Conference Report

The 136th SMPTE Technical Conference and World Media Expo Los Angeles Convention Center, October 12-15, 1994

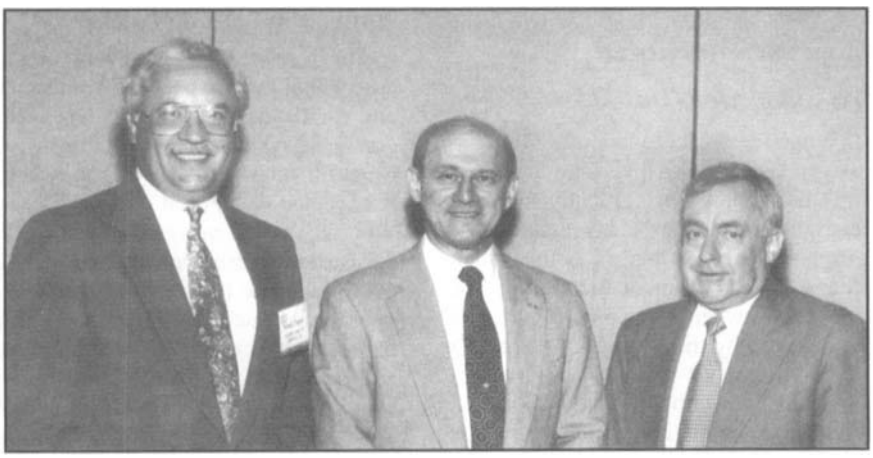
The 136th SMPTE Technical Conference and World Media Expo, held October 12 to 15 at the Los Angeles Convention Center, was a big success. The technical program, on the theme, "The Digital Era... Ready or Not?" attracted an audience of 1,665 registrants. The program encompassed three days of technical presentations preceded by a day of innovative tutorials and workshops exploring the latest technological and industrial developments in digital imaging.

On-site registration at the conference.

The conference was under the overall supervision of SMPTE Conference Vice-President Edward P. Hobson II, Graham-Patten Systems, Inc. The local arrangements were handled by General Arrangements Co-Chairmen Milton R. Shefter, Miljoy Enterprises, and John Brooks, Brooks/Flemming Associates, who dealt with the innumerable details involved in the smooth running of the event.

Editorial Vice-President David L. George, Imagineering Ltd., supervised the technical program, which was put together by Program Chairman Howard T. La Zare, FilmTec International, Program Vice-Chairman (Film) John L. Baptista, Consolidated Film Industries, and Program Vice-Chairman (Television) Frank J. Haney, Fox Television Stations.

World Media Expo marked the first time the SMPTE's equipment exhibit was combined with those of the Society of Broadcast Engineers (SBE), the Radio and Television News Directors Association (RTNDA), and the National Association of Broadcasters (NAB) Radio Show. The exhibit drew a crowd of 17,637 people. All SMPTE Conference attendees were eligible to attend the exhibit without the need for additional registration.

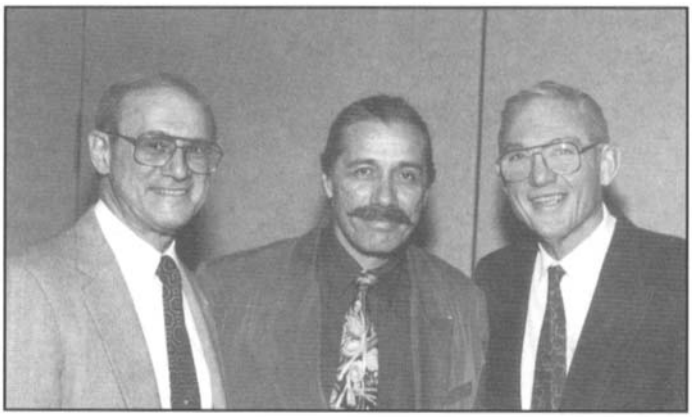


Newly elected line officers for 1995: incoming SMPTE Secretary/Treasurer Rick Thomas, President Stan Baron, and Editorial Vice-President Peter Dare.

In addition to the events mentioned below, meetings of the SMPTE Board of Governors, Executive Committee, Board of Editors, Papers and Publications Advisory, Progress, and Engineering Committees were held during the Conference. SMPTE 2000, a special meeting to consider SMPTE's future, was held on Sunday, October 16. Further details of this meeting are discussed in Stan Baron's Message from the President, in the first pages of this issue.

Technical Program

The technical portion of the conference program focused on a wide range of subjects. The program included 99 papers, presented in sessions on such topics as advanced technology, the information highway and digital storage, studio and post-production, digital terrestrial broadcasting, film technology, video compression, conversion to a digital broadcast plant, archival and special applications, and dedicated and general-purpose computer platforms. By special arrangement, all full-conference SMPTE registrants could attend one session at the SBE conference, which ran concurrently with the Society's. SBE attendees were also able to attend one SMPTE papers session.



(L-R) Stan Baron, Honors and Awards Luncheon speaker Edward James Olmos, and Irwin Young.

Guest speaker Edward James Olmos with Ed Hobson.

Two sessions and a panel on compression were held on October 14. According to Session Co-Chair Karen Mills, White Light Video, the video compression algorithms and techniques represented included discrete cosine transform (DCT), such as JPEG, motion JPEG, MPEG, and wavelets; and vector quantization (VQ), such as Indeo and Truemotion-S. DCT is also used by the telephone industry in its H.261 standard for teleconferencing. For the first time, MPEG hardware vendors from the computer industry; video teleconferencing system providers; semiconductor, desktop, and supercomputer manufacturers; transmission service providers (RBOCs and television stations); video equipment vendors; end-user project managers; and alternative compression technology providers all presented technical papers and participated in a very lively interactive panel discussion.

The consensus of the panel discussion was:

- There are some very complex issues associated with MPEG, especially in intellectual property licensing.
- If wavelets or some robust VQ compression techniques had been available eight years ago, when the MPEG standards efforts began, we might not have the DCT-based algorithms in use today.
- MPEG data streams are not editable and (supposedly) do not transport well over asynchronous transfer mode (ATM).
- Choice of algorithm is absolutely applications-driven.
- The standard's section on MPEG compliancy won't be completed until next year.

Mills summed up the program by saying, "What made the sessions and panel so exciting was the common ground being end-user applications — who, after all, are the people investing in and implementing all of this technology!"

Special Sessions

Film Formats Seminar

A special preconference session was held at the Paramount movie lot in Hollywood on Wednesday, October 12. The "Film Formats Seminar," a joint presentation of SMPTE and the Technology Council of the Motion Picture-Television Industry (TCMPT), took an innovative approach to the study of film formats, in which the same footage was shot in a variety of ways to allow for easier quality comparisons.

SMPTE Program Vice-Chairman Frank J. Haney welcomed guests to the seminar, followed by some introductory comments from Burton "Bud" Stone, past president of TCMPT. Rob Hummel, executive vice-president, TCMPT, explained the purposes and guidelines of the program. At the end of the session, a panel of experts who had participated in the format tests fielded questions from the audience.

Preconference Workshop on Electronic Editing and Digital Imaging for Motion-Picture Feature Films

A special two-hour, hands-on workshop on digital imaging and the principles of electronic editing of feature films was also held on October 12. Industry experts using state-of-the art equipment presented eight sessions, with two offered simultaneously at 8:00 a.m., 10:00 a.m., 1:00 p.m., and 3:00 p.m. The workshops were split into two one-hour sections, with participants divided into two groups of 12. During the first hour one group experienced the principles of electronic editing of feature films, while the other group learned about digital imaging. At the end of the hour, the two groups switched. All agreed that it was a lively and informative program.

Joint ACVL/SMPTE Session

On Saturday afternoon, October 15, a joint session by the ACVL and the SMPTE took place at the Convention Center, entitled, "User's Perspective of Video Editing/Digital Imaging for Motion-Picture Feature Films." The meeting featured two editors describing their views of video editing now and what they would like to see in the future. The second half of the session featured talks by users of the Kodak Cineon System and the Quantel Domino system. Their basic thesis was the comparison of the Kodak open-architecture philosophy versus the Quantel closed-architecture approach. According to SMPTE Papers Program Vice-Chairman John L. Baptista, CFI, who ran the session, the audience really appreciated hearing about these new technologies from the user's perspective.

Conference Opening Session

Following an opening film, *Space-*

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borne, from Pyramid Film & Video, the conference was inaugurated with an introductory speech by Program Chairman Howard T. La Zare, FilmTec International. SMPTE President Irwin Young, Du Art Film Laboratories, then delivered his welcoming address, followed by the presentation of an engineering report by Engineering Vice-President Kenneth P. Davies, Canadian Broadcasting Corp. Leo J. Thomas, Eastman Kodak Co., delivered the keynote address of the conference, which concluded the morning's session. The text of these speeches appears in this issue.

Howard and Phyllis La Zare at the Welcoming Reception.

Peter Symes and Ed Hobson tried out the flight simulator at the Museum of Flying.

Social Events

Welcoming Reception

As attendees have come to expect, the conference featured a full schedule of social events, leading off with a Welcoming Reception on Wednesday evening, October 12, at the Museum of Flying in Santa Monica. Guests enjoyed a relaxing and festive gathering with friends and industry leaders, as well as refreshments with a southwestern flavor.

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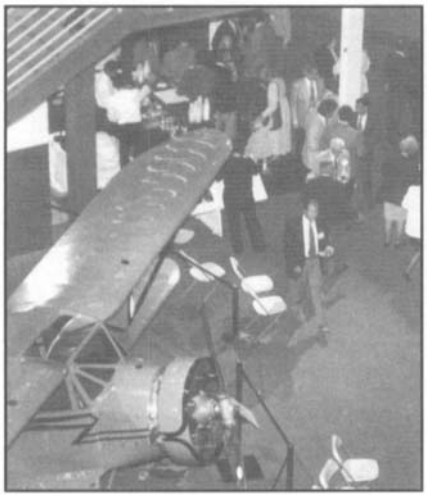


The Museum of Flying, site of the Welcoming Reception.

Milt Shefter (L) and John Brooks (R) each delivered remarks at the Welcoming Reception.

The 1994 Honors and Awards recipients: (seated, L-R) Bruce J. Penney, Dieter Poetsch, Masahiko Morizono, W. Tuckerman Biays, Harvey L. Rogers, David W. Gray; (standing, L-R) Kees A. Schouhamer Immink, David F. E. Corley, Ed H. Zwaneveld, Arnold M. Lund, David K. Fibush, and Angelo D'Alessio. (Not present for the photo were David Graham Hawkridge and Laurence J. Thorpe.)

Honors and Awards Luncheon

The annual Honors and Awards Luncheon was held on Thursday, October 13, in Petree Hall of the Los Angeles Convention Center. The luncheon, which was preceded by a reception at 11:15 a.m., featured the presentation of the coveted SMPTE awards, which recognize outstanding achievements in motion pictures and television, as well as service to the Society. Guest speaker at the luncheon was actor Edward James Olmos, familiar to viewers from television's "Miami Vice."

The following awards were presented: Honorary Membership in the Society, Masahiko Morizono, Sony Corp. (Japan); The Agfa-Gevaert Gold Medal Award, Dieter Poetsch, BTS Broadcast Systems Television GmbH (Germany — also named an SMPTE Fellow); The Citation for Outstanding Service to the Society, Harvey Rogers, SHOWCASE Television, Inc., and Angelo D'Alessio, BTS Broadcast TV Systems (Italy); The Eastman Kodak Gold Medal Award, David Hawkridge, The Open University (U.K.); The Fuji Gold Medal Award, David Corley, DSC Labs (Canada); The John Grierson International Gold Medal Award, W. Tuckerman Biays, Aqua-color Productions; The Journal Award, David K. Fibush, Tektronix, Inc.; Journal Certificates, Laurence J. Thorpe, Sony Advanced Systems Co., and Arnold M. Lund, Ameritech; The Technicolor/ Herbert T. Kalmus Gold Medal Award, Ed H. Zwaneveld, National Film Board of Canada; The David Sarnoff Medal Award, Bruce J. Penney, Tektronix, Inc.; The Samuel L. Warner Memorial Medal Award, David W. Gray, Dolby Laboratories, Inc.; and The Alexander M. Poniatoff Gold Medal Award for Technical Excellence, Kees A. Schouhamer Immink, Philips Re-search Laboratories (The Netherlands).

Fellows Luncheon

The Fellows Reception and Luncheon took place on Friday, October 14, from 12:00 to 2:00 p.m. in Petree Hall. New Fellows of the Society were introduced to their peers at the luncheon, which featured an address by Blaine Baker, MPL Film & Video, Past-President of the SMPTE and former president of the ACVL. The luncheon was limited to Fellows and Life Fellows of the Society. A member is eligible to become a Fellow if he or she has, by proficiency and contributions, attained an outstanding rank among engineers or executives in the motion-picture, television, or related industries.

The following were named new Fellows of the Society: Leslie R. Free, EMI, Ltd. (U.K.); Ronald J. Gnidziejko, NBC, Inc.; Mervin L. Graham, Cirrus Television Systems; Peter Hammar, Hammar Communications; Raymond C. Hills, Ray Hills Associates (U.K.); Edward P. Hobson II, Graham-Patten Systems, Inc.; Paul Kellar, Quantel Ltd.; J. Richard Monaco, Monaco Labs and Video; William W. Peck, Eastman Kodak Co.; Dieter Poetsch, BTS Broadcast Television Systems GmbH (Germany); Milton R. Shefter, Miljoy Enterprises, Inc.; Richard L. Thomas, Eastman Kodak Co.; Christian Tremblay, Miranda Technologies, Inc. (Canada); Eleonora L. Vinogradova, Cinema and Photo Research Institute (NIKFI, Russia); Thomas G. Wallis,

Peter A. Dare speaking to guests at the Honors and Awards Luncheon.

Irwin W. Young delivering his address at the Honors and Awards Luncheon.

Masahiko Morizono was awarded the Society's Honorary Membership.

Eastman Kodak Co.; and R. Evans Wetmore, consulting engineer.

The Society congratulates all of the 1994 recipients of its Honors and Awards, and the new Fellows on their elevated status.

SMPTE Banquet

The highlight of the social program, the annual Reception and Banquet, was held Friday, October 14, at the Hyatt Regency Hotel. A gala reception began at 7:00 p.m., followed by dinner at 8:00. Guests enjoyed a lively evening of entertainment featuring a show called "Sophisticated Sorcery," and dancing to the Joey Herrick Orchestra. The banquet provided a fitting finale to the conference social calendar.

Partners Program

A full program of events geared to the many attractions of the Los Angeles area was available to those accompanying conference registrants. Activities began on Wednesday, October 12, with an Afternoon Welcoming Tea at the Hyatt Regency. Following continental breakfast each morning, participants enjoyed lectures, museum tours, fashion shows, theater, and luncheons as part of the program, which ran through Saturday, October 15.

Partners Program Chair Phyllis La Zare and her committee did an outstanding job on the arrangements for the program. They wish to thank the following companies for their help and support: The Academy of Motion Picture Arts and Sciences, Agfa-Gevaert, Allied Film & Video, Byers Institute, Consolidated Film Industries, Degenkolb Engineering, Deluxe Laboratories, Du Art Film Laboratories, Eastman Kodak Co., FilmTec International, FotoKem Industries, Fox, Inc., Fuji Photo Film U.S.A., Hollywood Film Co., MCA Universal Studios, Mole-Richardson Co., National TeleConsultants, Pacific Title & Art Studio, Ringer Studios, Technicolor, and Technical Film Systems.

(L) John Brooks and Milt Shefter presented SMPTE Executive Director Lynne Robinson with a bouquet of flowers at the Banquet. (R) Frank Haney looks on following the presentation of flowers to his wife, Denyse Haney, in recognition of her work as Co-Chair of the Partners Program.

Student Education Fair

A Student Fair, organized by Donald McCroskey, consultant, was held Saturday, October 15, between 9:00 and 11:00 a.m. at the Convention Center. Representatives were on hand to acquaint high school and junior college students with colleges, universities, and trade schools around the country that offer training in the technical areas of motion pictures and television. Admission was free to students with valid identification and also included admission to the World Media Expo.

Sponsored Activities

The Society is very grateful to the following organizations for their invaluable support: Agfa Div. Miles Inc., Consolidated Film Industries, Deluxe Laboratories, Dolby Laboratories, Walt Disney Studios, Eastman Kodak Co., Foto-Kem Industries Inc., Fox Inc., Fuji Photo Film U.S.A., NBC, Pacific Title & Art Studio, Paramount Pictures, Sony Studios, Technicolor, Inc., Universal City Studios, Inc., and Warner Bros. Pictures. Many thanks to all of the companies, organizations, and individuals who gave freely of their time and effort to make this conference a memorable one.

— Joyce R. Hurwitz

Opening Address

136th SMPTE Technical Conference and World Media Expo

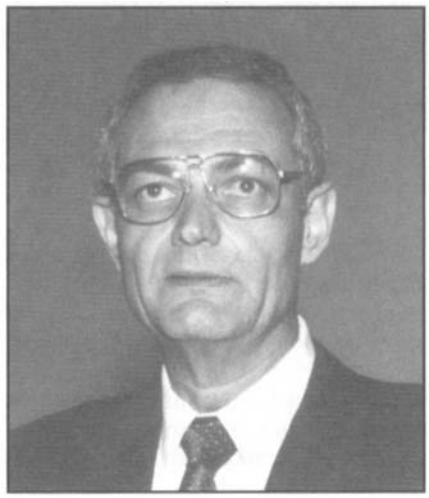
By Howard T. La Zare

Good morning, SMPTE! Welcome to the land of shake and bake, where compression technology takes on a whole new meaning.

It is my extreme pleasure to welcome you to the 136th SMPTE Technical Conference and World Media Expo — a new direction and beginning for our Society. My name is Howard La Zare, and I have the honor and privilege of being your Program Chairman for this momentous occasion. I wish I could take all the credit for this papers program, but I can't. This Herculean effort, spanning multiple disciplines, was most ably supported by your Program Vice-Chairs, Frank Haney and John Baptista.

The local arrangements for this conference, including directing a cast of thousands, was under the command of your Local Arrangements Chair Milt Shefter and his Co-Chair, John Brooks. My compliments for a job well done!

Our theme,"The Digital Era.... Ready or Not," is really relating to the visions of tomorrow while coping with the realities of today. Carl Sagan would say there are billions and billions of stars in the universe and each one of the stars contains billions and billions of elements. We could make the same analogy for the makeup of our perception of an image. It too is made up of billions and billions of elements that we call pixels. A pixel being defined as an element of visual information relating to the color and density of what we perceive to be an image. Most experts would agree that a 4,000 by 4,000 pixel array adequately defines our human limitations of the perception of an image represented on a typical frame of 35mm motion-picture film. This must be thought of as a compromise, since there is an infinite number of pixels in that image, but we accept this level of compromise as the first level of visual compression. This is because when an observer views a normal 35mm motion-picture image projected on a screen, he is more than satisfied with that visual experience. As each frame goes by, and if the story is well told, we are entrenched in the story line and the technical enhancements of sound and imagery.



To transmit this same experience to our homes requires additional compromises in the digital domain, giving birth to a whole new field of magic and wizardry — the wonderland of digital compression. Expert groups, from many different disciplines, have devised brilliant schemes of utilizing our psychophysiological limitations to deceive the eye and mind of the typical observer. But we are getting ahead of our story.

Hollywood is rapidly becoming more of a Silicon Valley than Tinseltown, and I don't mean by making mountains out of molehills. It has been said we are entering into the third epoch in filmmaking: first there were the silent movies, then talkies, and now the digital era. We are at the dawn of this new age of filmmaking, which could ultimately lead to producing a full-length live-action major motion-picture film within the confines of one room. Even now, using computer-generated imagery, one could scan-in three-dimensional objects, blue-screen actors, add matte painted backgrounds, use morph and rendering software with digital compositing, and lo and behold, people would believe the film was a true Hollywood production. Digital technology gives us unlimited power to previsualize entire scenes, composite images, remove wires and other unwanted objects, adjust color and sound, and even create new characters.

Digital technology has the ability to take us places we've never been before and create things that we've never seen before. Consider that the majority of the ten highest grossing motion-picture films of all time feature powerful special effects. Digital-age tools gave the *Jurassic Park* dinosaurs the organic appearance and fluidity of movement of living, communicating creatures. They created, and I quote: "dinosaurs with an attitude." In *Forrest Gump*, actors interacted with historical events in a most believable manner. Digital graphic imaging is an enormous field that's expanding like wildfire. Here the artists sculpt with computers by pushing around pixels instead of molding with clay or painting with a brush. Once information in any given original form, whether it be modeling data, text, graphics, sound, animation, or still and motion pictures, is converted into a set of binary digits, computers can manage it, package it, store it, replicate it, analyze it, slice it, dice it, and deliver it or express it in ways

Text of opening address at 136th SMPTE Technical Conference delivered on October 13, 1994, by Program Chairman Howard T. La Zare, FilmTec International, Chatsworth, CA 91311.

that no one ever dreamed of before.

It is projected that while most other industrial job bases will be declining, the motion-picture industry job base will be expanding to the tune of some 200,000 new jobs, over the next ten years, totally based on digital technology and information systems. Even though we can assume that studio heads will be counting on computer-generated imagery for their future successes, consider what George Lucas said when he was asked whether filmmakers will eventually eliminate actors and replace them with automated images. Lucas admits it's possible, but points out that a crucial element would be missing — "the quirkiness that only a human being can bring to a role." Let me add: at least based on today's technology.

After the dust of the digital revolution has cleared, most of Hollywood's traditional tricks and processes will be left on the cutting-room floor. The way films are planned, shot, edited, composited, and shown to an increasingly sophisticated and discerning public will fall to those who handle these new technologies best.

Digital technology means that our choices, at the beginning, are almost infinite. The potential of incalculable profiles reaped from a universal, enriched video environment is driving much of the current effort in digital technology development on three overlapping, competitive fronts: delivery, resolution, and interactivity.

Half a decade ago, then FCC chairman Alfred C. Sikes urged that a national priority be put on the development of a "video dial tone" system for home delivery of interactive video services; but it wasn't until September 1991, when a Supreme Court ruling finally removed the legal barriers that kept telephone companies from developing video services, that the competitive guns began blazing in earnest. By 1992 the FCC had reallocated part of the radio frequency band, opening it up for use by interactive television systems and paging and data services, among other new communication technologies. Today the FCC is awaiting the final testing of the HDTV system proposed by the Grand Alliance, which could lead to a standard by the end of 1995. This may be put into question by the terrestrial broadcaster's proposal, both here and in Europe, for a new improved HDTV system incorporating an expanded version of the coded orthogonal frequency division multiplexing technology used in digital audio broadcasting.

It is clear that computers, telephones, TVs, VCRs, disc players, and video games are evolving into some kind of integrated, optimized system for the mass delivery and interactivity of digital information.

Scientists worldwide have been on a common quest, searching for the best way to manage the overwhelming amounts of information that result from a video-to-digital conversion. The answer, of course, is compression technology — the process of squeezing digital data down to more manageable file sizes. The search for an international standard has been likened to that of the search for the Holy Grail. Recently two methods have found acceptance. One of these methods, optimized for the compression of still pictures, was devised by the Joint Photographic Experts Group (JPEG). The other, which holds greatest promise for video, is named after a consortium of industry specialists called the Moving Picture Experts Group — MPEG, and now MPEG-2.

MPEG intelligently decides which parts of a moving picture need to be compressed and which ones do not. Much of the picture information in any given video scene is identical from frame to frame or even from second to second. Imagine, for example, a scene of someone walking across an open field. The only picture information that changes significantly during the scene is that of the person walking. Most of the visual information, such as the landscape and sky, remains stagnant. It would be a waste of computer power and storage to make digital copies of that identical information 30 times per second. By looking backward and forward in time MPEG can recreate missing information so quickly that we perceive the final result as smooth motion. By scanning and processing only significant changes in each successive video frame, digital compression can eliminate more than 90% of the millions of bits of video information that would be required to display video frames conventionally.

This means that transmitting video today requires only 30% of the bandwidth that was required ten years ago. Applied another way, compression techniques could one day, theoretically, make it possible for a one-hour video program to be sent over a high-bandwidth cable in under five seconds, assuming the receiver has the means of storing and processing the video information. The viability of such a system would be dictated by profit and loss projections.

During this conference, two paper sessions will be devoted to exploring the latest developments in this rapidly changing technology.

Converting an analog NTSC TV signal into a digital format eliminates many annoying picture artifacts, such as straight lines that appear jagged and inaccurate color rendition, and compression enables near-studio-quality video to be delivered to existing TV sets. Consumer studies indicate that any picture quality lost through compression is virtually unnoticeable and completely overwhelmed by the improvements made possible by the digital transmission. Digitally compressed video makes direct-broadcast satellite TV possible, with approximately 150-channel delivery systems and the promise of 500-channel cable systems.

To deliver all this information to our homes and workplaces is an astounding feat — an even greater feat is how to sort through this massive amount of information. An individual deciding what to watch on a 500-channel cable or DBS system would have to take more than an hour to "tune through" this informa-

tion, spending just five seconds viewing each channel. Imagine pressing a remote control by mistake and misplacing the channel you were watching. Brilliant and clever schemes are being devised to customize our individual viewing habits to minimize this and other dilemmas.

We must now begin to deal with this cresting, irresistible wave of digital information, one that comprises the most powerful vision of communication ever known on Earth. It is a vision in which the bulk of all significant knowledge and recordable events will be inevitably cast with discrete, computer-negotiable pulses. Every new technology that brings goodness and wonder to civilization also brings a darker side. Consider that in every case, digitizing a real-world object or process yields a kind of mirror-like object that "lives" in the digital domain. Whether it be a document file in a personal computer, a single frame of video held in a silicon chip, or a passage of music on a compact disc, it can be stored, copied, and reproduced, indistinguishably from the original, as well as manipulated and modified to whatever purpose, or transmitted instantly from one computer to another half a world away.

Although the basic processes involved here have been known and applied in one way or another for almost the entire second half of this century, the impact of this technology on our lives today can still be subtle and shocking all at once. Consider the extent to which a person's signature is still both required and accepted as the corroborative form of identification when signing contracts or cashing checks. Yet the fact is that if one can obtain anything you've signed, your signature is replicatable. Utilizing devices from Apple's Newton to a simple scanner, people may unwittingly not only digitize their own signatures but send them to one and all via fax or modem. With less than $150 worth of scanning equipment attached to a personal computer and a laser printer, unethical people can affix your signature to a variety of new documents, from correspondence to contracts to personal checks. Likewise, the ability to undetectably alter photographs digitally is quickly placing these entities beyond the pale of legal evidence.

Now, as in past history, new technologies bring with their wonder and benefit challenge and danger. May the following days of papers, exhibits, and socializing bring you all the knowledge and enlightenment that you had hoped for.

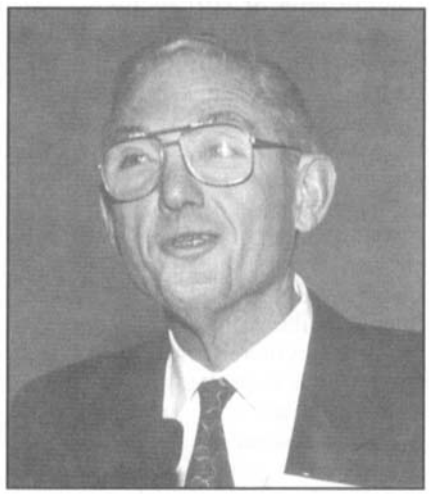
It is now my great pleasure to introduce a gentleman I've had the honor and privilege of knowing and working with over the last 30 years — the President of SMPTE, Irwin Young. Thank you.

Conference Opening Session Welcoming Address

By Irwin W. Young

Members of the Society and friends, good morning. On behalf of the officers and Governors of the Society of Motion Picture and Television Engineers, I would like to welcome you to the 136th SMPTE Technical Conference, titled "The Digital Era...Ready or Not?" and World Media Expo.

Many people feel that the electronic communication industry is at the threshold of a new technology wave that will further integrate the world of computers, telecommunications, television, motion pictures, and media publishing. All of these industries are positioning themselves for a dominant role in the new information



age of the 21st century. Our present "information network," with its future superhighways to be created by new technology, will form the National Information Infrastructure (NII) in the future. Let us be sure there are not too many toll booths on the superhighway and that there are avenues for the expression of independent thought and ideas, the very basis of our democratic society.

It is not uncommon and, yes, far more dramatic for us to hear the words "merge" or "converge" when referring to the effects of new technology on the communications industry. In *Webster's Dictionary,* merge and converge have very similar meanings: combine into one, move to one point, or come together. The different technologies in communications are not converging—what appears to be happening is an integration of the different technologies. This new relationship could be analogous to how this country was first seen as a melting pot of people of different cultures and nationalities and where we now see our society as multicultural, where everyone is

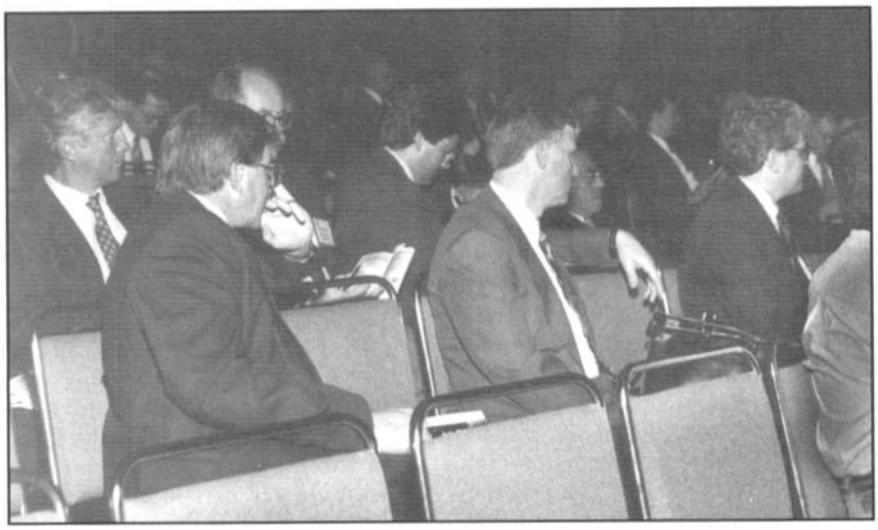
Text of welcoming address by outgoing SMPTE President Irwin W. Young at the opening session of the 136th SMPTE Technical Conference and World Media Expo in Los Angeles on October 13, 1994. Irwin W. Young is with Du Art Film Laboratories, Inc., New York, NY 10019.

brought together by the democratic principles established by our forefathers. New digital technology could well be the basis of the integration of the different technologies that are part of the communications industry.

The process of integrating these different technologies could become more and more an important part of the function of the SMPTE. In order to decide how to evaluate the Society's role in the coming century, the Board of Governors, at its upcoming meeting on Sunday, October 16, is conducting a strategic planning session to review its mission — its role in professional motion-imaging arts and sciences, the scope of the organization, and services to its members. This strategic planning session is the initial phase of SMPTE 2000.

The international role of the Society continues to grow. From July 5 to 8 of this year, I attended, with many of the national officers, the 6th Biennial Conference and Exhibition organized by the Australia North Section of the Society of Motion Picture and Television Engineers. I had the pleasure of making a welcoming speech, which was followed by our Engineering Vice-President Ken Davies' keynote address, entitled "Digital Television — Who Needs It?" Exhibition attendance was 6,434, up from 5,200 in 1992, reflecting the growth in communication and the strength of the economy of Southeast Asia. A meeting and a social function were held with the national and section officers to insure proper relations with our international sections.

Each year since 1992, our German, Nordic, Italian, and Russian Sections have planned and produced a European Conference of significant importance to the European countries. The 1994 European Conference was held in Cologne, Germany, from September 22 to 24, as part of the Photokina professional media show. John Carlson, our Sections Vice-President, represented SMPTE as the Welcoming Speaker, and Ken Davies presented a paper entitled "SMPTE: Preparation for the Era of the Information Highway." This conference was sponsored by the Montreux International Symposium and KolnMesse. For the first time in Europe, one day prior to the European Conference, SMPTE conducted a Sections Officers Training Seminar for its overseas officers, chaired by John Carlson.



The conference opening sessions attracted an attentive audience.

Prior to the European Conference, many of our officers and members attended the International Broadcasting Convention (IBC 94) in Amsterdam from September 16 to 20. At this convention SMPTE had a booth and held an Opening Night Reception for its members, sponsored by Sony Corp.

The Society has always been interested in strengthening its relationships with its sister societies all over the world in the science and technology of motion imaging. In June 1994 the Board of Governors approved a set of guidelines for cooperation with those organizations whose goals and missions are similar to SMPTE's and which are dedicated to improving the motion imaging arts and sciences as well as providing benefits to our members.

The success of a conference of this size is totally dependent upon the work of our dedicated volunteers and the support they received from SMPTE Headquarters staff. On behalf of the Society, I would like to thank Ed Hobson, our Conference Vice-President, and all of our arrangements chairpersons who, under the direction of Milt Shefter, our General Arrangements Chairman, and John Brooks, our General Arrangements Co-Chairman, provided the support system for the operation of this conference. Secondly, I'd like to thank David George, our Editorial Vice-President, for creating, under the direction of our Program Chairman, Howard La Zare, and all of his topic and session chairpersons, an interesting and thought-provoking schedule of papers presentations covering the most recent developments in the communications field.

I would also like to thank the Technology Council of the Motion Picture-Television industry for co-sponsoring yesterday's pre-conference event, "The Film Formats Seminar," chaired by Rob Hummel, Charles Swartz, and Frank Haney; as well as John Baptista, who chaired the pre-conference workshop, "Video Editing/Digital Imaging for Motion Picture Feature Films." I would especially like to thank my very good friend, Bud Stone, for all his help and support.

World Media Expo has been a success. This joint exhibition of the NAB Radio Show and the annual conferences of the Radio-Television News Directors Association (RTNDA), the Society of Broadcast Engineers (SBE), and the Society of Motion

Picture and Television Engineers (SMPTE), under World Media direction, has signed up 491 exhibitors occupying 135,000 net sq. ft. There are 257 video exhibitors occupying 80,000 net sq. ft. This combined exhibit will be more than a sum of its parts. It benefits our members because it shows them the practical applications of our technology as well as indicating to them how new technology will be applied in the future. The combined exhibit also creates an additional benefit of closer relationships with our sister organizations. Full conference attendees of either SMPTE or SBE have the opportunity of attending one session of the other conference. The future could bring about an expansion of this relationship with SBE as well as with other groups.

The continued success of World Media Expo is very dependent upon the success of our own conferences. With our dedicated membership I am sure SMPTE will continue, as in the past, to provide technical conferences that best serve our technology and members.

It is easy to predict what benefits new technology in communications will bring to our Society, but very difficult to know what changes it will bring to our way of life. Most of us in the industry have an insight into the power of communication. This gives us the additional responsibility of being sure it is used properly. J. Robert Oppenheimer, the physicist who directed the design and building of the first atomic bomb, knew the power of atomic energy and understood his responsibility towards its use. He said, "As long as men are free to ask what they must, free to say what they think, and free to think what they will, freedom can never be lost and science can never regress."

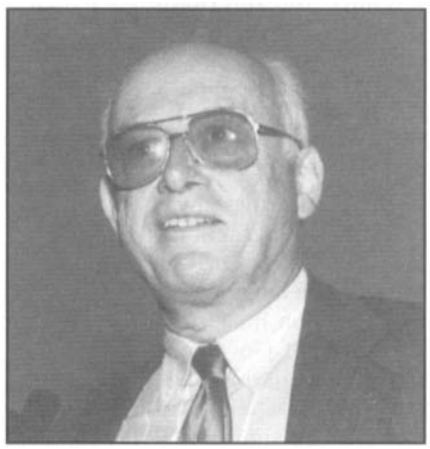
I hope many of you will be attending today's Honors and Awards Luncheon. Fourteen industry leaders will be recognized for their service to our industry, our technology, and our Society. On behalf of the officers and directors of the Society, thank you, everyone, for all your support.

Report of the Engineering Vice-President to the 136th SMPTE Technical Conference

By Kenneth P. Davies

Thank you, Mr. Chairman, for your kind introduction and good morning, honored guests, ladies and gentlemen.

As Engineering Vice-President, may I also welcome you to the 136th SMPTE Technical Conference. Yesterday, many of you participated in the two tutorial activities, the Workshop on Video Editing and Digital Imaging for Motion Picture Films and the Workshop on Film Formats, with its excellent and informative demonstrations. We now can turn our attention to the conference itself, with the theme "The Digital Era ... Ready or Not," and the exhibition, bringing together a vast range of companies, products and services under one roof, living proof of one aspect of the fabled "convergence." I am sure that much will be learned



from all these activities and that the technical networking in the social functions of the next few days will bring its own benefits. There are some busy times ahead indeed!

It is my pleasant duty this morning to bring you up to date on that part of the Society's work that has made SMPTE a common name worldwide and for which the Society was founded some 78 years ago. Standards are, perhaps, more important today in this era of convergence, cross-industry applications, and an increasingly open production environment, than they were at the founding of the Society. Standards and related engineering documents are the very foundation that enable the motion-picture and video industries to carry forward their work with a high degree of certainty that their products will be usable throughout the world. They are the very glue that holds together the diversity of equipment needed for production and distribution activities, and they ensure that the components will plug together and work right out of the box.

There is no doubt in my mind of the importance of this work, and the proof is found in the tremendous strides made in production and distribution technology each year. The open, fully documented standards supported by SMPTE are the basis of the current motion-picture and video industries, with their success seen in

Text of address presented at the 136th SMPTE Technical Conference in Los Angeles on October 13, 1994. SMPTE Engineering Vice-President Kenneth P. Davies is with the Canadian Broadcasting Corp. (CBC), Montreal, Quebec, Canada H4W 1R5.

their wide application and the willingness of individuals and corporations from all sides to build and maintain them. The investment in their creation is returned many times over in efficiencies in use and in reduced costs of purchase. It seems to me that SMPTE standards are one of the better investments that can be made. Can you imagine where the industries we serve would be without them?

Progress

Worldwide, this last year has been one of change. The very successful conference of the Australian Section in July and the European Conference of the SMPTE in September, held in conjunction with Photokina, along with the many contacts in North America, point to the fact that the development era of digital television is over. In this era, the emphasis was on developing the base technology and the application of these advances to the enhancement of current systems. The innovation and advantage was in the improvements in efficiency in the production process, as the road to the viewer was still essentially analog and innovations in services were difficult and unrewarding.

Digital delivery changes all that. Compression has rendered fully digital delivery to the home feasible, opening the possibility of flexible, user-controlled services. Already one satellite service has moved some considerable distance in that direction. A number of wired systems are experimenting with the uses of interactive services, including video on demand in mergers of cable, telecommunications, and computer technology. Cable delivery is poised to move digital delivery further into the viewer's home through set-top converter units. ATV will go further, moving the viewer into an era of integrated, flexible, fully digital receivers, or audiovisual appliances, as some describe them. The Grand Alliance has successfully demonstrated the potential for the delivery of high data rate digital streams over conventional terrestrial TV channels. Interactivity associated with broadcasting is in use experimentally and is the subject of much study for digital services. The National Information Infrastructure (NII), is now launched as a road that will revolutionize the availability and concept of digital services and a majority of them are likely to be video-based.

The landscape has changed. As each application has developed in isolation, at least to some degree, the challenge now is interoperability, interconnectivity, and above all, policy issues, regulatory and legislative matters, and business matters. The technology has produced myriad possibilities to enhance, improve, replace, and overwhelm the needs of the users. We are now in the process of reengineering the very concept and fabric of the TV services. The Digital Era is coming, Ready or Not, and enough can be seen now to know that it will bring sweeping changes. There is little time to lose in the preparations for its arrival.

SMPTE, in its roles of educator and standards-maker, must take responsibility for some essential parts of these preparations. Let me outline the directions that are being followed for the engineering activities.

In the past year, great strides have been made in setting the basis for the production of the content, the essential part of the digital era. In that year, SMPTE has produced some 40 new or revised standards, 30 recommended practices, and 6 engineering guidelines, which are now approved or reaffirmed. The highlights of this work include:

- The 1920 x 1080 @ 60 standard required for ATV development went out on ballot to Working Groups and Technical Committees on April 14 It was revised during the May cycle of engineering meetings and passed Standards Committee review in July. It is now available for public comment and tentative use, and it will also go to ITU-R October meetings. Related standards for 50 frame/sec, 24 frame/sec, and other resolutions now under way. SMPTE is, in effect, creating a descriptor language of global impact for digital TV images, in this work.
- Work has started on TV standards for packet video and for the use of compressed forms of video in production. This work seeks to establish the standards requirements for computer networks in desk-top video and in compressed form transmission and interchange in production. Current interest in this topic can readily be seen in the contents of this conference and the World Media Expo. The presence of major players in the computer business underscores the convergence in technologies.
- New work in the TRRT has begun, leading to new documentation procedures to accommodate the inclusion of a mix of generic, open, and proprietary elements in a layered recording format or storage media. This is already a problem with currently available formats and will be further challenged in the future.
- A major convergence is apparent in TV colorimetry, where the essence of a consensus has been achieved on a significant extension to the reproducible color gamut and on the adoption of optimized transfer characteristics and luminance coding for future TV systems. This approach has been coordinated with the BTA in Japan and with the EBU.
- A significant effort, involving both the North American and international sectors of the SMPTE, has resulted in the completion of the first phase of the development of the ES-Lan. This work extends the principles established some years ago in the ES-Bus, developed jointly by the SMPTE and the EBU, for the control of production equipment to the current and future needs for the full integration of such devices into the computer network. Further developments are already under way to extend it further to a greater variety of networks.
- The serial interface for HDTV signals, essential for practical system implementation, has been defined in both coaxial cable and fiber-optic techniques and has been brought to a near final document in joint efforts between SMPTE and BTA.

Liaisons

While some liaisons are definitely dangerous, SMPTE has established

some with more comfortable and tangible rewards to our constituency.

NII

SMPTE co-sponsored the NIST Workshop on Advanced Digital Video in the NII, May 10-11, 1994, in Washington, D.C. About 250 people were in attendance, from a wide variety of backgrounds. Other sponsors included ARPA, EIA, IEEE-USA, and ATSC. SMPTE presented the case for the entertainment industries, pointing out their value as content and service providers and as a key element in the delivery chain to consumers. A summary of this address is available and has been published in the *Journal*, along with some other contributions from the meeting. NII will have a significant effect on the distribution of entertainment and other cultural items in the future.

DAVIC

This is a new international, not-for-profit association, somewhat akin to the ATM Forum, with the mission of promoting and enabling interoperable standards for digital audio and video services. Recently formed, its current preoccupation is video-on-demand (VOD) services and from there will move to multimedia. There are obvious links between this work and the activities of SMPTE, and a close liaison is being maintained. The participation of the motion-picture and television production industry is urgently required. Major matters of IPR, copyright, security, and possible piracy must be overcome, as in the NII.

Telecommunications Industry Standards

A close liaison with the TIA 1.5 committee of the TIA has been requested and established to provide this group with current information on the interfacing standards for the TV industry in digital form. This group is working on standards for transmission in the future network, in particular, ATM.

ATSC

SMPTE continues to work closely with the ATSC and its member organizations in the preparation of standards relating to the definition, testing, and implementation of ATV. SMPTE is directly responsible for the production, storage, and distribution aspects of the work.

SMPTE is also developing production standards for ATV for the 50-Hz world and for other levels of the 60-Hz world, including 720 x 1280 progressive and 24-frame/sec video standards for motion-picture transmission.

Standards Sales

One measure of the success of a development program is to be found in the market. It is noteworthy that the sales of SMPTE standards are rising and estimated to total approximately $85,000 this year, a figure that is a useful contribution towards the cost of the activity. SMPTE standards are currently available in a number of formats, including individual prints, subscriptions, microfilm, and CD-ROM, on a worldwide basis.

Future Standards

The direction for the next phase of SMPTE work has been mentioned already — standards involved in desktop TV, probably including both hardware and software definitions, production level compression, packet /nonreal-time video and audio in production, production storage, and packaging of content for electronic distribution. There is a great deal of work to do to maintain our standards as current and relevant and to expand them to these new areas.

These new standards will be rather different compared to the current ones in a number of important ways, brought about by the changing face of the imaging industries, no longer simply motion pictures and television, and by the pervasiveness of digital technology and communications. Key differences that can be identified include:

- Standards will take full advantage of the power of digital processing and communications and will be less constrained by current TV systems — in other words, digital rather than digitized.
- A wider range of industries and applications must be taken into account with differing user needs and operational perspectives. There is a delicate balance here between practical functionality in a number of applications and economics, not a simple matter to resolve, requiring real dialogue between all parties in the equation. Increasingly, SMPTE standards will be built upon base standards of very wide application, and a challenge exists in obtaining the necessary inputs from our industries into this larger discussion.
- Digital technology has empowered the creative community. User needs and interfacing take on a much higher priority as the technical and economic barriers fall.
- Standards must be enabling, inclusive, extensible, and open-ended. Technology is moving too fast for simplistic, exclusive standards with everything nailed down. Standards become the common language describing the essentials of interchange and understanding instead of the rules on how to do it. Current work in respect to production standards for digital broadcasting or ATV are a step in this direction, incorporating commonality of pixel definition in a family of resolutions, geometries, and frame rates. Digital TV can offer similar, or even better media flexibility than 35mm film to the creative community, and the standards adopted for its production use should not introduce unnecessary constraints. The current debate regarding aspect ratios might be examined in the light of this reality.
- Current standards have already taken into account the advantages of layering with open interfaces between layers. This opens opportunities for innovation and cross-fertilization and is an essential component of future standards.
- SMPTE will need to become more deeply involved in the standards for the delivery of the products. The packaging of the content for distribution and related matters of interactivity, security, and transaction management all have an impact in the community of interest of SMPTE.

• Finally, it goes without saying that standards will be increasingly global in scope. SMPTE is in an excellent position in this respect, being international and having excellent participation in all regions. While some continue to use standards as barriers to the free flow of information and trade, that is certainly not the way of the future and brings only very temporary advantage.

Conclusion

The next years offer major challenges to SMPTE, the industries it serves today and to those that convergence will add to the list tomorrow. SMPTE must continue to expand its outreach to new areas of both application and of standards development to ensure that the engineering documents of tomorrow maintain the high standards for relevance, utility, and excellence that are taken for granted today. To meet these challenges, it is necessary for all involved to recognize that this commitment of resources, both financial and particularly of skilled, foresighted human expertise, is a critical investment in the future. In a world of convergence and integration of infrastructure, only good standards will preserve the openness, ease of access, and range of content and services that will be needed to render future systems viable and to deliver to the users, both consumer and professional, those services that they will need.

SMPTE can only be as good as the support that it receives and in the coming year has much to do. May we count on each of you for the years ahead. SMPTE recognizes the contributions of all those who have so willingly contributed to progress this year and can point to a their successes with satisfaction for a job well done and with pride. We thank all who have made this possible.

Finally, may I thank each of you who have contributed so much to the success of engineering programs in the past year.

Especially I would thank the Chairs of all the Working Groups and other Engineering Committees for their tireless efforts to reach consensus on complex and divisive technical issues; the Chairs of the Technology Committees for their leadership, guidance, and sensitivity to the needs of an open, fair, equitable, and balanced process for standards development; the Engineering Directors, Rami Mina (Motion Pictures) and David Fibush (Television) for their support, counsel, and hard work in defining and carrying forward the many programs of engineering; Si Becker, the Director of Engineering, and his Headquarters staff for their exemplary work in support of the engineering programs, in the preparation and distribution of documents, and in those many invisible tasks that have made my task in the past year both productive and pleasant.

Thank you for your attention.

Keynote Excerpts

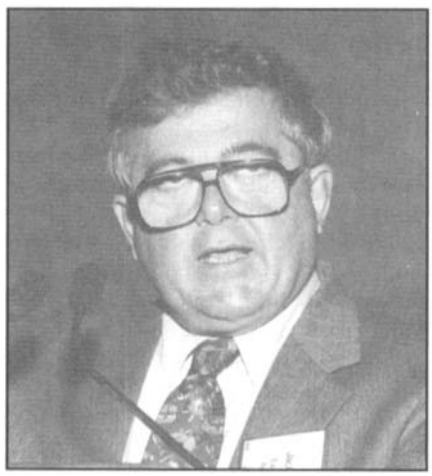
A Future in Imaging: Remarks to SMPTE

By L. J. Thomas

Thank you, and good morning. It's good to be back with SMPTE again.

It was ten years ago when I last stood before you and talked a bit about the broad sweep of imaging technology. I was Kodak's director of research at the time, and I described some of the visions we had and the realities we were dealing with. I also took the liberty of making a few predictions about the future.

When Irwin invited me back, I tried to determine whether he asked me back because he considered me a great sage, or because he agreed with the words of J. B. Priestly who, in the early years of this century, wrote: "Prophesy is obviously a futile proceeding, except insofar as it makes our descendants laugh."



In the end I decided my predictions were neither laughable, nor particularly wise. They seem, in retrospect, very modest. After all, you in this industry have gone far beyond them. It's hard to get ahead of you.

For example, back in 1984, I said, "In the future, motion-picture film images could be scanned electronically and placed on electronic storage media for editing and special effects manipulation. They could then be transferred back to film for distribution and display on theater-size screens."

All of that has come true, of course, but the example I showed to demonstrate what I believed possible involved a toy airplane flying in front of a blue matte screen and composited into an outdoor scene. That was pretty tame stuff when compared to computer-created dinosaurs interacting with real

Excerpts from keynote address at 136th SMPTE Technical Conference delivered by L. J. Thomas, Eastman Kodak Co., Rochester, NY 14650, on October 13, 1994.

humans in a fantasy landscape called *Jurassic Park* — or actor Gary Sinise, in *Forrest Gump*, moving around without legs that had been computer-removed.

Technological change, coupled with artistic vision, made that, and much more, possible. What particularly excites me about this change is, it's very different from other kinds of change — social, political, or even economic — in that it's irreversible.

True Lies, *The Mask*, *Star Trek*, *SeaQuest*, and many other motion pictures and television shows are current reality. We can only go forward. And I will go forward today — with four new predictions about our industry.

It's timely to do so, for several reasons; first, because of the ability we, as scientists and engineers, have to set change in motion. We can — and, I think, must — provide a starting point for the creative members of our industry. It's up to us to help push the edge of their imaginations.

Secondly, 1994 is a milestone of sorts. It's the 100th anniversary of motion-picture theaters in our country. A century ago, people began flocking to small "parlors" in New York City to see the first crude moving images.

Here are my predictions for those of us who expect to have a "Future in Imaging."

First, despite all the current rhetoric and uncertainty around HDTV, I believe high-definition television will be the foundation for a home entertainment experience different from anything we've known before. Before I explain my confidence in that, let me run through my other three predictions.

Prediction number two: Changes in the movie theaters of the future will be faster, and more dramatic, than we've seen in a long time.

Third, I believe the marriage between film technology and digital technology will be so strong and so natural that people will find it difficult to remember when they were seen as mutually exclusive alternatives.

My fourth prediction really builds on and complements the first three. I believe that film will set the standards for quality entertainment for the entire working career of the youngest member of this audience. That would put us well into the next century.

When I spoke to SMPTE ten years ago, high-definition television was a hot topic. Richard Stumpf and his working group had reached a recommendation for new material originated on HDTV equipment. That material would be shot in a ratio of 16:9. The recommendation seemed reasonable. It was approximately halfway between the most commonly accepted formats for 35mm motion pictures in the U.S. (1.85:1) and the standard for movies in Europe (1.66:1). But, judging by all the words being written and spoken about that topic today, reasonable is not good enough.

As you well know, an ASC (American Society of Cinematographers) committee has made a series of counter-proposals that center on their suggestion of a 2:1 ratio. They believe that ratio is more cinematic and more consistent with the way they're creating films for theatrical release.

They say they want to protect their artistic integrity and expand their creative latitude. Those in the engineering community believe protection and expansion are the right issues — but it's protection of investments already made in equipment, and it's expansion of the market for a system that's been in the experimental stage for a long, long time.

Words and points of view are flying back and forth, in symposia and in print, and often at full volume. In this case, neither side may be completely right — or completely wrong. But both sides could do a better job of listening to the other's point of view. I recognize that creative tension between art and technology is fundamental to progress — but ultimately that tension needs to be resolved.

SMPTE is making an important contribution to the process, and I applaud you for the work you're doing. Kodak's own entries into the electronic field have shown us what's involved in setting standards — you need to be prepared for a lengthy discussion. But the dialogue is healthy. With the prevalence of TV sets in homes today and the significant issues around transmission and reception, we hope the FCC and other governing bodies will listen carefully to all HDTV arguments and make their decisions thoughtfully. There is a lot at stake.

Whenever the decision is made, we believe there will be a period of time when there will be several standards in use. Here in the U.S., there will be at least two, NTSC and HDTV. Conversion will not come overnight. But, as HDTV sets enter homes on a wide scale, programming on demand will be a reality — movies, documentaries, favorite TV shows from the past or present — whatever we want, when we want it. We'll be able to skim through stories or enjoy them in greater detail; it will be up to us.

What will those TV sets of the future look like? The images will be far superior to the images we have today. Stereo digital sound will be a reality. Some day, the sets will be flat-panel monitors that hang on a wall, much like a picture does today. These small devices — about the size of today's remote controls — will be able to be programmed with our likes and dislikes. They will "know" whether we like movies or documentaries, sitcoms, or news. They will "channel surf" for us and store the programs we like, to be available on demand when we're ready. Our menu of choices will be on the screen, just like we use "Prodigy" or "America On Line" today.

The computer will be connected to the television set — and to virtually everything else in your home. They will all be part of a home communications center that will include more versatile telephones, affordable color home printers with fax capability, and access to an unlimited supply of images stored electronically in the home, or available via phone lines, from picture libraries in remote locations. Of course, we still need to find out whether people want all that technology, and what they'll pay for it, and how they'll use it. Those will be challenges, but they won't be insur-

mountable. I'm confident that you will play an important role in helping to provide the technical solutions that bring those visions to reality.

HDTV, with its improved image quality, will be here soon. And when that happens, the home entertainment experience will provide even more competition to the movies. To survive and grow, theaters will have to again move out front. I believe they will.

That brings me to my second prediction. I believe the changes in movie theaters of the future will come faster — and be more dramatic — than they've been in a long time.

In some respects, that could be my most daring prediction because the moviegoing experience has been constantly changing. One hundred years ago, that experience consisted of paying a dime for a movie that lasted around two minutes. Since those days, we've seen the rise — and, in some cases, the demise — of palace theaters and cineplexes, of stereo sound, color, and 3-D, and of special venue films where we can "ride" the movies.

What else could be in store? I believe there are several factors on the horizon — beginning with competition. And I don't think anything drives real improvement more forcefully than competition.

Home video looks very good today and will look even better in the future. TV screens are larger. Speakers are better. The window between the time a first-run movie leaves the theater and the time it's available for home viewing is shrinking dramatically. And, when you compare the price of watching those movies at home to the price of going to the theater, movie-makers are going to have to give people a better reason to go to the theaters. And I believe they will. I believe theatrical movies will increasingly offer what some industry leaders have called "an immersive experience."

Let me start with traditional theaters. What began as an effort to carve up existing facilities — or to create more screens, rapidly, in the suburbs — has resulted in what we call multiplexes. They have been both a blessing and a curse to the industry. On the one hand, they have made movies more accessible, but on the other hand, the screens have been little bigger than a TV set, the sound quality often marginal, and the comfort of the seats less than ideal.

That is now changing, and I point to the Kineapolis in Belgium as one example. This multiplex features excellent sound, large-size screens, and comfortable seats. A lot of new construction, in Europe and in the U. S., is proceeding along the same lines.

Another example involves special venue theaters. What began in a very few theme parks, or even fewer special theaters in museums and science centers, is now going mainstream. I'm talking about IMAX, 3-D, or Showscan, or some combination of those formats, often with a ride thrown in. The result is a magical and moving experience. What once existed only in a Disney theme park is now available in hotels — and what you could once only experience in a very few theaters in the U.S. will soon be coming to a local shopping mall.

There is, as you know, a lot of talk about the all-electronic cinema. There have been some sweeping predictions and a few modest experiments. Let me tell you how I see the situation.

The arguments for all-electronic movie theaters are pretty compelling — from several points of view.

For the distributor, satellite transmission of movies could eliminate print costs and transportation, which for the industry, run about a half a billion dollars a year. Every copy would be indistinguishable from the original, and there would be more marketing flexibility. Movies could be changed over much more rapidly.

For the exhibitor, there could be greater asset utilization. Live concerts or sporting events could be shown in the same facility. Film scratches or mechanical and optical problems would be a thing of the past, and it would be quicker and easier to change titles.

And, of course, the consumer could enjoy a different entertainment experience. All of that could be possible... if. If the technical and business issues can be solved. If there are projection systems with the brightness, resolution, color, and contrast range of the film projection systems of today. If there are cost-effective digital recording, storage, and playback systems available. And if we can develop systems with the bandwidth to transmit motion-picture images.

Even if we get the technical problems worked out, the economic ones still need to be answered. For example, what will be the cost of digital conversion and transmission? What will projectors and playback devices cost? Are the other uses for theaters — the live sporting events and concerts and the rest — really viable? And, above all, who will take responsibility for making the investments? Unless there is common agreement, and critical mass, the potential savings will be difficult to realize.

Those are important questions, and I don't have the answers. I do believe, as key members of this industry come together, the answers will be found. But, for the immediate future, I think the vision of the all-electronic theater will remain largely that — a vision, as film-based theaters continue to make important strides.

Those of you who attended yesterday's format seminar at Paramount know why I can make that statement with some confidence. The seminar was co-sponsored by SMPTE and the Technology Council, and it demonstrated how good film can be. You saw the emotional and image-quality differences between the same scenes shot and printed in different formats, including 1.85 spherical and anamorphic. You heard that the wide-screen anamorphic format didn't cost more money or take more time, or involve more equipment. But you saw the difference the wide image makes — and you saw the power and clarity and impact of a 70mm image. In this case, bigger is better. And, when "bigger" is combined with audience involvement, the result is a winner.

Let's revisit my third prediction,

the marriage of film and digital technologies. Of all my predictions, this one comes the closest, in my mind, to being a no-brainer. We are beginning to stop thinking about film and digital imaging as separate technologies. They are becoming one seamless imaging science.

That has already happened in TV commercial and music video production.Most creative people use film for image capture because it is a more flexible medium. They also have learned to think digitally when shooting that film. Even before their cameras roll, they plan to use computers to alter colors and control contrast. They know they can create new images from synthetic backgrounds, image libraries, and digital techniques.

As recently as three years ago, the use of high-resolution digital technology for post- production was still considered exotic. In 1993, there was a dramatic leap forward. That year, Hollywood's visual effects studios and post-production houses created about a million and a half digital frames of motion-picture film.

This year, that number will be up to about four and a half million frames. That sounds like a lot, but it's still only 15 hours of film — the equivalent of eight or nine movies, out of the hundreds that are released from here each year. So, we're just getting started on a long and exciting journey.

For long into the future, that journey will begin with film. But, as that film is processed, increasingly it will be scanned automatically into a digital format. Digital dailies, used by a few directors today, will become commonplace and sent via satellites or over phone lines to remote locations. There, directors and cinematographers will see their film images as only one ingredient of their final image. They will use computers to create different looks, alter moods, invent backgrounds, or add or delete objects and characters.

Computers will also be used to eliminate many of the normal risks of photography. They'll repair scratches, remove lens flare, and eliminate dirt. They'll correct or change colors of discrete objects in a frame, and they'll sharpen focus — and they'll do all this on a routine basis.

High-speed film recorders will produce digital internegatives from which film prints will be made. There will continue to be a huge after-market for film-based entertainment, although some of the ways we view it may be different, with HDTV and video CDs.

Again, video CDs will initially have competing standards, bringing back memories of the Beta versus VHS controversy. I think this new controversy will resolve itself soon and the video CD will be a dominant medium before the end of this century. With the ability to record entire movies with great images and sound on a disk small enough to hold in the palm of the hand, I think consumers and distributors will begin to build libraries on those disks.

Protection of those movies in an increasingly electronic age will still require the use of film. In fact, we believe those who are betting their future on the longevity of the video master made for TV are taking a big gamble. Magnetic media deteriorates — and image quality and aspect ratios may not be compatible with standards of the future.

That's why we believe it's critical to put the cut negative in a vault where temperature and humidity are properly maintained. Color film stored under proper conditions can last hundreds of years. And, with storage costs running only a few hundred dollars per movie a year, we think that's a very reasonable price for insurance.

As Ted Turner and others have proven, movies are a wise investment and those who protect that investment on film will be collecting dividends in the electronic age.

As we move into that age, I'll offer my fourth — and last — prediction. I believe that film will be the dominant medium of entertainment. In many ways, that prediction is fundamental to all the others.

Let me remind you, I began my predictions by talking about improvements in home entertainment — as HDTV comes into widespread use, film-based programming will look better than ever on the TV set. Then we talked about motion-picture theaters where film will remain the basis for more immersive experiences. Next, we moved on to the digital highway, where digital effects, created and printed at film resolution, are changing the way movies are made.

We come now to our common denominator — film. In terms of box-office revenue, it's more popular than ever. From a technical perspective, it offers enormous potential.

Well, those are my predictions. They are just a few of the many things I see happening in the future. Your list may or may not have the same items, but whatever you believe will happen, one thing is clear — we are in for times of great change. And perhaps the most profound change will be this — the boundaries are going away. The boundaries among technologies, between artist and technician, among movies and games and television, and every other form of entertainment. Increasingly, we are all in this together.

We are technical leaders who must think like artists. We are members of the creative community who must act like business people. We are filmmakers who must understand bits and bytes and data streams to be sent on optical fiber networks.

We share an incredible industry. It's an industry in which there are very, very few guarantees. For a hundred years, we've seen massive changes. Just in my career, there has been a lot of change. Much more will change in the future. But one other thing will not change — we will continue to make the investments required to improve imaging, in its many technologies and for its many purposes.

Film — the quality it offers and the capabilities it provides — has been fundamental to my predictions today, and it will continue to be an important tool for all of us who look forward to a long and successful "Future in Imaging."

Thank you.