in 35 mm format has a wide range of separation from 12 to 49 dB. There is a tendency for sound to "leak" from one channel into another, so separation is not complete. Dolby magnetic sound in the 70 mm format measures at a 50 dB level. Cinema Digital Sound measures at a 100 dB level. For practical purposes, once channel separation is above 40 dB, there is no noticeable difference. Therefore, the most dramatic difference in channel separation occurs in the 35 mm format.

Frequency range refers to the range of pitches of sound, from low, or bass, to high, or treble. In music, the highest frequency sounds are normally percussion. Without sufficient bandwidth, they are either not audible or they sound muddled. The frequency range for a 35 mm monaural optical sound track is 30 to 6,300 Hz. For a 35 mm Dolby stereo optical track, the frequency range is 40 to 12,500 Hz. For a Dolby 70 mm sound track, the frequency range is 30 to 14,500 Hz. For Cinema Digital Sound, the frequency range is 20 to 20,000 Hz. The low pitch is comparable in all systems, but with Cinema Digital Sound, treble is at the outer edge of a person's ability to discern pitch. The Digital Sound system will also eliminate "flutter," which is a change in pitch caused by even slight variations in projection speed. The digital system automatically detects and corrects flutter.

Distortion—one example is the sibilant distortion associated with higher frequency "s" sounds on both 35 mm monaural and Dolby stereo optical sound tracks. In both cases, the range of harmonic distortion is from 1 to 7 percent, primarily depending on the conditions of the print. A Dolby stereo 70 mm print has an average harmonic distortion of about 3 percent. The average harmonic distortion for a Cinema Digital Sound print is a barely perceptible 0.01 percent.

A 21st Century Technology,

"Cinema Digital Sound technology will take us into the next century," Flemming said. "There has been a great deal of discussion about so-called electronic theatres. But, after you have seen a high-resolution film print augmented with multichannel digital sound, there is simply no [illegible] ability to [illegible] an environment where the [illegible] and participate in a fantas[illegible]



FREDDIE FRANCIS WINS OSCAR FOR *GLORY*

If you liked "old Hollywood," you'll love *Glory.* It has scope and drama, and three incredible battle scenes that leave audiences breathless.

It has everything but a Hollywood ending. The final scene is nothing less than a descent into hell. A black brigade fighting in the Civil War storms the ramparts of an unassailable fort. There's no way to watch this scene without getting involved.

Violent explosions coming from shellbursts paint the black sky with splashes of light. The ground shakes, and you hear the impact of bullets thinning the ranks of soldiers, as the camera carries you along on a courageous but futile charge.

There's another way to look at *Glory:* faces. The movie is like a photo album filled with interesting faces. The three huge battles are surrounded by little scenes that bring you in eye-to-eye contact with the characters before they make their fatal charge and keep their final date with destiny.

Freddie Francis, BSC, earned his second Oscar for *Glory,* his first

since 1960, when he won for *Sons and Lovers.* His body of work includes *The Macomber Affair, The Innocents, The Elephant Man, The French Lieutenant's Woman* and *Dune.* He also directed around 30 films, mainly horror movies, which have made him somewhat of a cult figure among fans of that genre.

Francis started his career as an assistant to a still man at a London studio. He climbed the ranks from clapper boy to operator, but was at a ripe age for the military draft when World War II started. For most of seven years in the service, he was a one-man training film unit. Francis shot and edited films, and he even recorded sound. After the war, he operated for Ossie Morris, Chris Challis, and other top cameramen in London, until he advanced to first cameraman.

Producer Freddie Fields and director Ed Zwick handpicked Francis to shoot *Glory* because his body of work seemed to fit the challenges like a glove.

Glory is the true story of a Black brigade led into battle by Col. Robert Shaw, the 23-year old son of white Brahman abolitionists. The script is largely based on some 2,000 letters that Shaw wrote, as well as other history.

In the epoch night battle scene that brings the movie to its fatal conclusion, Francis wasn't allowed to bring any heavy equipment on the beach at Jekyll Island, off the Georgia coast, where it was filmed.

"It was a wildlife conservatory," he explained. "We couldn't get within 400 yards of the place, so we lit the night with two Musco units simulating the direction and quality of moonlight. I had never been on a film that used two Musco lights before. But without them, we could never have shot the way that we did."

There were also several lightning boxes, which used carbon arcs to create the illusion of shellfire painting the night sky with fleeting flashes of light. The big battle scenes were shot with five or six cameras to extend coverage, so the fields of view had to be as precisely planned like a military campaign. Francis shot this and other night exteriors with the 400-speed Eastman Color High Speed Negative Film 5294.

"I was getting a meter reading of about T-1.4 even with the two big Musco units," he said. "I had Lightflexes on most of my cameras. The Lightflex pre-flashes the film, which reduces contrast. That let us dig into the shadows and pull details out without using fill light. It allowed me to shoot in a range between stops T-2 and T-3, which I needed for depth of field."

Most of the film was shot with two Panaflex Gold cameras, and always with the Lightflex, to increase coverage from different perspectives, and to keep the pace of production moving. Daylight exteriors were shot on Eastman color negative film 5247.

Glory has the look and feel of an epic film, even though it was shot in the spherical 1:85 format. Francis created the illusion of scope with composition and movement. He composed images to the outer edges of the frame, and kept the camera moving in sync with the cast, using cranes and dolly tracks.

Filming was done mainly at practical locations in Savannah and Atlanta, Georgia, and on Jekyll Island. Some scenes were staged in a restored area of Savannah, where streets and homes have the look of Boston during the Civil War.

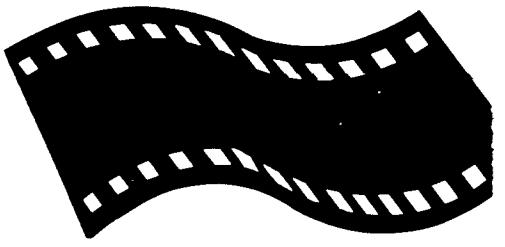
"I think the most interesting footage is in the smaller scenes, where the characters are revealed," Francis said.

In one scene, the men hear about a proclamation stating that they will be shot if captured by the Confederate army. The next morning, the colonel comes out of his quarters, and is standing in the rain peering into the ranks of troops, when he realizes that no one had deserted.

"You can see the bond developing between him and his men in their eyes," Francis said. "That's the magic of movies, when you can capture those types of feelings on film without words being said. There are other things you can do to enhance scenes like this; I like using an eyelight, or putting a dramatic shadow on someone's face. But, there are things you can't do...It just happens with some actors, and the way that film 'sees' them...it sees their insides rather than their exteriors."

Francis prepared to shoot by studying hundreds of period photographs. Also, the art department researched the kind of lighting used in the period, mainly candles and gas lamps. Francis wanted to know what kind of ambience they put out, and where they were located, so the intensity, color and direction of light were authentic.

"Audiences instinctively sense these things," he said. "If a room seems too bright; if the color of light isn't right; or if there are shadows that don't belong in a setting; all of those distractions subtract from the mood you are trying to establish. If you want the audience to suspend reality, you have to take the trouble to do it right."



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Eastman Kodak Company
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EASTMAN KODAK COMPANY
343 State Street
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