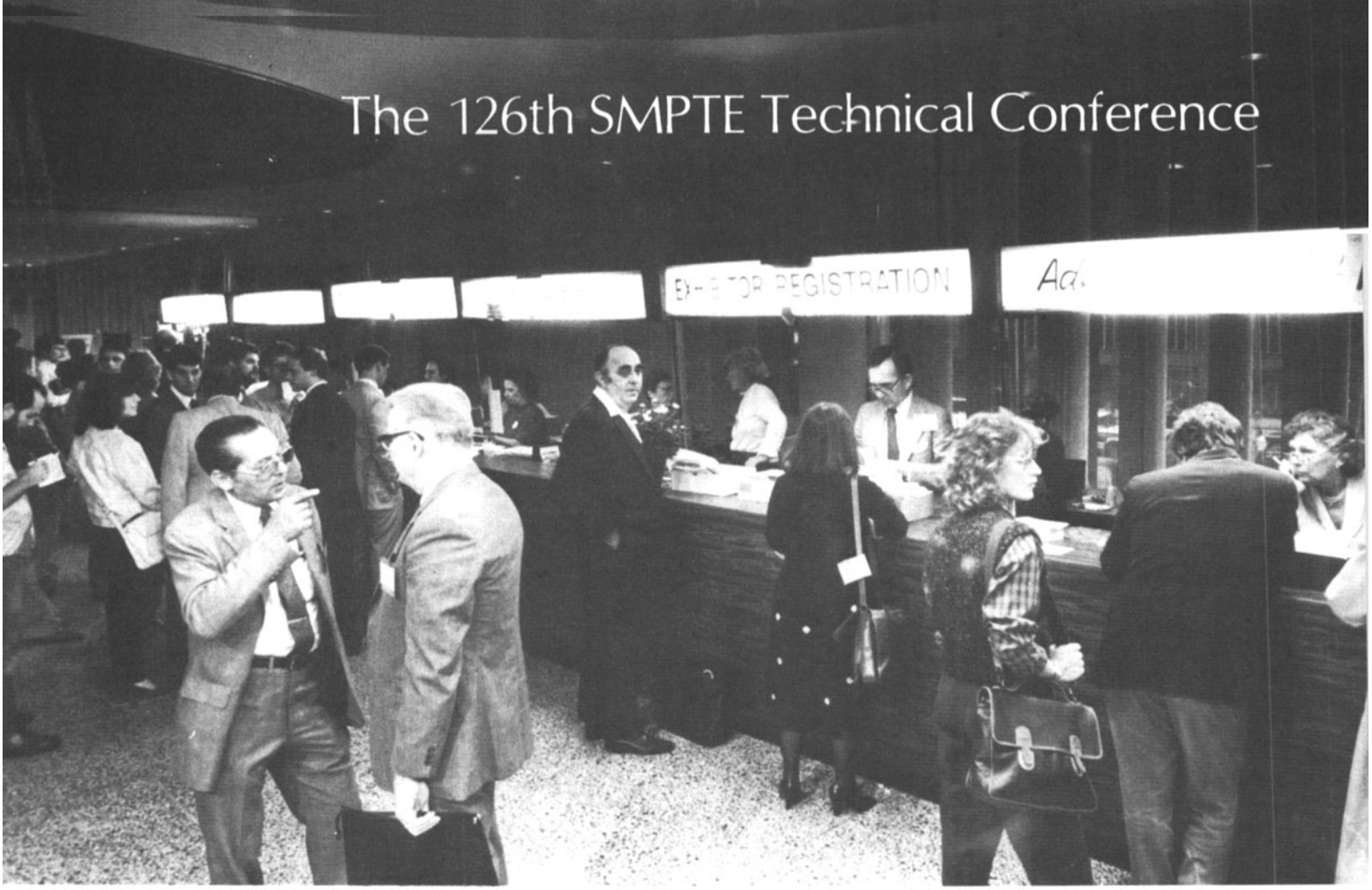
The 126th SMPTE Technical Conference



The registration area at the conference. (Courtesy Einzig Photographers)

The 126th Technical Conference and Equipment Exhibit, held October 28 to November 2 at the New York Hilton and Sheraton Centre Hotels, was the most successful New York conference in the Society's history.

Over 12,500 persons registered for this significant meeting, more than 10% above the attendance originally projected. More than 111 papers were presented during the five days of technical sessions. The equipment exhibit consisted of 479 booths, with 169 companies displaying the latest and most up-to-date equipment in motion pictures and television. This represented a 20% gain over the last New York conference, held in 1982.

The conference was under the overall supervision of Conference Vice-President Charles A. Ahto, Tape-Film Industries. The conference program was under the jurisdiction of Editorial Vice-President Maurice L. French, Canadian Broadcasting Corp.

Participants from many parts of the U.S. and from many parts of the world, including some from as far away as the People's Republic of China, were represented at the conference. The meeting proved to be an outstanding one, due in large part to the efforts of the various committees and their chairmen. Program Chairman Calvin M. Hotchkiss and Associate Program Chairman John C. Norris, Eastman Kodak Co., were responsible for the interesting and informative technical sessions. Local Arrangements Chairman Ed Burns, Eastman Kodak Co., was responsible for taking care of the infinite number of details necessary to make the conference run smoothly.

In addition to the technical program and the exhibit, a full week of activities was available for conference attendees. On Sunday evening, Eastman Kodak Co. sponsored a welcoming reception at the Copacabana to which all conference registrants were invited.

On Monday at noon, the Society held a reception and luncheon for the new Fellows of the Society. Former SMPTE President Robert M. Smith, Du Art Film Laboratories, Inc., was the speaker at the luncheon, which introduced the new Fellows to their peers.

On Tuesday at noon, the Society held its annual Honors and Awards Luncheon, with SMPTE President Leonard F. Coleman presiding. William F. Baker, president, Group W, Westinghouse Broadcasting and Cable, Inc., was the guest speaker. The various awards were presented by President Coleman and SMPTE Executive Director Lynette Robinson.

At the conclusion of the awards ceremonies, SMPTE Secretary M. Carlos Kennedy announced the results of the Society's election of new officers. Details of the election results were given in the December 1984 issue of the *Journal*. At the end of the luncheon, President Coleman turned over the gavel to the incoming President, Harold J. Eady, Novo Communications, Inc. Mr. Coleman now assumes the position of Past-President.

In addition to these and other social events detailed elsewhere in this issue, the Society provided a full week of interesting activities for spouses of those attending the conference, under the direction of Judith Hunt.

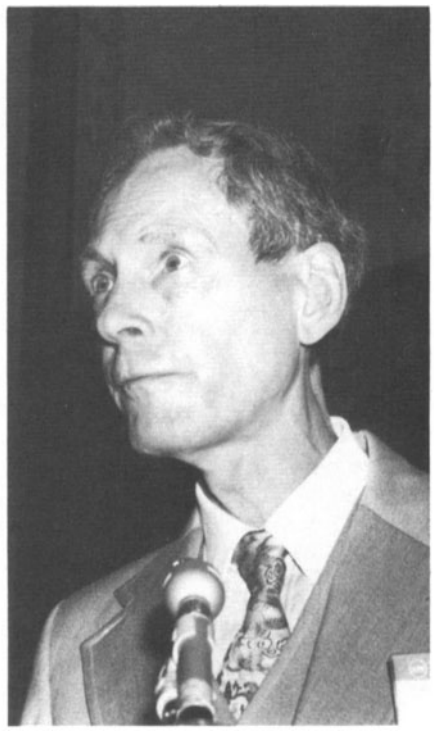
Conference photographs by Donna Foster-Roizen

Opening Ceremonies — Focusing on the Future of Image Technology

The opening session of Monday morning was well-attended, and set the tone for the week's activities. Program Chairman Calvin M. Hotchkiss made the introductory speech, after which SMPTE President Leonard F. Coleman welcomed the attendees. Executive Vice-President Harold Eady then gave the opening remarks. Editorial Vice-President Maurice L. French addressed the audience on the conference theme, "Focusing on the Future of Image Technology." This was followed by an engineering report from Engineering Vice-President Richard G. Streeter and an international report by Governor-at-Large Bengt O. Orhall.

The session also featured two prestigious guest speakers, Leo J. Thomas, senior vice-president and director of Kodak Research Laboratories, Eastman Kodak Co., and William G. Connolly, president, Sony Broadcast Co. The text of their remarks appears in this issue.

Associate Program Chairman John C. Norris.



Program Chairman Calvin M. Hotchkiss.

Message from the President to Conference Visitors

Once again, I would like to personally welcome you to New York City as attendees of the 126th SMPTE Conference. This year's conference in "The Big Apple" will again provide you with the experience of hearing interesting and topical technical presentations, along with the opportunity to meet friends and associates in the motion-picture and television industry.

I would be remiss in not pointing out the extensive work done by both the headquarters staff and the local committees for the preparation of this massive conference. Too often, it is taken for granted when we attend conferences that these well-planned events "just happen," but those people who have worked on the committees realize the long personal hours that are given up to make each of these occurrences a success. Our appreciation is extended to this group.

During 1984, the officers and governors of your Society have continued to work diligently to provide direction as well as leadership in both the disciplines of motion pictures and television. Our Society is, and with your efforts, will continue to be, the premier organization in the fields of motion pictures and television.

We hope you enjoy your week in New York City, and I will look forward to meeting many of you throughout the days of the conference.

Leonard F. Coleman
President, SMPTE

Executive Vice-President's Opening Remarks

By Harold J. Eady

Thank you Leonard, thank you ladies and gentlemen, and good morning.

I would like to also welcome everyone to the 126th SMPTE Technical Conference and Equipment Exhibit. This conference has every indication of being most successful, particularly due to the high quality of the technical presentations. This conference is focusing on the future of image technology and promises to display, discuss, and debate the very latest of the state of the art of our industry.

We have 109 papers at this conference, and since 2000 of the 8000 SMPTE members are from outside the United States, it should not be surprising that these speakers come to us from 11 different countries, including for the first time, the People's Republic of China. This will indeed be an ideal opportunity for an international exchange of ideas and events. We will be covering many, diverse subjects during 12 different sessions throughout the week.

A few of the highlights of the week include a presentation on resolution requirements on high-definition television based upon the performance of 35mm motion-picture film for theatrical viewing. Also this Olympic year will be the history of television coverage of the Olympics up to its current state of the art, and the latest in film technology. Something which promises to be very new and exciting, will be reports on IMAX cinematography and on the use of motion-picture film in the outer space environment.

If you are not afraid of sore feet, you will have the opportunity to wander through 50,000 ft^2 of booth space, a 20% increase over the space provided at the last conference in New York. Over 169 exhibitors will be occupying 479 booths this year. Small wonder the Will Rogers Institute has donated space to check your blood pressure.

Also, we have the opportunity to renew and extend friendships throughout the week. There are several activities such as the luncheon for Fellow members only on Monday, where our guest speaker will be Mr. Bob Smith of Du Art, a former SMPTE President; the Honors and Awards Luncheon at the Sheraton Hotel on Tuesday, where the guest speaker will be Dr. William Baker, President of Group W Television and Chairman of Group W Satellite Communications; and we have our annual Banquet Wednesday in the Grand Ballroom at the Hilton. In addition, our spouses will have an enjoyable week under a well-planned program by Mrs. Judy Hunt.

Executive Vice-President Harold J. Eady making the introductory remarks at the opening session.

I would also like to pay tribute to the many companies and organizations for providing necessary services to make this conference possible: American Broadcasting Co.; Ampex Corp.; Eastman Kodak Co.; Fuji Photo Film USA, Inc.; Magna-Tech Electronic Co.; Dolby Laboratories Inc.; Technicolor Inc.; 3M Co.; Will Rogers Institute; Multi-Track Magnetics Inc.; Hazeltine, Inc.; Information Display Systems; and the General Electric Co.

Ladies and gentlemen, I hope you will take the opportunity to participate in these activities. They are the fruits of the efforts of the many hard-working volunteers that make up this great Society, the SMPTE.

Thank you very much.

Conference Committee — Program Chairmen

Editorial Vice-President
Maurice L. French, *Canadian Broadcasting Corp.*

Program Chairman
Calvin M. Hotchkiss

Associate Program Chairman
John C. Norris, *Eastman Kodak Co.*

Program Co-Chairmen
Film: Irwin W. Young, *Du Art Film Laboratories, Inc.*
Television: Philip Godfrey, *ABC*

Image Technology in Action
Session Chairmen: Royce L. Pointer, *ABC*
Paul Berger, *ABC*

Laboratory Practices
Session Chairmen: Fred Franzwa, *Eastman Kodak Co.*
Jeanette L. Burger, *Eastman Kodak Co.*

Film and Television Production
Session Chairman: Herbert C. Ohlandt, *National Video Center*

Film Technology
Session Chairmen: Frank Hauser, *Guffanti Film Lab*
Dave Hubbell, *Eastman Kodak Co.*

Small Format Video
Session Chairmen: Bebe McClain, *B. F. McClain Productions*
Barry Parker, *PAG Ltd.*

Film/Tape Interface I
Session Chairmen: Ed Ancona, *NBC*
James Gibbings, *NBC*

Image Sensors
Session Chairmen: Sean K. Rabbit, *Amperex Electronics Corp.*
Ron Gurley, *RCA*

Film/Tape Interface II
Session Chairman: Richard Schafer, *Eastman Kodak Co.*

Lighting and Batteries
Session Chairmen: Ross Lowell, *Lowel-Light Mfg. Co.*
Marvin Seligman, *Lowel-Light Mfg. Co.*

Post-Production (Film and Television)
Session Chairmen: Eric Knutsen, *Post Perfect*
Mike Groth, *Eastman Kodak Co.*

Graphics and Digital Techniques I
Session Chairmen: David Rabinowitz, *NBC*
Christine Barton, *NBC*

Audio Technology and Projection Practices
Session Chairman: Leonard A. Green, *National Film Board of Canada*

Future Trends in Image Technology — Photographic and Electronic I
Session Chairmen: Jonathan Erland, *Apogee, Inc.*
Percy Engress, *Apogee, Inc.*

Television Systems and Broadcast Technology
Session Chairmen: Anthony Uyttendaele, *ABC*
Fred Faist, *ABC*

Future Trends in Image Technology — Photographic and Electronic II
Session Chairman: C. Robert Paulson, *AVP Communication*

Lining up to be photographed at the reception prior to the SMPTE banquet were (L–R) Edward J. Burns, Mr. and Mrs. Robert M. Smith, Mr. and Mrs. William Cooper, Mr. and Mrs. C. Bradley Hunt, Mr. and Mrs. Edward Messina, Mr. and Mrs. Irving Rosenberg, Neil Pilzer and guest Anita Iten, and James Hannafin.

Conference Theme:
Focusing on the Future of Image Technology

By Maurice L. French, SMPTE Editorial Vice-President

Good morning, Mr. President, members, and guests.

I am pleased to be invited to deliver the theme address at this, the 126th SMPTE Technical Conference. Attending Society conferences over the past 28 years, I always sense a vibrant atmosphere of expectation, uniquely synonymous with this Society and with the progressive motion-picture and television industry. In today's jargon, "This is where it's at."

Since the first meeting of the Society in Washington on July 24, 1916, there have been many outstanding gatherings of this event, each conference structured to provide a forum for the presentation and discussion of the most challenging issues. But new concepts, ideas, and discoveries presented in the form of technical papers are not brought together by mere coincidence. They need to be thought about, written, organized, and delivered — all of which emphasizes the meaning of that famous four-letter word — work!

Program Chairman Calvin Hotchkiss, Associate Chairman John Norris, Co-Chairmen Irwin Young and Philip Godfrey, the papers committee, authors, and Headquarters staff are aware of the Society's worldwide reputation and its long record of high standards. They are also knowledgeable and sensitive to the high expectation of the delegates. They have dedicated themselves to this task with much forethought, and they have approached it with vitality and enthusiasm. I believe they are to be commended for accepting and fulfilling this demanding responsibility.

This conference holds the promise of excellence. The theme, "Focusing on the Future of Image Technology," is engaging and pertinent. Forecasting is difficult, especially when it involves the future, but since the dawn of time, man has constantly been occupied with trying to predict what might happen tomorrow. In this age of rapid technological development, our need for insight becomes even more pressing and crucial, and an understanding of the situation is fundamental. Not to understand the situation reminds me of the story of the two men who were being chased by a grizzly bear. One of them stopped to put his running shoes on. The other said that running shoes won't make a difference. "We'll never outdistance this bear." To which the first replied, "I'm not concerned about the bear. I only have to run faster than you."

Editorial Vice-President Maurice L. French addressing the audience on the conference theme.

We are living in exciting but demanding times. The spectrum of new possibilities is broad, limited only by our imagination and our will to achieve. Although new discoveries may often stimulate improvement or enhance existing methods, they do not necessarily demand complete replacement. In our plans for the future, we must not be mesmerized by the avant garde philosophy that "new is better." The real value and advantage must clearly be seen, and the short- and long-term ramifications understood. To do otherwise is to bounce from one new idea to the next without direction or achievement.

Technology is, by definition, the application of science, and image technology has, indeed, evolved as a composite of the photographic, electronic, and computer sciences. An objective selection of the right combination of elements to produce and distribute the image is paramount.

New technology and available hardware are only part of the total picture. As with all major revolutions, the key element is people. It is, after all, people that make programs. Paint, a brush, and canvas are the resources, but without the touch of the artist's hand, they will never become a masterpiece. It is the human creative contribution to a production that determines success or failure.

Innovative equipment design should

provide the technical and creative community with a range of compatible equipment and recording media to enable them to produce exciting, dynamic images and sounds. The human freedom to create must not be impaired or suppressed by the magnificence of the machine. The tail should not wag the dog! But how much greater our potential as human beings when we have magnificent machines to keep carrying our thoughts and ideas out of our imaginations and into reality.

While some of the earliest images or hieroglyphics were confined to the walls of caves or sealed in the tombs of the ancient pharaohs, images today are broadcast or exhibited worldwide, and millions of people have home receivers enabling them to select from an increasing number of sources, events, or programs that inform or entertain them. They have been tantalized and stimulated. New standards have been set and our audience's expectations are high and constantly rising. The worldwide distribution of programs to meet the insatiable demand in a competitive market not only mandates quality program content of optimum technical quality, but places high priority on international standardization.

Since its inception, the Society of Motion Picture and Television Engineers has assumed a leadership role in standards. Many of today's excellent standards are the result of years of dedicated work by Society members, but the evolving magnitude and scope of the task, influenced by the immediacy of need, adds still new responsibilities and places even greater emphasis on the importance of international standardization.

As we move towards the future with new and ever-changing technology, we must be mindful to leave a retrievable and conveniently readable record of our past. Archival and stockshot material is an essential record and a valuable program resource. At any given moment, we are — as individuals or as a country, the sum total of our experience and our accomplishments — in other words, our history. The present is fleeting, the future unknown. Only the past is a tangible foundation for our leap into the future. The important events of our time, our artistic contributions, and our scientific accomplishments form part of the legacy we leave for the next generation. If they do not know where they came from, it may be difficult for them to know where they are going, and as Confucius said, "One picture is worth a thousand words."

These are some of the fundamental issues that confront us as we assess our present and future position. The theme of this conference, "Focusing on the Future of Image Technology," was chosen to try to provide some of the answers to the many complex questions that emerge. In mountainous country when you are trying to find your bearings, you do not go down into the valley, but instead move up towards the mountain top. The authors presenting papers here this week are recognized experts, and they should provide us with a choice of directions. The decisions we make today will greatly influence our tomorrow. The future is in our hands. We can make the future happen!

There are members who are unable to join us here this week. Thus a special 126th Conference Report issue of the *SMPTE Journal* will be published in January and, of course, many of the papers presented here will subsequently be published in later issues. Since the *SMPTE Journal* is the only link that many offshore members have with the Society, the Society is pleased to announce a new air mail service to our overseas membership. This will ensure that now all members will receive the *SMPTE Journal* as soon as possible.

And finally, every individual who has taken a personal interest in making this conference possible hopes that, as we focus on image technology of the future, *your* picture will become a little clearer!

Thank you. Now, enjoy the conference!

Conference Committee — General Arrangements

Conference Vice-President
Charles A. Ahto, *Tape-Film Industries*

General Arrangements Chairman
Edward J. Burns, *Eastman Kodak Co.*

Facilities Chairman
C. Bradley Hunt, *Eastman Kodak Co.*

Entertainment Chairman
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John Low, *Motion Picture Enterprises*

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Banquet Co-Chairman
Michael Fisher, *ABC*

Banquet Co-Chairman
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Irving Rosenberg, *CBS*

Audiovisual Television Chairman
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Hospitality Chairman
Neal Pilzer, *Motion Picture Enterprises*

Opening Films Chairman and Administrative Assistant
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Finance Chairman
James Hannafin, *Technicolor, Inc.*

Transportation Chairman/Administrative Assistant
William L. Cooper, *William L. Cooper Productions*

Security Chairman
Edward Messina, *ABC*

Security Co-Chairman
Robert Smith, *Du Art Film Laboratories, Inc.*

Spouses Program Chairwoman
Judith E. Hunt

Engineering Report

By Richard G. Streeter, SMPTE Engineering Vice-President

For almost 70 years, our Society has had as a primary function the development of industrial standards for the motion-picture world, and for the past 34 years, for the operational aspects of television. From its beginning in 1916, when 26 leading engineers banded together to standardize motion pictures, we have grown to a group of over 500 nationally and internationally recognized engineers working through the Society's approximately 30 technical committees.

During this time, the SMPTE has clearly established itself as a leading engineering society in the motion-picture and television fields. This is further exemplified by the 27 engineering committee meetings to be held during this conference week. This compares with the eight meetings held at our conference just ten years ago.

To coordinate the development of standards in the diverse technologies which contribute to the broadcasting industry, and to meet the needs of manufacturers and users while avoiding redundancy of effort, the Society joined forces in 1951 with two other organizations concerned with broadcast television. These were the Institute of Radio Engineers (now the IEEE) and the Radio Manufacturers Association (now known as the EIA). With the addition of the National Association of Broadcasters (NAB) and the National Cable Television Association (NCTA), they became the Joint Committee of Intersociety Coordination (JCIC).

In addition to this liaison, the Society works closely with the U.S. National Committees for the International Radio Consultative Committee (CCIR), the U.S. National Committee for International Electrotechnical Commission (IEC), the European Broadcasting Union (EBU), the Advanced Television Systems Committee (ATSC), and the British Kinematograph, Sound and Television Society (BKSTS).

Many awards attest to our outstanding contributions. In 1958, the Society was presented with an Oscar for technical achievement. It has been recognized by the Academy of Television Arts and Sciences with awards for the development of the time and

Engineering Vice-President Richard G. Streeter presenting his engineering report.

control code for the quadruplex videotape system, and for the development and standardization of the 1-in. Type-C helical videotape format. Recently the Society received an Emmy for its contributions in the establishment of a world digital standard.

In the last few years, the technological environment in which we work has changed dramatically. This has forced us to reexamine our role of service to the industry. There was a time when an innovative scientist or engineer could retreat into his laboratory and design and build some new piece of equipment, often pushing forward the frontiers of technology. The creative community, continually seeking means to be innovative and more efficient, eagerly put the equipment into service, often with less than optimum results.

Today, however, we work in an environment in which technology is advancing at an explosive rate. There is a real danger of its providing not only everything asked for, but also providing brilliant and sophisticated solutions for problems that do not exist — at least in the form envisioned by the technologist.

In this new environment, where equipment installed today may be technically obsolete before it has been fully depreciated, the role of the Society in developing standards is especially challenging. A standard established too soon in an area of rapid technological changes may well stifle the full development and advantages of the technology. If delayed too long, the marketplace will already be filled with a number of de facto and incompatible standards, and manufacturers will be unwilling to abandon their investment in the development, production, and marketing of their existing products.

Indeed, it may well be asked: In this environment, do we need standards at all? I believe the answer is yes.

First, let me say that the economic benefits of timely standards are today more indisputable than ever. Television programs are now distributed and interchanged worldwide. International communications by satellite have made it vital to work towards national and international standards. Such standards not only spread the cost of developing and manufacturing equipment across a world market, with great economic benefits to manufacturers and users alike, but also simplify the problems of program exchange.

For their part, manufacturers must compete as always, but if they work towards meeting a standard, they will be competing in a single large market, rather than in a plurality of fractionated markets. But the standard must be timely, and the challenge to develop standards in a timely fashion falls squarely on us all.

While SMPTE can act as a moderator of the process and provide the administrative machinery, the work itself must be done by dedicated members drawn from the industry itself. The standardization process is really a self-regulatory program. We can no longer look to the government to promote, establish, or enforce standards.

I know that some will say: This is all very well, but why does it take so long to develop a standard? Let me take a moment to outline the procedure we follow.

An area of developing technology which will clearly benefit from standardization is selected and is normally given to a working group which develops a draft standard. This is often not a simple process. All views must be heard and detailed information presented for consideration. There may be

substantial differences of opinion, and it is necessary that the group, under the guidance of the chairman, reach a consensus. Once this is achieved, the draft standard is then reviewed by the appropriate parent technology committee.

When approved, it is next reviewed by the Standards Committee, composed of the chairmen of all of the technology committees in addition to specialists in the field of international standards. It is the responsibility of this group to ensure that the proposed standard fits into the overall system and does not conflict with other standards already established.

Next, the proposed standard is published in the Society's *Journal*. Anyone concerned has the opportunity to respond and comment on it.

Last, the Executive Committee for Standards Approval, reviews the proposed standard and approves it on behalf of SMPTE, having determined that a true consensus of opinion exists. At this point it is an SMPTE Standard.

It is then submitted to the American National Standards Institute (ANSI) for recognition as an American National Standard. ANSI publishes the proposed standard, and if no adverse comments are received within 120 days, it is then passed on to their review board, which determines whether all due process procedures were followed. It then becomes a national voluntary standard.

The problem with this equitable, but necessary, pedestrian procedure is that it can take considerable time (one or more years). In that time, there is a danger that technology may have made the standard irrelevant, if not obsolete, and manufacturers are reluctant to watch a market pass them by.

In this challenging situation, the Society is taking administrative steps to expedite and streamline the process, while retaining the necessary assurance of a proper consensus. Again, we must turn to the members who constitute our technical committees and ask them to accelerate their efforts.

We must recognize that no matter how quickly a standard is developed and established, its useful life in the middle of this technological revolution may be short. *Nothing is forever!* It is necessary that standards established today be reviewed at least every five years to assure their continued relevance, and to see that they do not constrain further technological progress.

With the knowledge that any standard developed may have a limited period of application, I believe that members serving on our various committees may be encouraged to agree more quickly with a proposed standard than if they were attempting to foresee the industry's needs for the next 20 years or so.

The Society is aware of the need for continuing improvement of picture and audio reproduction in television as well as the theater, and stands ready to assist the efforts needed to ensure the best that technology can offer. Certainly establishing standards is difficult and challenging. But as someone once said, challenges are what make engineering fun.

International Report

By Bengt Orhall, Governor-at-Large and Chairman, International Relations Committee

It is my privilege, as Chairman of the Society's International Relations Committee, to address a special welcome to all our international members and guests here today. It is interesting that in spite of a strong American dollar, we have over 300 foreign delegates registered as of yesterday, from more than 20 countries. And, of course, it is very important for the Society to be more international.

The first step toward that goal was to appoint so-called international governors to the Board of Governors here. The first two governors are John Barry from Australia and myself. Our task is to inform the Board of how the Society can serve the international membership in a better way. You have heard one of the results already from Maurice French — that the *Journal* will be shipped by air mail to all international members. I think it is important that in other countries we can have a fresh *Journal* that has news, and that we get information about all the activities of the Society.

Bengt Orhall, Governor-at-Large and Chairman presenting International Report.

If any of the international members here have ideas or complaints or comments about the work of the Society, feel free to call either John Barry or me so we can inform the Board of Governors here, and maybe we can make some changes in the future.

This year there was also the first conference outside North America. This was held by the Australian Section in Sydney. The Australian Section really did a tremendous job with that conference and the event was a great success. There were over 600 delegates to that conference, and I think it was very important for the Society to show what we are doing in that part of the world.

Also this year, the Society was represented at the UNIATEC meeting in Paris. UNIATEC is a very interesting society where ideas are exchanged from the Western to Eastern countries and vice versa. I hope that activities like these will encourage more people to join the Society, because it is important for us to have more international members. The strength of a society is directly related to the membership. When you go home to your native country, I suggest you pick up the membership application form and give one to a friend so we can think double the number of international members.

To conclude, I wish all of you a very interesting and stimulating conference here.

Standardization and the Role of SMPTE

By William G. Connolly

I consider it a great privilege to have been invited here to speak to you this morning. I also consider it to be a great opportunity. It doesn't matter to me that being the last guest speaker at SMPTE has been compared to singing the national anthem before the Super Bowl. You know everyone's just waiting for you to finish so they can get down to the main event. And certainly, the SMPTE Conference and Exhibit has become one of the main events in our industry.

I'm especially pleased to be able to speak to SMPTE in 1984. Not because of any Orwellian significance, but because it's an important year of self-evaluation for the broadcast industry.

Every four years, the industry meets the dual challenge of providing live coverage of the Olympic Games and the U.S. Presidential campaigns — from the primaries to party conventions, right up through the drama of election night next week.

These events speak to the very essence of broadcasting. They have an immediacy, a human drama, and a scale that broadcasting is uniquely qualified to deliver. The events themselves don't change that fundamentally from one election or Olympiad to another. But the technology that broadcasters bring to their coverage of these events changes dramatically.

This is something that we can be proud of, and also something that gives us cause to think carefully about the future.

Next week's election night coverage will demonstrate to millions of Americans the latest benefits of the marriage between video technology and computer graphics. Other advances are less visible at the moment but just as important. I'm talking new resources like the advances in CCD cameras, slow-motion video, high-definition video systems, and the replacement of terrestrial transmission lines by satellites for network affiliate distribution.

The year 1984 is a milestone for incredible technical achievements. The technology of the industry has evolved to the point where it is no longer a limiting factor. In 1984, we moved one year further into the era of not what *can* technology produce — but, what *should* technology produce?

Guest speaker William G. Connolly speaking on the SMPTE and standardization.

To a great extent, that question will have to be answered by the users. Their needs should determine the direction of future technological development. As an industry, we now have the power to shape technology to meet user needs.

People throughout the broadcast and film industries now have a vital role to fulfill in ensuring that this new-found power is efficiently harnessed.

SMPTE is a key player in harnessing this power. For the world to realize the benefits of these technologies, we must have standards. Standardization is the one issue that towers over all others when we talk about the future of image technologies. That issue is vital to this society and its role in the global communications networks of tomorrow.

Since commercial television began changing America's lifestyles some 35 years ago, the need for the international standardization of broadcasting systems has never been more obvious, or more critical.

In a book about the development of Silicon Valley called *The New Alchemists*, author Dirk Hansen puts the need for global communications systems in historical perspective.

He points out that the Industrial Age didn't reach its full global potential until a worldwide energy network was put into place. Today we have that network, and the Industrial Age is history.

We are now in the Information Age, and it needs another kind of network to deliver on its benefits. The Information Age requires a global communications network. That's what nations, companies, and technologists of the world are seeking, even if their progress at the moment is piecemeal and disjointed.

But you can't expect massive societal changes to operate like a well-designed software program. The Information Age is the product of the information revolution, and that revolution has been percolating for longer than people sometimes realize.

The seeds of that revolution go back as far as the first television transmission experiments in the 1920's, and maybe even earlier to the development of Morse code in the 19th century.

Television was in its infancy when the transistor was invented in 1947. No one knew it at the time, but the foundation for the Computer Age had been poured. And the merger of computer and broadcast technology is the pillar of the Information Age.

While the pace of technological innovation is miraculous, we won't experience anything like the full potential of this technology until we make similar progress on other fronts.

In terms of consistent standardization of broadcasting systems, this industry is first emerging from the Dark Ages. We must close the gap between our rapidly expanding commitment to new technology and our willingness to make the sacrifices that are part of orderly growth.

Our ability to close that gap is the key to answering a vital question about the future. Will the U.S. broadcast industry take the lead in the business of universalizing the benefits of the Information Age, or will we delay those benefits because of an inability to deal effectively with technical standards?

I hope that will turn out to be a rhetorical question, because the scope of the issue is enormous.

Through my 20-odd years at CBS,

William G. Connolly is president and chief executive officer, Sony Broadcast Products Co., Teaneck, N.J.

and more recently on the manufacturing side with Sony, I have been a strong supporter and believer in the SMPTE organization. I believe that a strong SMPTE is vital to the industry.

SMPTE has an unexcelled track record in its dissemination of technical information. No matter where I travel around the world, I can always find the *SMPTE Journal* on the shelves of technical libraries.

As video and film technologies have merged, SMPTE has taken the lead in coordinating the needs of both creative forces.

Most important, SMPTE has demonstrated its ability to develop vital standards that have benefited everyone in this room. The Society's ability to expand this work in the years ahead will have a critical affect on the orderly growth of Information Age technology.

Realistically, we have to evaluate the Society's future role in the context of what's happening right now in government and business. Government deregulation is trendy. The last four years have seen the de-regulation of industries as vital to the national interest as telecommunications, banking, and even college football. It is a trend that has enjoyed the support of both political parties.

In the light of today's regulatory reality, it is clearer than ever that neither the FCC nor any other federal agency is going to provide guidance on intelligent growth and systems standardization. SMPTE, which is to say the film and video industry itself, will have to provide studio standards and practices.

When it comes to setting standards, SMPTE doesn't have the FCC's luxury of regulating by fiat. Instead, we have to deal with a form of control that is both more tenuous and in the long term more effective. That form is *consensus*.

SMPTE doesn't *set* standards in the sense that the Federal Reserve Board sets monetary policy. Instead, SMPTE's role is to bring the players together and lay the groundwork for the evolution of a mutually acceptable standard. This is a much more creative and demanding process, and we know it can work.

The SMPTE standard for 1-in. Type-C evolved through that process. And I don't think anyone here today would disagree with me that Type-C is one of the great success stories of this Society. The entire industry benefited from the C-Format standard and continues to benefit as manufacturers like Sony have maintained compatibility in new products with the C-Format standard.

The SMPTE/EBU time-code standard was another positive example of regulation by consensus. So was the digital studio interface. And the progress we've made to date towards a digital VTR standard is also the result of intelligent arbitration initiated through SMPTE.

As I said earlier, I am an SMPTE believer. But you know, and I know, that we have fallen dangerously short of our potential. In many areas relating to standardization we're in a state of gridlock.

When J. W. McNair was technical director of the American Standards Association, he pointed out, "It is the business of a gyrostabilizer to keep the ship on an even keel when it is being buffeted by waves, not to stop the ship. Just so it is the business of a successful standard to help industry maintain itself in dynamic equilibrium, not in a static condition."

That observation clearly applies to us. Without a standard, our industry is left static. This is what happened in the development of the ½-in. format. And it is happening now in the case of high-definition video.

The lack of a standard for something as basic as the ½-in. VTR is an indictment of SMPTE's inability to bring together the manufacturers involved and to arrive at a standard. This industry needs a strong SMPTE, a traffic cop, to provide the direction that will trigger the fusion of corporate interests.

You might argue that it was the manufacturers who refused to cooperate with SMPTE's efforts at arriving at a ½-in. standard. But, it is SMPTE's responsibility to the industry to bring the interests of manufacturers and users together early in the developmental process and to act as the arbiter. This is not a popular job — but it is vital to the growth of new technologies that will advance this information revolution.

High-definition video is yet another area where we are approaching gridlock. And if that happens, we will be denied the benefits of one of the most exciting video technology advances since color television.

I'm not suggesting for a minute that securing a standard for either of these technologies would be easy. But I hope I am very clearly stating that this difficult task belongs to SMPTE.

We must not allow the concept of regulation by consensus to atrophy into regulation by convenience. Worthwhile regulation is never convenient. And standardization is the most worthwhile regulation to consider.

If SMPTE is to deliver the kind of intelligent leadership we need in this area, then we also have to be willing to set some standards for how we operate as an organization.

For starters, as a Society we must stop listening to the cry that it is too early to set standards. This kind of thinking reflects a misunderstanding of the role of standardization. When we create a standard, we do not create a freeze-frame on its further development. Just the opposite. A universal standard is a taking-off point for future development. Standardization should take place earlier rather than later, before commitments are made by manufacturers.

Part of the problem in getting started is that all of us here are perfectionists. We want the perfect standard covering every possible feature imaginable. But, we also now have the talents to adopt our designs to existing formats. As I said, the standard is the taking-off point, not the end of development.

When the Type-C format was designed, no one envisioned a slow-motion recorder, recording 180 fields. No one foresaw using the Type-C recorder for single-frame animation recording or as the basis for a high-definition videotape recorder. And, you can be sure we'll see developments based on the Type-C format for years to come.

The digital VTR format we arrive at will allow unforseen products and features to be developed for many, many years. It is not too early to talk digital VTR standards.

Too often we hear, "it's too early to set a standard." Then, it's too late. We must establish a window on when standardization is to take place.

For standardization, we need to initiate a mutual educational process between designers and the potential users in the capabilities of the state of the art. It is incumbent upon the users to inform designers of operational and performance requirements before and after the designers go to the drawing boards.

Even more important than how we

pursue standards is the question of whether we pursue them at all. I urge you, as individual members and as the collective membership of SMPTE — don't walk away from this responsibility.

The future benefits of image technologies are only as strong as our ability to deliver them. And we can't begin to deliver those benefits at anything near their full potential until everyone in the global picture can receive and transmit the same signals.

This won't happen until we get behind workable, worldwide standards.

This need goes beyond the market share of any company or the life span of any product. When we talk standardization, we're talking about nothing short of delivering on the promise of the Information Age.

That's a heavy responsibility. But it's one SMPTE is uniquely qualified to assume. It won't be easy, but it will be well worth the effort.

As a longtime SMPTE member and supporter, I look forward to working with all of you. And I look forward to our ultimate success.

Thank you very much.

Imaging Technology: The Vision and the Reality

By Leo J. Thomas, Jr.

I'm pleased to be here today to discuss imaging technologies and the future. I think it was Will Rogers who once said that it's difficult to predict things — "especially when it comes to the future."

Predicting is still difficult, but the future is not completely unfamiliar to the industrial research scientist — and for good reason. That is where we try to spend much of our time. Our mission is to look ahead, to shape a practical vision of tomorrow's products.

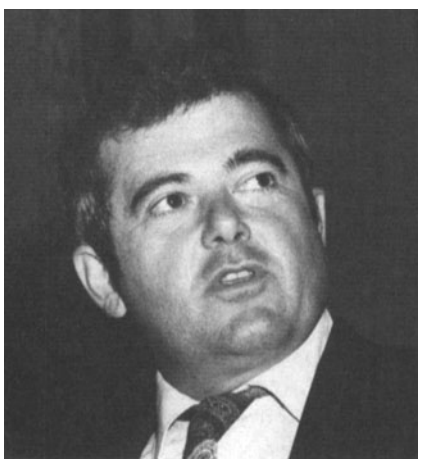
Long ago, Jonathan Swift defined vision as "the art of seeing things invisible." To that, I might add this thought: research and development is the science of turning vision into reality.

My topic today is "Imaging Technology: The Vision and the Reality."

In one way or another imaging is familiar to all of us, yet it can mean different things to different people. Let me begin with a fanciful view which appeared recently in *The New Yorker*. This "vision" on imaging is expressed in a poem called "Scenic View" by Don Hall:

"Every year the mountains get paler and more distant — trees less green, rock piles disappearing — as emulsion from a billion Kodaks sucks color out. In fifteen years, Monadnock and Kearsarge, the Green Mountains and the White will turn invisible, all tint removed, atom by atom, to albums in Medford and Greenwich, while over the valleys the still intractable granite rears with unseeable peaks fatal to airplane."

Dr. L. J. Thomas, Jr. is senior vice-president and director, Kodak Research Laboratories, Rochester, N.Y.



Guest speaker Leo J. Thomas gave a talk on standards at the opening sessions, accompanied by a film presentation.

The New Yorker notwithstanding, man does not live by poetry alone. Photography and other imaging technologies are making life *more* colorful, *more* enjoyable, and *more* beneficial for us all. To those in the motion-picture industry, imaging technology is the means through which creative ideas enlighten, elucidate, and entertain.

To those in the medical profession, imaging technology is a non-invasive means to look inside the body, to diagnose illness, and to understand the complexities of the human chemical system. New techniques will soon allow us to detect small changes in the chemical composition of certain organs as early-warning signals of disease.

In business and industry, imaging technology flourishes to serve a range of needs from records management to communications. And of course, for millions of amateur and professional picture-takers, today's imaging technology provides the means to capture moments in time, preserve memories, and engage the human spirit.

As a tool for science, the continuing advance of imaging technology allows us to know much we couldn't know before, to keep and catalog aspects of life that otherwise might be lost forever. It allows us to record those physical and natural phenomena that occur either too quickly or too slowly — or are too small or too large — to be seen by the human eye. It can freeze a home run ball at the moment of impact — or stop a high speed industrial process in mid-cycle. Today, both can be done with photography, but also with electronic cameras. The Kodak SP2000 motion-analysis camera can record 2000 frames of images a second. It's a small compact system that records as much information as 35 tape recorders running simultaneously in perfect synchronization.

Today, we are witnessing the convergence of two rapidly advancing sciences — photography and electronics. This convergence allows us to see things that have never been seen before.

Powerful ion-emission microscopes allow us to see individual atoms. Lasers allow us to measure processes that occur in less than one millionth of one millionth of a second. The movement of atoms within molecules occurs in this very short time frame. And we can use this information to understand and control chemical and biological reactions.

Imaging technology not only unlocks the mysteries of the microscopic world, it carries us to the far reaches of the cosmos.

A current effort to update the map of the skies in the northern hemisphere involves Kodak, the California Institute of Technology, and the National Geographic Society. This ambitious undertaking will lead to maps that will allow us to see three times as far as we can with existing maps. Advances in optics and photographic emulsion technology combine to make this possible.

These sky maps will be critical aids to astronomers who will use powerful ground and space-based telescopes to probe distant stars and planets. As these telescopes gain just one order of magnitude, the number of observable objects in the universe doubles. Today, we can see — and record — perhaps ten billion million stars and planets. New technology is extending our vision further still.

The most powerful telescopes use photographic plates and electronic sensors to record images of stars a billion times as far away as the sun. Photographic plates will map large areas of the sky, while electronic devices record smaller areas with great sensitivity. Solid-state microelectronic chips in the telescope cooled to 300° below zero and highly sensitive to light will record events that occurred more than a billion years ago.

The photographic result will bring new clarity to our vision of the universe. It is in the research laboratory that this vision takes shape, where it begins on the journey toward tomorrow's reality. It is in this context that I would like to discuss the road ahead for imaging technology, and the junctures at which vision will meet reality.

To gain perspective on the pace of innovation in the future, it is helpful to consider how far we've come. It took 56 years for the telephone to go from discovery to commercial product; 35 years for radio; 21 years for xerography; 15 for radar; 12 for television; and only 5 for the transistor to find its way from the laboratory to the market.

The transistor has been replaced by the integrated circuit, which itself is based on photographic principles. In fact, light-sensitive photoresists are the basis for production of these tiny circuits. We introduced photoresist more than 30 years ago — as a product to eliminate unwanted portions of printing plates. I'm sure that its inventor never dreamed of its application in very large scale integrated circuits (VLSI). With VLSI, we can now put hundreds of thousands of electronic switches on a silicon chip which measures only a centimeter square.

Microelectronics, along with advances in optics and traditional photographic film technology, will have tremendous implications for the ways we use and enjoy images in the future. For imaging technology is now at the heart of what is now being called the information age. The transition to the high-tech world of information represents tremendous change — and uncertainty for all of us.

John Naisbitt, author of *Megatrends*, puts it this way:

"We have not quite left behind yesterday, but we have not embraced tomorrow, either. We have done the human thing: we are clinging to the known past in fear of the unknown future."

Mr. Naisbitt is right. I think most of us agree that change is good — for someone else. The problem people have with technological change is that it is different from other kinds of change — political, economic, social. Technological change is irreversible. The scientific principles upon which the atomic bomb is based will not go away. We can't undo the fact that man has set foot on the moon. There's no way that we can repeal the laws of physics, like we can the laws of government.

As a result, scientific and technical visionaries have never been very popular. Charles Kettering, the great industrialist and inventor, once remarked, "Most people think of inventors as longhairs and screwballs. But we inventors are so small in number we don't dare say what we think of most people."

Even Thomas Edison was not immune from criticism and skepticism. This editorial comment appeared in *The New York Times*, December 30, 1878:

"Some curious facts regarding . . . electric light . . . raise the point whether (its) properties . . . are such as to render it a safe and wholesome substitute for light produced by combustion."

Another statement closer to home for me appeared in the *Penrose Annual* in 1935. It dealt with Eastman Kodak and consumer photography:

"To imagine that dividends can be paid to shareholders in a process that seeks to supply the public with snapshots or portraits in color is extreme foolishness."

And yet, the foolish dreamers kept on believing. Dr. Edwin Land was one of those dreamers. The key to his innovation was to put the darkroom — chemicals and all — in the film package. The ability to accomplish this allowed the picture-taker to see the results in seconds.

For some, however, the dream was hard to visualize. In Dr. Land's letter to the stockholders in the Polaroid Annual Report of 1979 he writes:

"Famous in our circles is the story of the visiting English banker who in 1948 upon seeing our model 95 camera commented, 'Very interesting, but why would one want a picture in a minute?' "

There is an important point here. Scientific research may produce new knowledge, it may lead to invention, but each of these is only a part of the innovation process. An innovation requires application of knowledge — and it requires public acceptance. As David Ogilvy, the advertising giant says, "There are only two reasons why new products fail: either because they are too new or because they are not new enough."

Creative vision is also demanded of those who carry scientific ideas into the marketplace. This was done well by what was a small Rochester, N.Y., company only a few decades ago.

Known then as the Haloid Corp., its management, under Joseph C. Wilson, became concerned that the existing business had limited growth prospects, and therefore a new approach was needed. This, as much as Chester Carlson's invention of xerography, was the beginning of the Xerox story.

Carlson had patented his invention in 1942, but the first Xerox copier took many more years of refinement and development. And the first Xerox copier didn't come to market until 1959.

Reflecting in his later years, Wilson said that Xerox made two great decisions: the first was to go with xerography. That was basically a technical decision. The second was just as important: to lease the machines instead of selling them outright, despite the implications that had for the small company's cash flow. This led to an increasing number of placements of a very expensive technology, but guaranteed a virtual transformation of the marketplace.

The historic progress of imaging technology offers insight into the

continuous application of scientific knowledge. When we compare it to perhaps the greatest invention of all — writing — we see an absolutely disparate time scale of progress.

Photography is a little more than 150 years old. The written word, on the other hand, was several thousand years old before the invention of the printing press in 1454. The process of change was slow, unconscious, and unexpected.

This was not the case with photography. During the 19th century, the process of advancement became quick, conscious, and expected.

The first to successfully achieve the permanent recording of an image was Joseph Nicephore Niepce, a 61-year-old Frenchman who, in 1826, sensitized a piece of pewter, pointed his camera out the window of his home, and eight hours later obtained a rather indistinct record.

Eleven years later, another Frenchman, Louis Daguerre, reduced exposure times to 30 minutes and gave birth to a photographic process called daguerreotype.

From that point, technology gathered momentum as photography generated interest. To trace the progress, let us assign arbitrarily a value of "one" to the information recording capability of the daguerreotype. We'll use this number to keep score on the speed and information content of photographic films.

When George Eastman introduced his American Film in 1885, the information recording capability number was up to 30,000. And photography was finding its way into a variety of applications beyond amateur picture-taking.

In the late 1800's, Eastman collaborated with Thomas Edison to develop motion pictures. Their relationship illustrates how vision and innovation go hand in hand.

While Eastman was producing transparent film, Edison was working in his laboratory in West Orange, N.J. Edison wanted to increase the appeal of his phonograph to the public with a device that would reproduce motion as well as sound. So he went to Eastman with the idea and asked him for help.

Eastman studied the problem, then asked Edison: "Well, how wide should we make the film?" The great inventor raised his hand, extending his thumb and forefinger to approximate the width of today's 35mm film and said, "Make it about this wide." And so 35mm film was born, along with the motion-picture industry.

Edison and Eastman shared another quality necessary in bridging the gap between scientific principles and useful products. They had the vision to organize scientific research for industrial ends. Eastman saw the path to progress lay in the establishment of a research and development organization where photographic theory could be developed and applied in useful ways. In 1912, he brought a young British scientist, Dr. C. E. Kenneth Mees, to Rochester as head of the new laboratory.

In 1912, when Mees began his work in the new Kodak laboratory, a major objective was to make color photography commercially practical. Yet it wasn't until 1935, 23 years later, that Kodachrome film was introduced. Its speed was ASA 8, it was available only in 8-exposure rolls, and its 28-step developing process took many hours.

Since that time, some remarkable advances have been made in color photography. In still photography, today, there are color films available with a speed of 1000 or more. Kodacolor VR 1000 film has a recording capability number more than 50 million times that of Daguerre's film.

Great strides, too, have been made in motion-picture film technology. Since 1950, exposure indices of these films have increased from 16 to 400, which means directors have more flexibility in terms of the lighting conditions in which they work.

Over the last 50 years efficiency of X-ray recording has improved to reduce patient exposure by a factor of 10. In the last eight years alone, patient exposure has been reduced by about 50%. Today's chest radiograph is equivalent to less than a month of exposure received from walking around in the open air.

Like photography, electronic imaging is the sum of many individual innovations, each taking the technology ahead one step at a time. Twenty-five years ago, for example, a video camera and magnetic recorder cost $100,000. The recorder alone weighed 1200 lbs and was the size of a large desk. It required 3500 W of electrical power.

Advances in microelectronics and magnetic technology over the last 20 years have now, of course, made home video recording convenient and affordable. From 1955 to the present, the information storage capacity of magnetic recording has increased 20,000 times. And it can record that information 60 times faster.

Equally dramatic is the reduction in size and power consumption of the electronic cameras themselves. We now stand at a new threshold in the application to imaging of the same kind of solid-state devices that revolutionized computers.

To better appreciate the potential for future progress in imaging technology, it is useful to consider some of the measuring rods we use in defining this progress. One measuring rod is the bit — or binary digit.

The average English word requires 30 bits of information. If Carl Sagan, in his book *Cosmos* is right, all the words and pictures in all the books of the world's libraries total more than 10^{16} bits. That's a one followed by 16 zeros — a number even more difficult to comprehend than the national debt.

It's been said many times that a picture is worth ten thousand words. But measured in bits of information, pictures are worth much, much more. A single frame of Kodacolor VR 200 35mm film can hold more than 75 million bits of information — the equivalent of 2.5 *million* words.

Now we can compare that with the information capacity of a color sensor, which was developed at the Kodak Research Laboratories. It is used in an experimental device which displays your snapshots on a television screen. This sensor has the information storage capacity of 15 home computers of reasonable power. Even so, it is more than an order of magnitude below the information capacity of film. And we see the information recording capability of film advancing even further in the future — to at least 10 times its current capability.

Dramatic advances will be made in semiconductor technology as well. The 64K chip will soon be surpassed by the 256K memory device. And there is no doubt that future chips will have one million-bit storage capacities.

Dramatic progress is at hand. Roland W. Schmitt of General Electric uses this analogy: Today, it's possible to put the information content of a street map of San Francisco onto a chip. Within a few years, the information content equivalent to a street map of the entire state of California will be contained on the chip.

Another important measure of an imaging system's performance is

bandwidth. Bandwidth has important implications when we consider future systems such as high-definition television, which will increase by seven times the quantity of information received in the home TV picture. This can easily be translated into a larger screen, higher-quality picture. However, to capitalize on this potential, we will need a new broadcast system with greater bandwidth requirements.

This sequence of images shows how quality improves with the increase in scan lines in a high-definition system. We go from 500 lines to 1000 lines, and then to 1400 lines. The 1400-line image is certainly more than acceptable.

Each of those images was originated from a motion-picture frame of Eastman Color negative film 5247, which measured about 14 × 21mm. Since the image quality continued to increase along with the number of scan lines, it is clear that Eastman Color negative film has more than enough information for a high-definition television system.

Bandwidth in electronic communication has grown impressively in only a few years. We've gone from telegraphy at a few bits/sec, to telephone at a few thousand bits/sec, to satellite communication providing information in the millions of bits/sec. And now, fiber optics technology is opening up new horizons in information transfer. This example from the *Wall Street Journal* illustrates the scope of advancing technology in optical fibers:

"Gutenberg spent five years setting the Bible in type. Today, the book in electronic form can be transmitted over ordinary copper wires in less than an hour."

This same amount of information transmitted via light through optical fibers requires less than a second. And even more advanced fiber optics has the capacity of transmitting enough text to fill *sixteen* bibles in a single second.

Film can record information at very high rates. Let's say a camera's shutter captures a scene in $^1/_{60}$/sec. That's 75 million bits captured at the rate of almost 4.5 billion bits/sec. By any standard, that is enormous capability.

A third major area advancement will be in the signal-to-noise ratio. Under ideal conditions, we would see this message clearly and precisely. But in man-made visual systems such as photography or television, the clarity of the signal can be reduced or obscured by what is called visual "noise."

In photographic systems, noise is controlled by the size and number of silver halide grains coated and developed, the ability to coat the emulsion uniformly, dye forming chemistry in the film layer, and the film-layer structure.

The application of T-grain technology, which involves the formation of flat, tabular silver halide grains, allowed the development of 1000 speed color negative film with low graininess. This technology has since been applied to X-ray films and Kodacolor disk film products. Its application will undoubtedly expand to other products in the future.

Factors that control noise in solid-state sensors are similar to those in film. The size of the imaging cell is important because it determines in part the number of electrons that can be used in an image. The more electrons stored in each cell, the less noise. Dark current — or the amount of charge injected into an imaging cell — can produce the equivalent of film fog. And just as all silver halide grains do not have the same sensitivity to light, individual imaging cells in an electronic sensor can have different sensitivities — thus producing pattern noise.

The goal of the imaging scientists in both electronics and photography is to reduce the amount of noise in an image while increasing the clarity and sharpness of the recorded signal.

Motion pictures, for example, have signal-to-noise ratios 100 times the 525-line signal standard of American television. That's why movies can be blown up to such proportions and still have the larger than life quality that creates a unique entertainment experience. And it's also a reason why film is an ideal medium for HDTV origination.

Finally, in our comparison of film and electronic imaging, let's examine resolution. Again, we can demonstrate through images.

This is a simulation of a resolution of 16 × 16 picture elements, or pixels. If we increase that resolution to 64 × 64 pixels, we see the image taking on some form. This may not be very useful for human viewing, but it may be good enough for applications such as robot vision systems.

At 256 × 256 pixels, we have a definite image. But not nearly the quality of a 35mm print. Quality is improved significantly with 1024 × 1024 array. Even so, close inspection would reveal that it is not equal in quality to the 35mm print. But it may be an acceptable level of quality.

However, as of today, there is no sensor of that dimension made with high enough manufacturing reliability to put into any but the most expensive, government-sponsored research programs — such as the deep space program. To help put this in perspective, the image shown in the accompanying film came from one-third the area of a 35mm frame. Thus it would require a sensor with three million pixels, or an array of about 1800 × 1800 pixels, to provide the quality of a full 35mm imaging area.

Future imaging technologies will be much advanced not only in the amount and clarity of information conveyed, but in the ability of photography and electronic images to interact with one another.

Images captured on silver halide technology will be stored on film and displayed on prints like they are today. They will also be displayed on television screens. The film video player is an example of this capability. At a touch of a button, the user can enlarge the image and freeze it for closer viewing, and savor the rich information detail in film. In the future, prints of these images may be produced at the press of a button.

Film images will also be stored electronically on magnetic disks and optical disks for transfer to prints or television images. This interactive ability will play a role in motion-picture production.

In the future, motion-picture film images could be scanned electronically and placed on electronic storage media — such as ultra-high-density magnetic disks or optical disks — for editing and special-effects manipulation. They could then be transferred back to film for distribution and display on theater-size screens.

At the laboratory level, we have demonstrated an experimental optical disk which can store 100,000 pages of information in an area the size of a phonograph record.

Used in conjunction with solid-state laser technology, these optical disks have a very high signal-to-noise ratio. Future information systems will require high accuracy in recording. Bit error rates — that is, the chances of a bit being wrong — can, with error

correction techniques, be less than one error in 10^{12} data bits. That is the equivalent to one error in only one letter of one of the words contained in two million full-length novels.

Ultra-high-density floppy magnetic disks measuring only 5¼ in. in diameter have the potential to store 20 million bits of information. That's the equivalent of all the words contained in more than a dozen copies of the novel *Gone With The Wind.*

It is not clear yet how these two technologies — magnetic and optical recording — will divide future markets for information storage. In our research laboratories, each has its champion. My own guess is that both will be important for the next 25 years.

Computer scan technology is also advancing rapidly. This allows us to take the information in a frame of film and convert it to electronic bits of information. It then can be transmitted to remote locations. Information managers in business, industry, and government are especially interested in this capability. The medical profession, too, will take advantage of this technology to transmit diagnostic images for referral or expert opinion.

Scanning techniques are also being developed which will take poorly exposed images, manipulate them electronically, and return sharp, clear, recognizable images impossible to create today. Certain simple steps, such as recognizing the edge of an object and sharpening it, have been possible for some time.

Digital processing equipment designed by our laboratory can perform these functions at very rapid rates. Fast digital logic makes it possible to invoke algorithms in less than a second. A conventional mainframe computer would require one half-hour to do the same work.

This capability will be greatly enhanced with the development of artificial intelligence in computers, which is in the experimental stage today. The ability of the computer to "think" like a human being will allow it to look at an image, recognize and differentiate between such elements in the picture as grass, sky, and faces, and correct each element in an optimum way. The benefit to the amateur photographer should be dramatic.

And rapid strides are being made in the motion-picture industry through the combination of film and electronics for special effects applications. Here is one primitive example demonstrated by scientists in our laboratories.

What you see here is the original scene. We took a second image — a toy jet airplane photographed against a blue matte background. We scanned and digitized both images, recorded them on tape, and then recombined the images electronically to drive a laser output scanner writing on film. This type of manipulation could be done with any two or three images, or with a set of images or designs stored on magnetic or optical disks.

All of that — and more — will be possible as vision meets reality. Those of us in imaging face an exciting future.

In traditional photographic imaging, we'll see continued advances in its already powerful information recording ability. We can expect film's overall capability to improve at least an order of magnitude — ten times its current capability. Recent breakthroughs such as T-grain technology, which more than doubled Kodacolor film's sensitivity, will find many other applications.

In electronics, image capture will be aided by the microelectronics revolution. Color sensors of the future will contain at least one million elements for quality images.

Electronic recording materials — magnetic and optical — will progress rapidly, and will interact fully with film in the hybrid systems of tomorrow. These hybrid imaging systems will take full advantage of film's vast information content and match it with the inherent flexibility of electronic systems.

The combination of all these technologies will open up new avenues of communication through images in business, government, science, medicine, entertainment, and an array of other applications which will be realized as the technology advances.

None of this will come to pass, however, without a continuing tradition of invention and innovation. Our vision of tomorrow is rooted in the accomplishments of past pioneers in imaging. Isaac Newton once credited his own vision and his particular success in advancing scientific knowledge to his predecessors. "I stood on the shoulders of giants," he said.

Imaging scientists today owe much of their accomplishment to pioneers and to those who contributed to the steady advance of imaging science. A debt is owed, as well, to those who saw these advances as opportunities, and applied them to real problems. Their mission was to foster change, to find a better way. But it was always a mission carried out in the context of human needs and aspirations.

That tradition is what makes imaging science a rewarding challenge. And that's why I believe that tomorrow's imaging technology — though far advanced over today's in its applications — will still serve a fundamental urge of mankind's: to go beyond the limits of natural vision, to expand knowledge, and to help create a better world in which to live.

Thank you very much.

(L–R) General Arrangements Chairman Ed Burns, Audiovisual/Motion Picture Chairman Richard King, and PA and Recording Chairman Earl Arbuckle.

Board of Governors Meeting

Meeting of the Board of Governors.

The SMPTE Board of Governors met on Sunday, October 28, at the New York Hilton. As the top governing body of the SMPTE, the Board decides policy which governs all Society activity within the framework of the SMPTE Constitution and Bylaws.

The Board of Governors holds three regularly scheduled meetings each year, one of which takes place at the annual technical conference.

Executive Vice-President Harold Eady, President Leonard Coleman, Past President Charles Anderson, and Executive Director Lynne Robinson share a humorous moment at the otherwise serious meeting of the Board of Governors.

Press Briefing

The SMPTE held a press briefing on Sunday, October 28, at the New York Hilton. The purpose of the press briefing is to introduce the members of the press covering the conference to the key Society officers and conference chairmen, and to familiarize the press with the conference activities.

Chairman of the Public Relations Advisory Committee Edward Messina, ABC, introduced SMPTE President Leonard F. Coleman, Conference Vice-President Charles A. Ahto, Editorial Vice-President Maurice L. French, and Engineering Vice-President Richard G. Streeter to the press and invited them to submit questions to the officers.

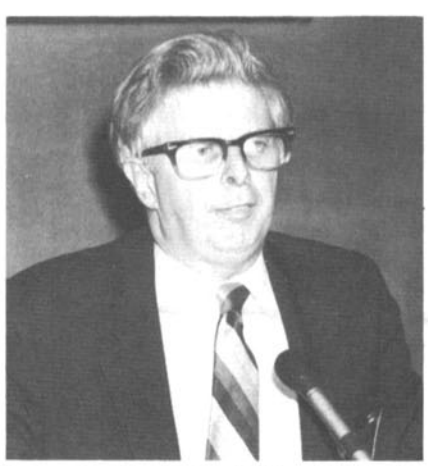
President Leonard F. Coleman speaking at press briefing.

Conference Vice-President Charles A. Ahto speaking at press briefing.

Officers and Governors of the SMPTE.

Press briefing at the conference.

Editorial Vice-President Maurice L. French answers questions at press briefing.



Engineering Vice-President Richard G. Streeter responding to questions at press briefing.

Chairman of Public Relations Advisory Committee Ed Messina speaking.

Sunday Evening Reception

Eastman Kodak Co. sponsored a welcoming reception for conference attendees on Sunday evening at the Copacabana. Conference registrants and other guests filled the club to capacity. Cocktails, hors d'oeuvres, and dancing got the conference off to a good start. SMPTE President Leonard F. Coleman was on hand to welcome guests to the evening's festivities. All agreed that the party was one of the highlights of the conference week.

Conference Vice-President Charles A. Ahto and Local Arrangements Chairman Ed Burns at the Sunday evening Kodak reception.

Conference registrants and guests enjoyed the Eastman Kodak reception at the Copacabana. (L–R) Mr. and Mrs. Robert Smith, Edward Burns, Mr. and Mrs. John Kowalak, and Mr. and Mrs. Leonard Coleman.

Honorary Membership award-winners Dr. Charles R. Fordyce (left) and Linwood G. Dunn (right) with former SMPTE President Kenneth Mason (center).

(L–R) Southern Regional Governor John W. Caluger, former President Charles E. Anderson, Journal Award winner John L. E. Baldwin, and incoming Central Regional Governor Frederick M. Remley.

The Honors and Awards Luncheon.

Honors and Awards Luncheon

The Honors and Awards Luncheon, one of the highlights of the Conference, was held on Tuesday, October 30, at the Sheraton Centre Hotel. During this event, the Society presents a wide range of awards that have been established over the years in recognition of outstanding achievement in the fields of motion pictures and television and for service to the Society. A Board of Governors reception in honor of the awards recipients preceded the luncheon.

Secretary M. Carlos Kennedy, Ampex Corp., opened the luncheon and introduced President Leonard F. Coleman, Eastman Kodak Co., who welcomed the conferees and introduced the guests on the dais. Coleman expressed his pleasure at having had the opportunity to serve as President of the Society for the past two years. Following a brief description of his service in other offices, he said that there were five basic "thank you's" he wanted to give: to the Headquarters staff for their support; to the officers and Governors of the Society and in particular, the seven members of the Executive Committee for their efforts in keeping the Society running successfully; to Eastman Kodak for allowing him the time and financial backing to do the job, and in particular Bill Cook; to the members of the Society for giving him the opportunity to serve as President; and finally, to the person most involved — his beloved wife, Norma. Coleman thanked the audience again for an experience he will never forget.

Following these remarks, Coleman introduced the guest speaker at the luncheon, Dr. William F. Baker, president of Group W Broadcasting and chairman of Group W Satellite Communications. He described Dr. Baker as being a man of unusual interests, including polar exploration. Dr. Baker is one of eight people in history to have visited both the North and South Poles.

At the conclusion of the speech, Executive Vice-President Harold J. Eady, Novo Communications, introduced the winners of the Society's awards for 1984. A description of the awards and their recipients follows.

Following the presentation of the awards, Secretary Kennedy announced the results of the Society's election of new officers. Harold J. Eady, Novo Communications, Inc., has been elected President, succeeding Leonard F. Coleman, Eastman Kodak Co., who will move on to the position of Past-President. M. Carlos Kennedy, Ampex Corp., has been elected Executive Vice-President. Howard T. La Zare, Deluxe Laboratories, Inc., was elected Editorial Vice-President. Charles A. Ahto, Tape-Film Industries, was re-elected Conference Vice-President. Stephen D. Kerman, Tektronix, Inc., was elected Secretary. Irving Rosenberg, CBS Television Network, was elected Treasurer.

SMPTE President Leonard F. Coleman presiding over the Honors and Awards Luncheon.

SMPTE Secretary M. Carlos Kennedy announcing the results of the Society elections.

The newly elected governors of the Society are: Canadian Region: Howard Wilkinson, Canadian Broadcasting Corp.; Central Region: John F. X. Browne, John F. X. Browne Associates, Inc., and Frederick M. Remley, Jr., University of Michigan; Eastern Region: Herman Badler, CBS, Inc.; Hollywood Region: Roderick T. Ryan, Eastman Kodak Co., and Richard J. Stumpf, Universal City Studios; New York Region: Irwin W. Young, Du Art Film Laboratories, Inc., Earl F. Arbuckle III, WPIX, Inc., and Michael T. Fisher, ABC Engineering; Southern Region: James D. Caron, Cine Craft, Inc.; Western Region: Glen Pensinger, San Jose State University.

Coleman then turned over the gavel to incoming President Harold J. Eady, formally concluding the luncheon.

Outgoing President Leonard F. Coleman handing over the gavel to President-Elect Harold J. Eady.

Some Remarks on Standards

By William F. Baker

At the Honors and Awards Luncheon of the Society of Motion Picture and Television Engineers (SMPTE), William F. Baker, Group W Television president and chairman of Group W Satellite Communications, said history shows that . . . "too many standards applied to one thing can be as great a disservice to society as no standards at all."

"Throughout the ages great rulers were quick to recognize the importance of a good system of standards of weights and measures. The very economic health of their empires was dependent on this," Baker said. But, he cautioned, standards built upon political whimsy, as opposed to the immutable laws of nature, are destined to go the way of their creators. And, he noted, most efforts at standardization fell short, and corruption ran rampant.

On the more positive side, Baker pointed out that this country was quick to recognize the importance of good standards. In spite of this, in 1902, in Brooklyn alone, there still were four different standards for the foot — all legal!

"Without primary standards, how could we expect to develop day-to-day working standards? How could we specify a standard for machine screw-threads that meant anything, unless we first had a single standard for length? What would our music sound like without a good working-standard for time?" Baker asked.

Guest speaker William F. Baker addressing guests at the luncheon.

As for today, Baker praised SMPTE for its many accomplishments including SMPTE time code, the quadruplex and 1-in. formats, and current efforts to standardize a single 1/4-in. videotape format for ENG applications and for high-definition television. "There is a crying need right now for standards in these areas," he said.

He went on to say: "What is happening with regard to standards creation in our industry? Well, thanks to SMPTE, a lot has happened and is happening right here at this conference. There are currently 265 documents in the SMPTE standards book. These include SMPTE-sponsored American National Standards, Society Recommended Practices, and Engineering Guidelines."

"Ten years ago you might have found eight technical meetings coincident with an engineering conference. At this conference, 27 technical committee meetings are scheduled. International liaison is much stronger now than in the past. With our shrinking world, we need international standardization more than ever."

According to Baker, engineers in television are rarely regarded as creators, but rather as fix-it persons. To regain the kind of respect television engineers rightly deserve, they must take a leadership position.

Baker was enthusiastic about the new direction in TV. "Clearly, in the 1980's we see TV moving from an analog to a digital base," he said. "Digital technology blasted into TV in news production and weather presentation; commercial production and programming followed." He expressed his excitement about the not-too-far-off world of digital editing, and other devices for digital technology.

The Honors and Awards Presentations of 1984

The Society presents a number of awards in recognition of outstanding achievement and confers certain grades of achievement annually.

Certain practices and rules are common to all the awards. Award Committees consist of five Honorary, Fellow, or Active Members of the Society appointed annually by the President and confirmed by the Board of Governors. The Journal Award Committee is appointed by the Editorial Vice-President. Membership in the Society is not a prerequisite for an award.

Any member of the Society is entitled to make a nomination for an award. Such nominations should be made in writing to the chairman of the appropriate committee, giving the reason why the writer believes the award justified. The Committees forward their reports to the Secretary of the Society in time for presentation to the Board of Governors at their mid-year meeting. Normally, awards are presented by the President at the national Conference of the Society following approval of the award by the Board of Governors.

The highest award and greatest distinction that can be conferred by the Society is Honorary Membership, which includes eventual inscription on the Honor Roll of the Society. The Progress Medal is the premier medal award of the Society. The Agfa-Gevaert Gold Medal, the Eastman Kodak Gold Medal, the John Grierson International Gold Medal, the Journal Award, the Herbert T. Kalmus Gold Medal, the Presidential Citation, the Citation for Outstanding Service to the Society, the Alexander M. Poniatoff Gold Medal Award, the David Sarnoff Gold Medal Award, and the Samuel L. Warner Memorial Award recognize achievement in the special fields of accomplishment described under each award on the following pages.

The Citation for Outstanding Service to the Society

1984 Award Winners —
Ivan Barclay,
Grant Dearnaley,
Ted H. Horn, and
Charles D. Kircher

The purpose of this citation is to recognize individuals for dedicated service to the Society over a sustained period of time. The 1984 award was presented to the following:

Ivan Barclay was awarded the Citation for Outstanding Service to the Society.

Grant Dearnaley displays his Citation for Outstanding Service to the Society.

Ivan Barclay, Ottawa Section, for his services as Chairman of the organizing committee to form the Ottawa Section, as Ottawa Program Coordinator, as Educational Program Manager, and as Section Manager.

Grant Dearnaley, Montreal/Quebec Section, for his services as Registration and Finance Chairman of the 18th Television Conference, as Registration and Finance Chairman of the 25th SMPTE Canadian Anniversary Mini-Conference, and as Manager, Secretary/Treasurer, and Chairman of the Montreal/Quebec Section.

Ted H. Horn, Detroit Section, for his services in the first and second Detroit Television Meetings, the predecessors of the present Television Conferences, as Facilities and Projection Chairman of the 10th Television Conference, and for six terms of service as Section Manager, Secretary/Treasurer, and Section Chairman over a period of fourteen years.

Charles D. Kircher, Hollywood Section, for his 15 years of service to the Society as Membership Chairman, Secretary/Treasurer, and Chairman of the Hollywood Section, as General Arrangements Chairman for the 125th Conference, and as a member of the Educational and One-Day Seminars in Hollywood.

Service to the Society.

Outstanding Service to the Society.

Gold Medal Sponsors

The Agfa-Gevaert Gold Medal Award: Agfa-Gevaert N.V.

The Eastman Kodak Gold Medal Award: Eastman Kodak Co.

The John Grierson International Gold Medal Award: National Film Board of Canada

The Herbert T. Kalmus Gold Medal Award: Technicolor, Inc.

The Alexander M. Poniatoff Gold Medal for Technical Excellence: Ampex Corp.

The David Sarnoff Gold Medal Award: RCA Corp.

The Samuel L. Warner Memorial Award: The Estate of Samuel L. Warner

The Progress Medal Award: The Society of Motion Picture and Television Engineers, Inc.

The Presidential Proclamation

1984 Award Winners — Edward H. Reichard and David W. Samuelson

The Presidential Proclamation recognizes individuals of established and outstanding status and reputation in the motion-picture and television industries worldwide.

The Presidential Proclamation for 1984 is awarded to the following: **Edward H. Reichard,** for his active support of the SMPTE over many years, in which he continuously served on the Board and on numerous Engineering and Administrative Committees, and for his outstanding contributions as a motion-picture engineer during his career; and **David W. Samuelson,** for his continued support of the industry on an international level, and his long-standing contributions as a writer and lecturer.

Edward H. Reichard, who retired in 1983 after a distinguished career with Consolidated Film Industries (CFI), has been a strong influence on motion-picture engineering for the past 50 years. He continued to serve as a technical consultant to the motion-picture industry in the U.S., Canada, and Europe.

Edward Reichard has received recognition from the Academy of Motion Picture Arts and Sciences as a recipient, with CFI associates, of 11 scientific and technical awards. A Life Fellow of the SMPTE, Reichard received the SMPTE Commendation Plaque in 1960, and was awarded the Society's highest honor, the Progress Medal Award, in 1976, for his many notable contributions to the design of equipment and procedures and for his significant technical achievements in the field of motion-picture laboratory technology.

Reichard has served for 24 continuous years as an officer or member of the Board of Governors of SMPTE, and is a member of the Academy of Motion Picture Arts and Sciences and the National Academy of Television Arts and Sciences. In addition, he is an Associate Member of the American Society of Cinematographers and a member of Tau Beta Pi, the National Honorary Engineering Society.

David W. Samuelson is director, DSAM, Ltd., London, England. He has been involved in film production since 1941, and has filmed newsreels and documentaries in over 40 countries, covering every type of news event, including the coronation of Queen Elizabeth II, four Olympic Games, and two World Cup Soccer events.

Samuelson is a past-president and Fellow of the British Kinematograph, Sound and Television Society (BKSTS), a Fellow of the SMPTE, a Fellow of the Royal Photographic Society, a member of the American Academy of Motion Picture Arts and Sciences, an associate member of the American Society of Cinematographers, and a member of the British Society of Cinematographers, and Governor of that organization since 1980. He is also chairman of the Incorporated Association of Kinematograph Manufacturers, chairman of the Governors of the London International Film School, and former vice-president of the International Union of Film

Leonard F. Coleman presented the Presidential Proclamation to Edward H. Reichard (L).

David W. Samuelson received the Presidential Proclamation from Leonard F. Coleman.

Technical Associations (UNIATEC).

In 1978 he was awarded the Special Commendation Award of the SMPTE for outstanding contributions to motion-picture technology. He received a Scientific and Technical Award from the Academy of Motion Picture Arts and Sciences for the development of the LOUMA Camera Crane. Samuelson is the author of numerous books and articles on cinematography, and is responsible for several original inventions, including through-the-lens video-assist viewfinders for film cameras, a remote control system for the LOUMA Camera Crane, the Samcine Inclining Prism, and the Mitchell BNC/Front Projection Conversion.

The Journal Award

1984 Award Winners — Wilfried Liekens and John L. E. Baldwin

It is the purpose of this award to recognize the two outstanding papers originally published in the Journal of the Society during the previous calendar year; one in the field of motion pictures and the other in the field of television.

The Journal Award for a motion-picture article went to **Wilfried Liekens** for his article, "Psychophysical Relationship of Image-Quality Characteristics of Motion-Picture Color Films," published in the September 1983 *SMPTE Journal*. Dr. Liekens' activities at the research and development laboratories of Agfa-Gevaert Co., Mortsel, Belgium, involved image quality and visual perception. He developed a procedure to obtain objective measures for the subjectively perceived image quality, based on a statistical paired comparisons method, and his findings were applied to the development of Gevachrome. He contributed to the invention, development, and application of the contrast control system of Copycolor and new films for aerial photography. Dr. Liekens is now graphic arts systems manager of Agfa-Gevaert, with responsibility for scanner, rapid access, and industrial reprographic applications.

The Journal Award for a television article went to **John L. E. Baldwin** for his article, "Analog Components, Multiplexed Components, and Digital Components — Friends or Foes?" published in the December 1983 *SMPTE Journal*.

John L. E. Baldwin is staff engineer, Development, of the Independent Broadcasting Authority, London, England. For his leadership of the DICE (Digital Intercontinental Conversion Equipment) project, he received the Geoffrey Parr and PYE Colour Television Awards of the Royal Television Society in 1973, the David Sarnoff Gold Medal of the SMPTE in 1975, and an Achievement Gold Medal at Montreux in 1977.

Baldwin holds patents on many inventions for the television industry, and has participated in the work of several SMPTE groups, including the Task Force on Digital Standards and the Digital TV Tape Recording Group. He is a member of EBU groups on Video Coding Standards, Enhanced Vision Systems for Satellites, and of MAGNUM Digital TV Recording. He is also a member of the CCIR Joint Interim Working Party on Digital Recording. A graduate of London University, Baldwin is a member of the Institute of Physics, a Fellow of the Royal Television Society, a member of the SMPTE, and a Freeman of the City of London.

The Agfa-Gevaert Gold Medal Award

1984 Award Winner — Bengt Modin

It is the purpose of this award to honor the recipient by recognizing the individual's outstanding leadership, inventiveness, and/or other achievements in the research, development, or engineering of new techniques and/or equipment which result in a significant improvement to the interface between motion-picture film and television imaging systems, whereby the com-

The Journal Award was presented to Wilfried Liekens for his paper in the field of motion pictures.

John L. E. Baldwin received the Journal Award for his paper in the field of television.

The Agfa-Gevaert Gold Medal Award was presented to Bengt Modin.

bined advantages both contribute to the further development of visual communications systems.

The Agfa-Gevaert Gold Medal Award is presented to **Bengt Modin,** in recognition of his contribution to the improvement to the interface between motion-picture film and television imaging systems. He designed and developed an A&B telecine operation to accommodate 16mm films where the original negative is cut in A&B format. This system takes advantage of the image quality of color negative when transferred to video, and it enables video techniques to be used for dissolves, superimposed images, titles, etc. The complete operation is handled by a computer, where all instructions, including grading, are stored.

Bengt Modin has been affiliated with Swedish TV, Stockholm, since 1960, and has been involved in various phases of technical research and development of film in television, with special emphasis on subtitling and time code. The recipient of the Phil Berkeley Award from BKSTS, he was made a Fellow of the BKSTS in 1984. He is an Honorary Member of the Swedish Society of Cinematographers (FSF), and vice-chairman of the Society of Swedish Film and Television Engineers (SSFT). In addition, he was the Swedish representative to ISO Working Group 5 on Film in Television, and to EBU Group 3 on Film in Television.

The Eastman Kodak Gold Medal Award

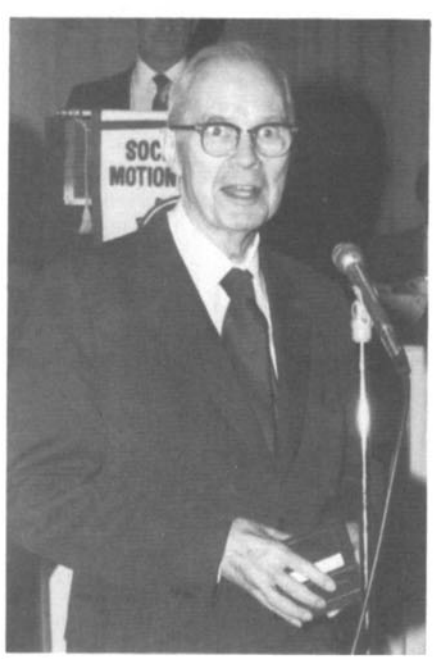
1984 Award Winner — Jay Leyda

It is the purpose of this award to honor the recipient by recognizing outstanding contributions which lead to new or unique educational programs utilizing motion pictures, television, high-speed and instrumentation photography, or other photographic sciences. The award shall recognize developments in equipment, systems, or instructional applications which result in advancing the educational process at any or all levels.

The Eastman Kodak Gold Medal Award for 1984 was presented to **Jay Leyda,** an internationally recognized figure in film education and scholarship.

Jay Leyda is known primarily for his translations of Soviet director Sergei Eisenstein's writings, including *The Film Sense*, *Film Form*, *Film Essays*, *With a Lecture*, and V. Ndizhny's *Lessons with Eisenstein.* In making Eisenstein's work available to English-speaking film scholars, students, and filmmakers, Leyda, one of Eisenstein's former scholars, has helped shape the course of film education in the U.S. and Great Britain. In addition, Leyda has also made contributions to the study of film through his work as an archivist for the Museum of Modern Art, the Chinese Film Archive, and the Staatliches Filmarchiv der D.D.R. in Berlin, and as a historian.

Other important works by Leyda include *Kino: A History of the Russian and Soviet Film; Films Beget Films: A Study of the Compilation Film; Dianying (Electric Shadows): An Account of Films and the Film Audience in China; Voices of Film Experience: 1894 to the present;* and *Eisenstein at Work*, which won the Theatre Library Association Award for the best film book of 1982. For the past ten years, Leyda has served as Gottesman Professor of Cinema Studies at New York University.



Jay Leyda accepted the Eastman Kodak Gold Medal Award.

Kenneth Richter was presented with the John Grierson International Gold Medal Award.

The John Grierson International Gold Medal Award

1984 Award Winner — Kenneth Richter

It is the purpose of this award to honor the recipient by recognizing significant technical achievements related to the production of documentary motion-picture films.

The John Grierson International Gold Medal Award is presented to **Kenneth Richter** for the design and manufacture of specialized motion-picture equipment that has contributed to the improvement of the quality of documentary and travel films throughout the world. The design of a portable autocollimator for checking lenses in the field is of particular significance.

After graduating from Harvard, Kenneth Richter spent a number of

years working on major Hollywood studio camera crews. He has worked in over 80 countries, making educational, documentary, and advertising films. He designed and developed the Richter Auto-Collimator System, and developed and manufactured the Richter EMP 16mm motion-picture camera. He is the owner and manager of Richter Cine Equipment and Richter Aero Equipment.

Richter was one of the founders of the Film Lecturers Association, and is a member of the Projection Standards Committee of the SMPTE. He has won many prizes and awards for his film productions, including a gold medal from the Austrian government for his *To Austria with Love*. With all of his varied interests, Richter finds film lecturing his most important job — his contribution to furthering understanding among the peoples of the world.

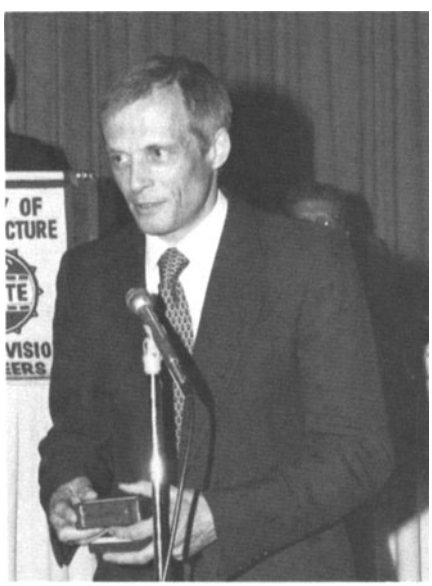
The Herbert T. Kalmus Gold Medal Award

1984 Winner —
Christoph Geyer

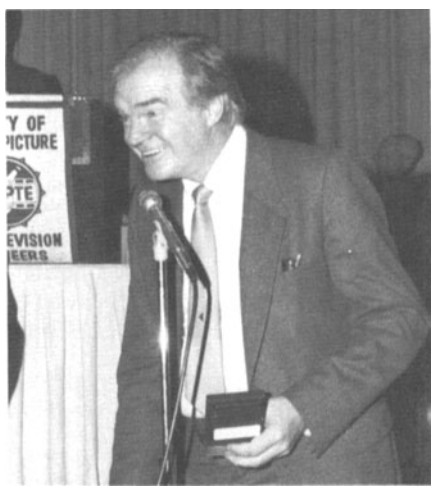
It is the purpose of this award to honor the recipient by recognizing outstanding contributions in the development of color films, processing, techniques, or equipment useful in making color motion pictures for theater or television use.

The 1984 Herbert T. Kalmus Gold Medal Award is awarded to **Christoph Geyer** in recognition of his work in the design, engineering, construction, and application of total immersion wet printing gates and the liquid support systems for such installations. Of particular note is his responsibility for the development of a unique total immersion wet-gate facility for the Rank Cintel Mark III Telecine, a design now being commercially manufactured and installed in telecine equipment worldwide.

Christoph Geyer is technical director of Geyerwerke GmbH, Hamburg, West Germany. He holds a patent on a wet-gate which became the basis for further development of wet-gate systems. He has delivered several papers at meetings of the SMPTE, ACVL, FKTG, and BKSTS dealing with technical developments of machines and devices which are in daily use at Geyerwerke and/or Geyer-Video. In 1983 he became a Fellow of the BKSTS.



The Herbert T. Kalmus Gold Medal Award was presented to Christoph Geyer.



Allen J. Trost received the Alexander M. Poniatoff Gold Medal for Technical Excellence.

The Alexander M. Poniatoff Gold Medal for Technical Excellence

1984 Award Winner —
Allen J. Trost

It is the purpose of this award to honor the recipient by recognizing outstanding technical excellence of contributions in the research or development of new techniques and/or equipment that have contributed significantly to the advancement of audio or television magnetic recording and reproduction.

The Alexander M. Poniatoff Gold Medal for Technical Excellence is presented to **Allen J. Trost** for significant contributions to video recording technology.

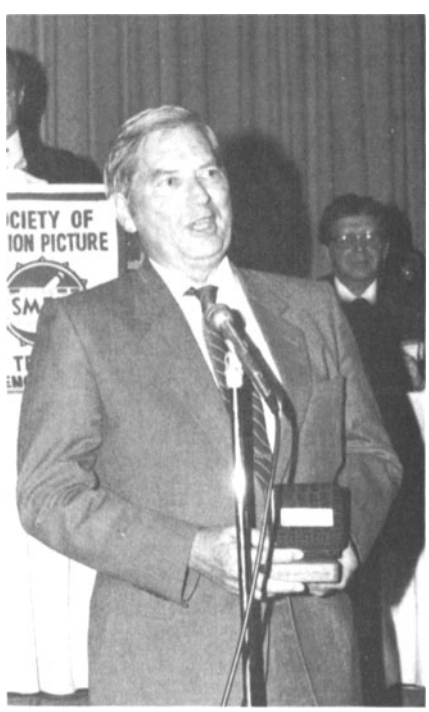
Allen J. Trost is principal engineer at Ampex Corp., and was the recipient of the Ampex Poniatoff Award in 1975 for his work on the AVR-2 videotape recorder. A specialist in video signal system design, he has had significant impact on most of the videotape recorders manufactured by Ampex, both in design and engineering project management responsibility. Trost also designed the first solid-state processing amplifier. He holds patents on devices affecting auto tracking for quad recorders, automatic video head optimization of quad recorders, and a pilot carrier system for video recorders.

The David Sarnoff Gold Medal Award

1984 Award Winner —
Richard S. O'Brien

It is the purpose of this award to honor the recipient by recognizing outstanding contributions in the development of new techniques or equipment which have contributed to the improvement of the engineering phases of television, including theater television.

The David Sarnoff Gold Medal Award is presented to **Richard S. O'Brien** for a distinguished career of leadership in the planning and reali-



Richard S. O'Brien was presented with the David Sarnoff Gold Medal Award.

zation of advanced television production facilities and for significant contributions to the technical literature of television production.

Richard S. O'Brien was managing director, planning, for CBS until his retirement in 1982. He was responsible for the design and installation of CBS television facilities such as Broadcast Center, Television City, KNXT, and others. His early work, which established the basics of staging and lighting practices for both monochrome and color television, was recognized by the SMPTE Journal Award in 1954.

O'Brien served on the Board of Governors of the SMPTE from 1964 through 1978, including four years as the Society's first Vice-President for Television Affairs and six years as Secretary. He is a Life Fellow of the SMPTE and of the Audio Engineering Society (AES), and a Life Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), in addition to membership in the honorary fraternities Eta Kappa Nu and Sigma.

The Samuel L. Warner Memorial Award

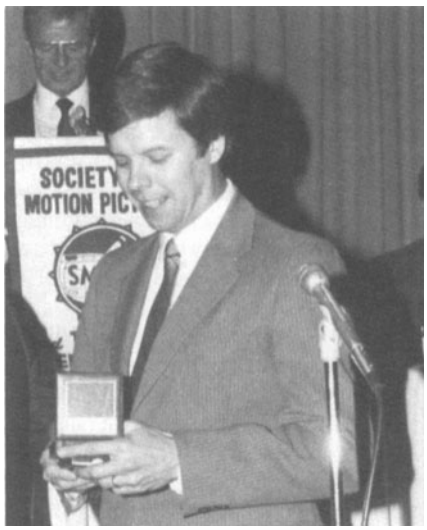
1984 Award Winner —
Ronald E. Uhlig

It is the purpose of this award to honor the individual by recognizing outstanding contributions in the design and development of new and improved methods and/or apparatus for sound-on-film motion pictures, including any step in the process.

The Samuel L. Warner Memorial award is presented to **Ronald E. Uhlig** in recognition of his contribution to the advancement of photographic sound recording through the development of stereo photographic sound tracks, improved sound negative film, and continuing work to implement improved quality control techniques.

Ronald Uhlig began his career with Eastman Kodak in 1968, immediately following his graduation from college. His early work primarily involved photographic motion-picture sound tracks. His involvement in projects related to stereo photographic sound tracks, quality control of photographic sound tracks, and development of a new sound recording film has resulted in the publication of papers on these subjects in the *SMPTE Journal*.

Uhlig is now senior photographic engineer at Kodak's Photographic Technology Div., and has recently been involved in the study of the use of SMPTE time code in motion-picture post-production systems, especially as it relates to the use of Datakode magnetic control surface as the media for recording the time code. New equipment has been developed to show the potential of time code in the motion-picture industry.



The Samuel L. Warner Memorial Award was presented to Ronald E. Uhlig.

Uhlig also contributed to the standards activities in this area, drafting proposed recommended practices for a time code on 24 frames/sec motion-picture films and for the application of user bits in that time code. He has been active on the Audio Recording and Reproduction Engineering Committee for several years and is a member of the SMPTE Board of Editors. Several of his papers have been published in the *SMPTE Journal*.

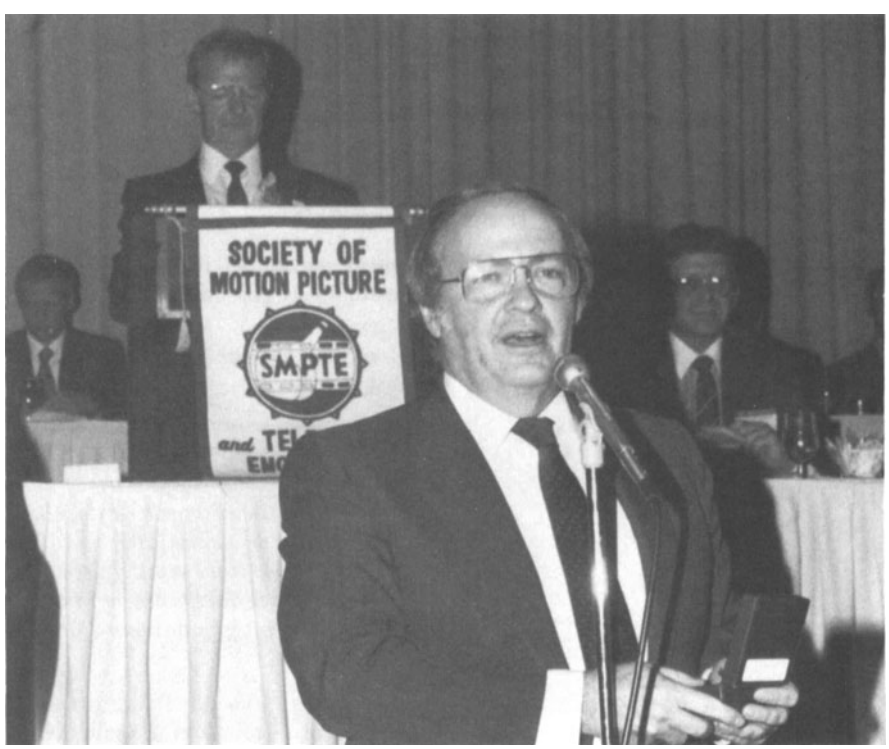
The Progress Medal Award

1984 Award Winner —
Joseph A. Flaherty

It is the purpose of this award to honor the individual by recognizing outstanding technical contributions to the progress of engineering phases of the motion-picture and/or television industries.

The Progress Medal Award is presented to **Joseph A. Flaherty** in recognition of his outstanding contributions to the television industry: for the conception and leadership in the implementation of new technology, including ENG, off-line electronic editing systems, electronic cinematography, high-definition television, and his contribution to the establishment of a world compatible standard for the digital coding of television signals.

Joseph A. Flaherty is vice-president, engineering and development, CBS, with which he has been affiliated since 1957. In his present position, he is responsible for all television and radio engineering and development activities for the CBS Broadcast Group, in-



Joseph A. Flaherty accepting the Progress Medal Award.

The Honors and Awards Committees for 1984

HONORARY MEMBERSHIP
Charles E. Anderson, *Chairman*
G. Carleton Hunt
Kenneth M. Mason
Barton Kreuzer
Robert M. Smith

PROGRESS MEDAL AWARD
Harold J. Eady, *Chairman*
Howard T. La Zare
Richard G. Streeter
M. Carlos Kennedy
Joseph A. Semmelmayer

AGFA-GEVAERT GOLD MEDAL AWARD
Irwin W. Young, *Chairman*
Edward J. Blasko
D. Thomas Mann
Edward J. Messina, Jr.
Gary E. Thompson

EASTMAN KODAK GOLD MEDAL AWARD
Stephen C. Chamberlain, *Chairman*
John Belton
Michael E. Mirabito
Evan W. Cameron
Peter Hammar

JOHN GRIERSON INTERNATIONAL GOLD MEDAL AWARD
Roderick T. Ryan, *Chairman*
Edmund M. DiGiulio
Jack Behrend
Howard T. La Zare
Arnold C. Schlieman

HERBERT T. KALMUS GOLD MEDAL AWARD
Julian D. Hopkinson, *Chairman*
Howard T. La Zare
Manfred G. Michelson
Everett L. Hanson
Colin F. Mossman

ALEXANDER M. PONIATOFF GOLD MEDAL AWARD
Stephen D. Kerman, *Chairman*
K. Blair Benson
Michael T. Fisher
Thomas E. Mehrens
Frederick M. Remley

DAVID SARNOFF GOLD MEDAL AWARD
John F. X. Browne, *Chairman*
Warren Happel
Thomas B. Keller
Frederick M. Remley
Donald R. Musson

SAMUEL L. WARNER MEMORIAL AWARD
Richard J. Stumpf, *Chairman*
John V. Leahy
Fred Hynes
Joseph D. Kelly
Waldon O. Watson

JOURNAL AWARD
Howard E. Wilkinson, *Chairman*
Arthur Kaiser
Julian D. Hopkinson
Robert J. Ringer
Paul Kaufman

CITATION FOR OUTSTANDING SERVICE TO THE SOCIETY
Sherwin H. Becker, *Chairman*
Charles A. Ahto
Maurice L. French
Richard G. Streeter
Bengt O. Orhall

PRESIDENTIAL PROCLAMATION COMMITTEE
Leonard F. Coleman, *Chairman*
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Sherwin H. Becker

cluding planning and coordinating the development of new equipment and the installation of technical facilities.

Flaherty received an Emmy Award Citation for the CBS Minicam Color Camera in 1969, and in 1974 was awarded the SMPTE David Sarnoff Gold Medal for progress in television engineering. On behalf of CBS, he received the 1975 Technical Emmy Award for Electronic News Gathering (ENG), and in 1979 he was awarded the Montreux Achievement Gold Medal for the development of the concept and operational implementation of ENG. In 1983 he was the recipient of the National Association of Broadcasters (NAB) Engineering Award.

A frequent lecturer on television technology, Flaherty is the author of several technical articles on various aspects of television broadcasting. He is a Fellow of the SMPTE, and has served as SMPTE Vice-President for Television Affairs, Treasurer, Financial Vice-President, and Executive Vice-President. He is also a Fellow of the Institute of Electrical Engineers (IEE) and of the Royal Television Society (RTS) in the U.K., a member of the Society Fernseh-und Kinotechnischen Gesellschaft (FKTG), Federal Republic of Germany, and a member of the Societe des Electriciens, des Electroniciens et des Radioelectriciens (SEE) in France. In addition, he is a member of the Executive Committee of the Montreux International Television Symposium and the Executive Committee of the Advanced Television Systems Committee (ATSC), and a corresponding member of the International Broadcasting Convention (IBC).

Honorary Membership

1984 Award Winners — Linwood G. Dunn and Charles R. Fordyce

It is the purpose of Honorary Membership in the Society to honor an individual who has performed eminent service in the advancement of engineering in motion pictures, television, or in the allied arts and sciences.

Honorary Membership is bestowed upon **Linwood G. Dunn** for a long and fruitful career in motion pictures that started in 1923, and most especially for his outstanding contributions to special effects in motion pictures. He was instrumental in the conception, engineering, and development of the Acme-Dunn Optical Printer for motion-picture special effects. He has delivered countless lectures to a wide variety of groups, and has received many awards, including an Oscar, for his work in the field of special effects.

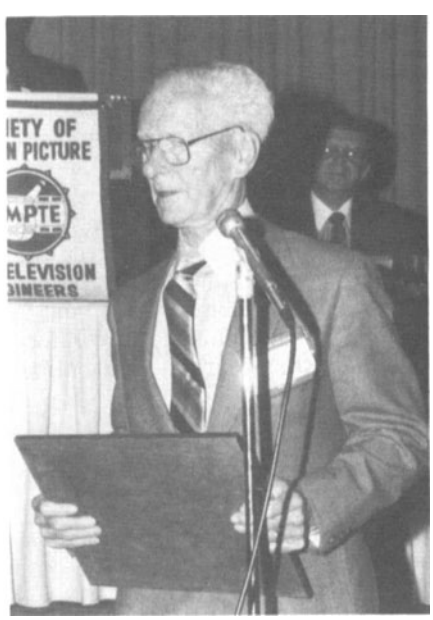
Linwood Dunn has been associated with the motion-picture industry since its early days in 1923. His career has encompassed many of the most famous films to come out of Hollywood, where he created special photographic effects for over 100 films. During World War

Linwood G. Dunn was awarded Honorary Membership in the Society.

II, Dunn was commissioned to design and supply special effects optical printers to armed forces photographic units throughout the world. In collaboration with his associate, Cecil Love, Dunn designed, secured the financing, and supervised the construction of these printers, which became the first of their kind to be commercially manufactured, and are still in use throughout the world. Dunn and Love were given an Academy Award in 1981 for this important technical achievement, the Acme-Dunn Special Effects Optical Printer.

In 1946 Linwood Dunn founded his own company, Film Effects of Hollywood. It pioneered in 16mm special optical effects, and made the first feature blow-up from 16mm to 35mm color internegative. Dunn is the author of many engineering papers and technical articles, and has given many lectures on motion pictures. He is a former president of the American Society of Cinematographers, and has been director of photography, International Photographers, Local 659, for 50 years. A Life Fellow of the SMPTE, he is also a member of the Board of Governors of the Academy of Motion Picture Arts and Sciences, a former chairman of the Special Effects Academy Award Committee, and a member of the Academy's Scientific and Technical Awards Committee and Grants Committee.

Dunn has been the recipient of many awards, including the SMPTE Herbert T. Kalmus Gold Medal Award in 1972 and the "Golden Hugo" at the Chicago International Film Festival. He was awarded a special citation by the SMPTE at their 1978 Conference, and received a special Academy Award in 1979 for outstanding service and dedication. He was awarded an honorary Doctor of Fine Arts degree by the San Francisco Art Institute. He has developed effects for many major films, and was nominated for a Special Effects Academy Award for his work in the film *Hawaii*.



Honorary Membership was awarded to Charles R. Fordyce.

Honorary Membership is awarded to **Charles R. Fordyce** for a distinguished career as a chemist and manager of research and development that has made significant improvements in motion-picture film over a period from 1929 until 1967, when he retired. He pioneered the development of safety cellulose triacetate motion-picture film base, which was introduced in 1948 and is still the most common type of motion-picture film base in use today. This development allowed discontinuation of the highly flammable nitrate base which has been used for motion pictures since the time of their invention.

Dr. Charles R. Fordyce held various positions during his long and distinguished career of almost 40 years with Eastman Kodak Co. Prior to his retirement from the company in 1967, he held the position of technical advisor to the general manager of Kodak Park Works.

He pioneered the commercial development of safety cellulose triacetate motion-picture film base, for which he received the SMPTE Samuel L. Warner Memorial Award in 1950, and for which Eastman Kodak was awarded an Oscar by the Academy of Motion Picture Arts and Sciences. He also played a prominent role in the commercial development of Estar polyester film base, and supervised experimental work on numerous motion-picture film projects. In 1968 he was awarded the Progress Medal Award by the SMPTE for his contributions to the development of cellulose materials for photographic film and for his work on film dimensions, stability, and other problems of projection.

Dr. Fordyce is a member of the American Chemical Society and a Fellow of the SMPTE. He has served on numerous committees of the Society over many years, including the 8 and 16mm Committee, the Film Preservation Committee, the Board of Editors, the Membership Committee, the Publications Advisory Committee, and served as chairman of the Honorary Membership Committee and the Admissions Committee. He is also a member of Sigma XI honorary scientific fraternity, Phi Beta Kappa, and Alpha Chi Sigma fraternities. He was awarded the Cornell College (Iowa) Alumni Citation in 1953.

Fellows Luncheon

The SMPTE held its annual Fellows Luncheon on Monday, October 29, at the New York Hilton. The luncheon is held to honor the newly elected Fellows and to present them with their plaques. Guests enjoyed a pre-luncheon reception sponsored by Magna-Tech Electronic Co., Inc.

Former SMPTE President Robert M. Smith addressed guests at the luncheon, which was limited to Fellows and Life Fellows. Twelve members were elevated to the grade of Fellow this year.

Elected Fellows — 1984

Emil Neroda
The Sound Shop, Inc.

Donald C. McCroskey
American Broadcasting Co.

Jerry P. Zaludek
VTR Productions Ltd.

Otto Schulze
Südwestfunk, Germany

Alan F. C. Hirst
Kodak Ltd., England

Patrick T. Kurtz
Eastman Kodak Co.

William S. Halstead
Engineering Consultant

John J. Clarke
RCA Corp. (retired)

Fritz Gabriel Bauer
Moviecam-Voest Alpine, Austria

Joseph A. Semmelmayer
Eastman Kodak Co.

Richard C. Sehlin
Eastman Kodak Co.

Donal L. Clayton
Photographic Analysis Ltd., Canada

Some Thoughts on the Meaning of the Word "Fellow"

By Robert M. Smith, former SMPTE President

Good afternoon, and welcome to this, our ninth Society Fellows Luncheon. While this is the ninth Fellows Luncheon, we are celebrating today the 50th anniversary of the Fellow grade of membership within our Society. This honorary membership grade was first approved by the Board of Governors of SMPE in 1934 and, while procedures for becoming a Fellow have changed over the years, it has been 50 years since this honorary grade was first introduced to our Society.

I recall that when I was first notified that I was approved as a Fellow of the Society, I went to a dictionary and looked up the meaning of the word "fellow," as well as to review the by-laws of the Society for its meaning. When Leonard Coleman asked me to say a few words at this year's Fellows Luncheon, I again returned to the dictionary, as well as other reference books, to learn more about the history and meaning of the word "fellow." I am sure you all have had the experience when starting to research something of being amazed at the amount of information and reference material that is available on any given subject. I found no less than nine definitions of the word "fellow," and, in one reference book, there were 111 meanings and definitions listed. Only two other words listed in that reference book had a larger listing — the words "friends" and the word "agreeable." We might add a new definition, making it 112, using these three words, "fellow agreeable friends."

Among the references were quotations from Moses, Ceasar, Shakespeare, Patton, Harry Truman, and Truman Capote. Probably Shakespeare gave the best definition, at least of how it relates to our Society -- "being amongst one's fellows is like finding one's other favorite shoe."

If a reference book can give us 111 definitions, I guess it's all right for our Society to make numerous by-law changes over the years pertaining to its Fellow Membership activities. As you may know, the Society Headquarters has been located in many different office buildings throughout the years. Only for the past 12 years has it had its own permanent home — which, I understand, is presently subject to change. Because of these many moves, as well as one or two fires over the years, some of the early records seem to be incomplete, and based on this fact I will stand corrected if any of the dates or information given are not quite accurate.

From the beginning of the Society in 1916, the Society had four membership grades, i.e., Pioneer, Honorary, Active, and Associate. An individual could apply for Pioneer Membership if he or she was in the motion-picture industry as an engineer or executive for at least 15 years and paid a lifetime membership fee of $250. One could also apply for Honorary Membership if he had at least ten years experience in our industry and paid a membership fee of $100. An Active Membership required at least three years' experience in the industry and a yearly $25 membership fee, while an Associate had to have a general interest in the motion-picture industry and pay an annual $25 fee as well.

In the 1920's, changes were made in the membership grades, doing away with the Pioneer Membership and Honorary, a membership grade which one could not apply for but would have to be nominated for by the Board of Governors. In 1934, a new member-

ship grade was added to the Society, where an individual could apply for membership as a Fellow. The individual had to be a minimum of 30 years of age, have at least three years of experience as an engineer or executive working in the motion-picture industry, be sponsored by three Fellows of the Society, and pay annual dues of $20. There was a footnote on the 1934 membership application stating that if a person applied directly for Fellow Membership status, he must submit biographical information with his application attesting to his outstanding rank among engineers or executives in the motion-picture industry. Of course, an individual could also apply for Active or Associate Membership during these years.

In the early 1930's, the Board of Governors, through its divine or blind wisdom, passed a by-law change which limited the holding of elected office or governor position within the Society to only two membership grades, i.e., Honorary or Fellow. After January 1, 1935, an Active Member could no longer serve on the Board of Governors either as an officer or governor. This rule stayed in effect for only a short time (approximately three years), when it became very apparent that it was a very limiting restriction placed on the nominating committee. In 1938, the by-law was changed, allowing an Active Member to serve as an officer or governor, and this is still in effect today.

Also in 1938, at the conference held in Detroit, Mich., the Board of Governors approved a change in the by-laws which would forbid any individual to apply directly for Fellow Grade Membership. The by-law change went on to say, "Fellow Membership will be granted by the Board of Governors," and recommended that a Committee on Fellow Membership be established to make recommendations to the Board of Governors for those individuals they thought eligible for this membership grade, and that these individuals so nominated would have to be approved by three-fourths approval of the Board of Governors.

In the late 1930's and early 40's, I was unable to verify the establishment of the Fellow Selection Committee, but in 1940 the Society had a total of 1342 members, of whom 140 were Fellows, or approximately 11% of the total membership. In 1943, an article in the *Journal* stated that an 11-man Fellows Committee was being appointed by the President. In reviewing the minutes of the 1943 and 1944 Board of Governors' meetings, there seems to have been an oversight in the 1938 by-law change, causing concern and confusion about who might be appointed a Fellow. In July 1945, the Board of Governors approved another by-law change which stated, "Nominations for Fellow shall be made only from the Active Membership."

Former SMPTE President Robert M. Smith addresses guests at Fellows Luncheon.

From 1938 to 1945, it was possible that someone other than a member of the Society could have been appointed as a Fellow. In 1946, a full report was made by the Fellow Membership Committee, at which time seven Active Members were recommended to the Board of Governors for elevation to Fellow grade membership, and these individuals received their Fellow certificates at the fall conference. At that time, they were presented at the Society's conference banquet. Basically, the rules that were established in 1938 and 1945 concerning Fellow Grade Membership are still in effect today.

Over the years, the administrative practice procedures for the committee have been changed and modified, and today that committee consists of the elected officers of the Society, chaired by the Past-President. Two-thirds of that committee's approval is needed before an individual is recommended to the Board of Governors.

During my involvement in the Society, I have kept a scrapbook of my own Society activities. In that book there are approximately 19 special letters, one of which I feel explains very well what the Fellow Membership is all about. Shortly after a previous Fellows Luncheon I received a thank-you letter from one of the new Fellows, who said that he did not understand how he had been selected for this honor, nor did he fully understand its meaning.

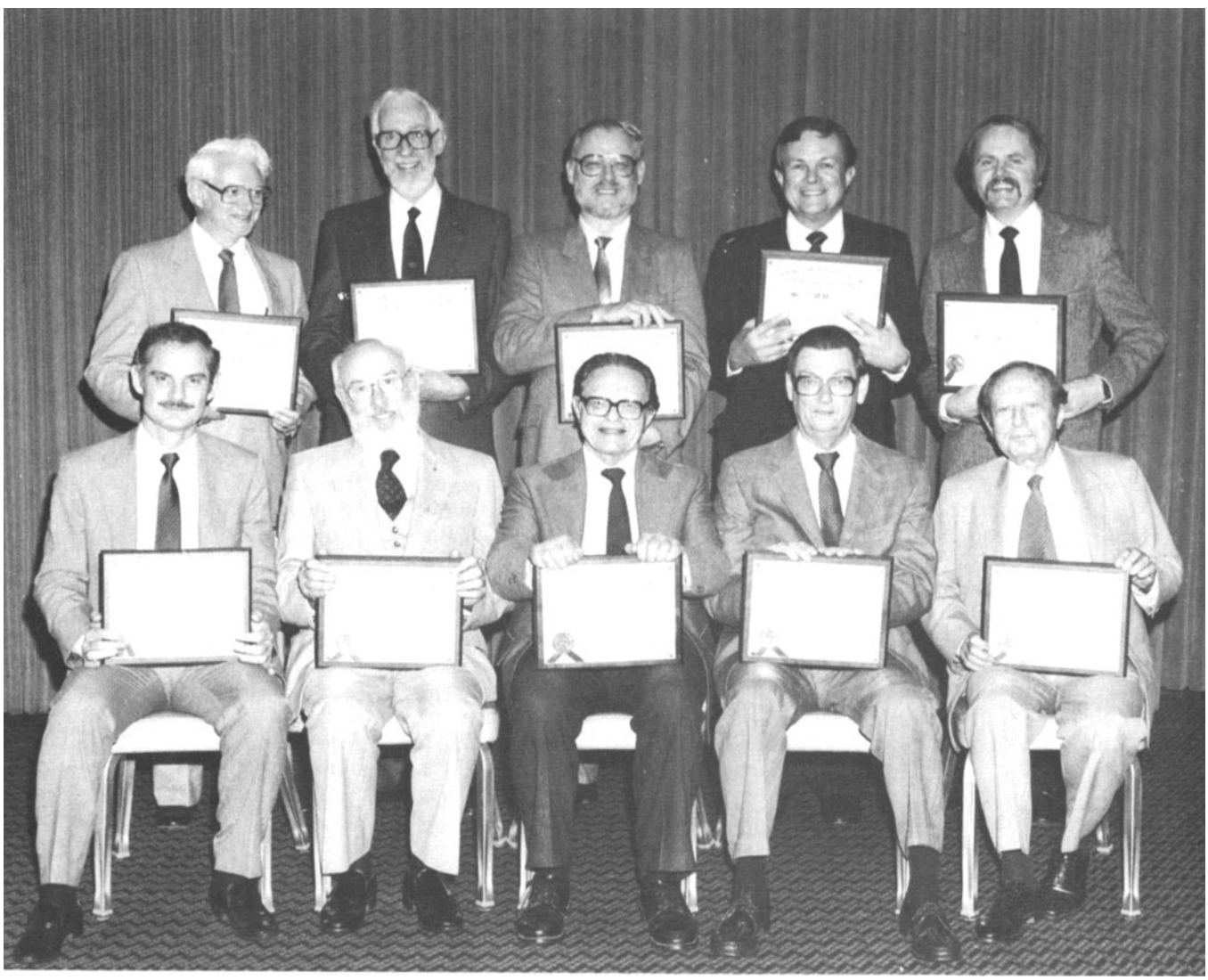
I answered his letter by basically explaining the procedures as outlined in the Administrative practices, that he was nominated by someone on the 65-member Fellows committee and had to be sponsored by two Fellows of the Society, with each applicant being reviewed at that time by an Affairs Vice-President for his evaluation. Then the names of the nominees are circulated along the nine members of the final Fellows Selection Committee for

their evaluation, after which a preliminary non-binding mail preference ballot would be taken by the committee. Finally, the committee would meet to discuss each of the nominees under consideration, with an individual ballot taken on each nominee, when an individual received the necessary support, i.e., six out of nine affirmative votes, his name would be forwarded to the Board of Governors for their consideration, and required three-quarters Board approval.

A few weeks later I received a second letter. The individual showed amazement that he was selected under this procedure and asked whether it would be proper if he had a list of the members of the final Fellows Selection Committee. I informed him that this information is available in the Membership Directory. At that time, I thought the individual was going to write and thank each of the Fellows Committee members individually.

A short time later I received a third letter from the same person, and this is the one that I have saved for my archives. He stated that he had never been so honored in his life in receiving his Society Fellow certificate since now he fully understood the procedures. He stated that it was especially meaningful since five of the nine members of the final selection committee were individuals whom he considered major competitors. Over the years he had had many disagreements and arguments pertaining to engineering methods and technologies, marketing techniques, and sales, either directly with these individuals or their firms, and he said that receiving this type of recognition from his peers is very rewarding — to receive this recognition from competitive peers is unbelievable. He went on to say that his Fellows plaque has now been elevated to a more prominent place of honor in his den, slightly above his marriage certificate and slightly below his birth certificate. I guess this is probably as good an example as can be given about being made a Fellow in our Society — being singled out and recognized by one's peers, not only by friends but often by one's competitors, in recognition of one's efforts and dedication to the industry.

I would like to congratulate each of the new Fellows being honored here today, and I would have to agree with Mr. Shakespeare, that being here today with so many of you is like finding one's other favorite shoe.



New Fellows of the SMPTE: (top row, L-R) Donal L. Clayton, Alan F. C. Hirst, Jerry P. Zaludek, Joseph A. Semmelmayer, Richard C. Sehlin; (bottom row) Patrick T. Kurtz, John Joseph Clarke, Donald C. McCroskey, Emil Neroda, and William S. Halstead. Fritz Gabriel Bauer and Otto Schulze were not present for the picture.

New Fellows of SMPTE

A Fellow of the Society is one who is no less than 30 years of age and who has, by his proficiency and contributions, attained an outstanding rank among engineers or executives of the motion-picture, television, or related industries.

Fritz Gabriel Bauer was born in Vienna, Austria, and has worked on film and theater productions throughout Europe. He is known throughout the world as the designer of the Moviecam 35mm camera, which he developed and brought to the market despite intense and well-established international competition.

Bauer is an unusual combination of engineer and artist, having started his career as a mechanical engineer. He held several jobs in the metal industry before enrolling at the Academy of Fine Art in Vienna, where he studied art direction for the theater and film. He founded his own film production company in 1970, and became a successful producer and director of commercials and industrial films.

In 1975, Bauer came up with his first design for the Moviecam 35mm camera, and in 1977, he invented the movement and design for the complete Moviecam system. The design of the Moviecam arose from the need to improve the steadiness of existing cameras, and to interrelate with the rapid development of video. Bauer determined to add both high speed and the facility to change speeds while shooting. Later developments included Moviecam III and Moviecam Super.

Bauer is currently president of Moviecam-Voest Alpine, and has been a member of the British Kinematograph, Sound and Television Society (BKSTS) since 1979. He received the 1972–74 Clio Award for commercials shot in New York in his capacity as director and cameraman.

John Joseph Clarke began his career in 1946, following his graduation from Glasgow Technical College with a B.S. degree in Electrical Engineering. He was involved in various stages of the design and development of magnetic sound recorders, airborne radar design and development, and wide-band tropospheric scatter systems. In 1958, he joined the Broadcast Systems Division of RCA Corp., where he worked on the design and development of STV microwave links. He transferred to camera engineering in 1960, and from then until 1983, he had design responsibility for several innovative television cameras, including the TK47 and Hawkeye models for which RCA received Emmy Awards.

In 1976, Clarke received RCA Broadcast Systems' Engineering Award and the RCA/IKK Team of Tigers Award, and in 1977, he was presented with the David Sarnoff Gold Medal for Outstanding Technical Achievement. He entered semi-retirement in 1983, and now works as an independent television consultant. His most recent project was to act as consultant to a Saudi Arabian TV network.

Donal L. Clayton is president of Photographic Analysis Ltd., Ontario, Canada, which he founded in 1965. He became interested in photography during World War II, when he was assigned to a special photography unit.

Clayton was responsible for the invention of the Pallite VIII Photo-Instrumentation Lighting Unit in 1972, the reflex through-the-lens viewfinder or the LOCAM camera in 1973, an electronic frame counter for use with the L-W Photo-Optical Data Analyzer and PCD Digitzer, and 30-V battery packs utilizing gelled electrolyte batteries for use in cold climates. In 1978, he developed a pistol grip, shoulder brace, and two-speed operation for the LOCAM camera.

Clayton has been an active member of SMPTE since 1957, as well as of the Society of Photo-Optical Instrumentation Engineers (SPIE), for which he is the Canadian National Delegate to the International Congresses on High-Speed Photography. In 1976, he served as chairman of the 12th International Congress, which was held in Canada. He has arranged and participated in several SMPTE conferences, and has presented a number of papers on photo-instrumentation at the Toronto Section. In 1983, he was given the Photo-Sonics Achievement Medal Award by the SMPTE, in recognition of his designs for a light source used in high-speed motion-picture photography, and of a reflex viewfinder for a high-speed intermittent camera.

William S. Halstead has been active in the international and domestic television and radio broadcasting fields for more than forty years, starting immediately after his graduation from Haverford College in 1927 with a B.Sc. degree in Physics. At present he is chairman pro tem of the Unitel International Television Foundation, a nonprofit organization that serves as a catalyst in the development of a proposed global communications satellite system to be operated under the aegis of the U.N. as a means of developing better understanding between the peoples of the world.

Halstead was one of the pioneers in the development of FM stereophonic broadcasting. In the early 1930's, he was granted a patent on what is considered to be the first use of a motion-picture sound localizing system, which utilized photographic control tracks for positioning sound in the left, center, or right portions of a screen. In 1950, as president of Multiplex Development Corp., he was the first to originate and demonstrate FM stereo broadcasting by mutliplex method. During the early 1950's, he served as television systems consultant to the Nippon TV Network Corp. (NTV), the first and largest commercial television network in the Far East, and recommended adoption of the American 525-line system. He later served as television system-planning consultant during the 1960's to the governments of Jordan, Uganda, and Nigeria.

Halstead has been granted more than 80 U.S. and foreign patents, and is the author of many technical papers on electronic telecommunications, several of which have been published in the *SMPTE Journal*. In 1950, he was awarded the Popov Medallion during the International Electronics Conference in Moscow, for his contributions in the telecommunications field.

A former Life Member of the SMPTE, Halstead is now being elevated to Life Fellowship status. He is also a Fellow and Life Member of the Audio Engineering Society (AES), a Fellow of the Radio Club of America, a Life Senior Member of the Institute

Fellow Membership Committee

Charles E. Anderson, *Chairman*
Charles A. Ahto
Jack G. Baer
Blaine Baker
John L. Baptista
John Barry
Sherwin H. Becker
K. Blair Benson
Max Berry
Edward J. Blasko
John F. X. Browne
John W. Caluger
Patrick Coakley, Jr.
Leonard F. Coleman
Ken P. Davies
Bernard L. Dickens
Harold J. Eady
Herbert E. Farmer
Donna Foster-Roizen
Veneranda Fox
Maurice L. French
John C. Gates
David A.Ginaven
Philip Godfrey
Leonard A. Green
George E. Halonen
Geoffrey E. Healy
Tomlinson Holman
Julian D. Hopkinson
Thoms B. Keller
M. Carlos Kennedy
Stephen D. Kerman
Charles D. Kircher
Michel Lacaille
Fung F. Lam
Howard T. La Zare
Joseph Macaluso, Jr.
Edward J. Messina, Jr.
Donald C. McCroskey
M. A. McDaniels
Michael Muderick
Eugene R. Myler
Stan Nalski
Frederick R. Nobbs, Jr.
Bengt O. Orhall
Kerns H. Powers
John P. Pytlak
Frederick M. Remley
Irving Rosenberg
John P. Rusche
Roderick T. Ryan
Joseph A. Semmelmayer
Sam P. Stalos
Burton Stone
Richard G. Streeter
Richard J. Stumpf
John F. Swanson
Norman A. Thelen
Robert M. Vaive
Bill R. Watson
Howard E. Wilkinson
Irwin W. Young
William C. Young, Sr.
Donna D. Zingelman

of Electrical and Electronic Engineers (IEEE), and a member of Phi Beta Kappa.

Alan F. C. Hirst began his association with Kodak Ltd., England, in 1944, working on motion-picture processing technology. From 1956 to 1984, his responsibilities involved motion-picture sales, quality control of color processing, and technical service. He is currently in charge of coordinating the sales support group of Kodak Ltd.

Hirst is a Fellow of the British Kinematograph, Sound and Television Society (BKSTS), and immediate past president of that organization.

Patrick T. Kurtz graduated from Cornell University with the M.S. degree in Chemical Engineering, and from the Executive Program of the UCLA Graduate School of Management. He joined Eastman Kodak Co. as a photographic engineer, and has held a number of other technical and management positions with the company. He currently holds the position of marketing director for Kodak's international photographic operations in Japan.

Kurtz developed a water conservation program and held information seminars in California from 1976–1977. In addition, he designed the Eastman Color Process Control Program, and developed the technical publication *WorkPrint*. He also acts as Eastman Kodak consultant on the storage and preservation of motion-picture film.

An active participant in SMPTE activities, Kurtz served as program chairman for conferences in Chicago and Rochester, is a member of the Laboratory Practice Committee, and chairman of the Working Group on Storage and Preservation of Motion Picture Film. He has presented several papers before the SMPTE and the Association of Cinema and Video Laboratories, Inc. (ACVL). He is also a member of the Society of Photographic Scientists and Engineers (SPIE).

Donald C. McCroskey attended Washington State University, receiving the B.S. degree in Electrical Engineering in 1944. Following service in the Army Signal Corps, he joined ABC in Hollywood as a studio engineer. ABC began television broadcasting in the Los Angeles area in 1949, and McCroskey has been active in various engineering operations and design projects since then. He is now manager of the Audio/Video Systems Dept., where he was responsible for the design and installation of three presentation control rooms for the 1984 Summer Olympic Games.

McCroskey has been a member of SMPTE since 1956, and has had an active role in many section activities. He has served as manager, secretary-treasurer, chairman, and past-chairman of the Hollywood Section. In addition, he was a member of the Hollywood Section One-Day Seminar Committee, a member of the Color Monitor Setup Committee and the Motion Picture/TV Sound Study Group, and secretary of the High Definition Study Group. As chairman of Hollywood Section's Education Committee, he organized and taught courses in television techniques at the University of Southern California. He has been television papers chairman and session chairman at three Society conferences and is the author of two technical papers which were published in the *SMPTE Journal*. He is currently serving as SMPTE Governor, Hollywood Region, for the 1984–85 term, and has also been appointed editorial director, television.

Other professional organizations of which he is a member are the Institute of Electrical and Electronic Engineers (IEEE), the Audio Engineering Society (AES), the Society of Broadcast Engineers, the Society of Television Engineers (secretary/treasurer and president), and the Academy of Television Arts & Sciences Blue Ribbon Engineering Awards Committee.

Emil Neroda has been a pioneer in the field of audio production and post-production for film and videotape during the past 40 years. As president of The Sound Shop, which he founded in 1972, he has been responsible for scores of laboratory improvements leading to technical advances in film sound. As far back as 1948, Neroda first designed a sound-track developing laboratory that resulted in improved sound quality for variable area and variable density sound.

In 1949, he became the first to use 200-mil direct positive recording, eliminating the need for the negative-to-positive system in use till then. In 1951, Neroda initiated the use of 35mm magnetic recording as an original track for re-recording. He was the first audio engineer to adapt advanced motion-picture recording procedures for the mixing of sound to videotape, and he has continued to successfully adapt motion-picture re-recording procedures to the mixing of sound for videotape. These improvments on existing audio technology have made Neroda a leading authority in the area of audio mixing in videotape post-production. His paper on "Audio Mixing for Videotape Post-Production" is considered a milestone in explaining the creative advances taking place in the videotape industry.

Neroda has been honored with three Emmy Awards from the National Academy of Television Arts and Sciences — in 1968 for "Elizabeth the Queen," in 1970 for "Annie, the Woman in the Life of Man," and in 1971 for "Leopold Stokowski." More recently he received the 1981 Monitor Award of the Videotape Production Association for his work on "A Connecticut Yankee in King Arthur's Court," and The Sound Shop won the 1983 Monitor Award for "Laser — the Light Fantastic."

A member of SMPTE since 1956, Neroda is also a member of the National Academy of Television Arts and Sciences and the Videotape Production Association.

Otto Schulze is known as a pioneer in the use of film techniques in television. His first contact with the film medium was made as head of a test department in Berlin handling microphones, loudspeakers, movie sound recording and playback amplifiers. From 1935 to 1945, he worked in television, becoming increasingly aware of the need for close interface between film and television. Schulze designed a TV-owned film processing plant for 35mm black-and-white film in the negative-positive process to speed the transmission of film programs.

In 1940, he designed the Nietsche-Kamera. This was the first 35mm camera with continuous light measurement behind the lens. He was also responsible for the first application of magnetic sound technology in film production.

Following the end of World II, Schulze joined Sudwestfunk/Baden-Baden, one year after the introduction of television in the Federal Republic of Germany. He worked in support of the use of film technology in television, and participated in the introduction of TV-suitable 16mm reversal processing with controlled second illumination and reversal copying technique.

Turning his attention to studio illumination, Schulze became the first chairman of a working group for studio illumination of the ARD/ZDF. In addition to designing a standard uniform illumination measurement, he was involved in the lighting of the sports arena for the 1972 Olympic Games in Munich. The development of metal quartz iodine vapor lamps of different power consumption is based on this work. Schulze has worked on many committees and working groups relating to standardization of film recording, film post-production, film playback, and film illumination techniques.

Schulze is now being elevated to Life Fellow status. He has written numerous papers and articles on film techniques in television, and holds a patent on one of his inventions. He was awarded the Oskar-Mebter Medal by FKTG in 1980 at the Technical University of Berlin in recognition of his efforts. He is now retired.

Richard C. Sehlin is product and process development group leader at Eastman Kodak Co. He received a Bachelor of Chemical Engineering degree from the University of Minnesota, and a M.S. and Ph.D. from Carnegie Mellon University. In 1973, he joined Kodak's research laboratories, where he designed the initial prototype of the Ektaprint processor and developed Vericolor internegative film 6011/4112. He later moved to the photographic technology division, where he participated in the development of Eastman color print film 5/7384 and process ECP-2. In addition to working on new coupler technology, he helped to develop the following films: Eastman color high speed negative film 5/7293, Eastman color high speed negative film 5/7294, and Eastman color negative film 7291.

Sehlin is the author of numerous articles on film, many of which have been published in the *SMPTE Journal*. He received the Journal Award in 1983 for his article on Eastman color high speed negative film 5293, and in 1984, he was appointed liaison between the SMPTE and other professional societies. From 1980 to the present, he designed and taught courses on Eastman color films and laboratory practices in Hong Kong and major U.S. cities.

Joseph Semmelmayer, regional coordinator, engineering service, Eastman Kodak Co., San Francisco, has spent his entire professional career with Eastman Kodak. He started in 1948 as a technician in their film testing division in Rochester, N.Y., progressing through assignments dealing with various phases of film testing and quality control.

During this period, Semmelmayer attended the University of Rochester, graduating in 1961 with the B.S. degree. That year he became a product engineer responsible for testing, quality control, and new product development on television recording and direct electron beam recording products. He helped develop the Viscomat Processor, helped to effect product changes designed to minimize shutter bar in television recording, and designed tests for predicting sound recording characteristics of films.

After a short time with Kodak's microfilm subsidiary, the Recordak Corp., Semmelmayer returned to Rochester in 1967 as product planning specialist in the motion-picture and audovisual markets division. Since 1970, he has been providing engineering service to Kodak's motion-picture and television customers throughout the Northwest. His responsibilities have included conducting seminars, teaching classes, and introducing new products and processes to the industry. In 1981, he went to the Middle East to help the Ministry of TV and Information of Kuwait establish a motion-picture laboratory for the Persian Gulf countries.

Semmelmayer joined the SMPTE in 1961, and has been an energetic participant in its activities. He served the Rochester Section as committeeman for miniconferences, and has been manager, secretary, treasurer, and chairman of the San Francisco Section. He was conference chairman for the 9th SMPTE Television Conference, and has helped to plan and organize all of the TV conferences held in San Francisco. In addition to presenting numerous papers at SMPTE

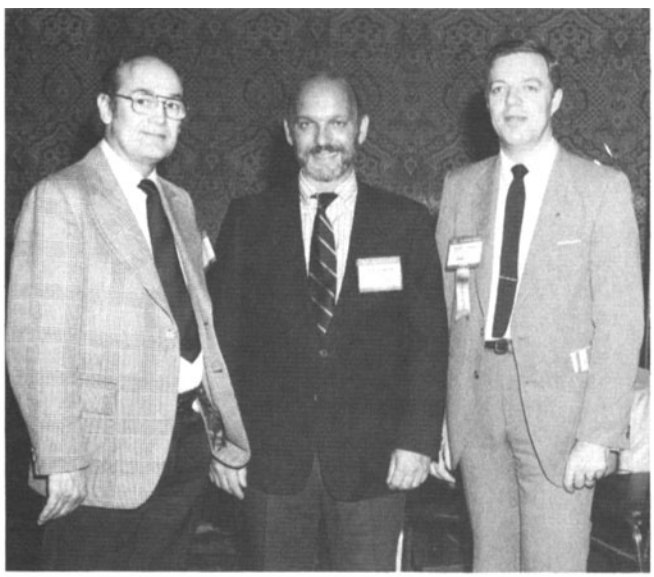
section meetings, he has been a contributor to several papers on viscous processing, shutter bar elimination in TV film recording, rapid processing of panchromatic negative film, and electron beam data recording. In 1979, he was awarded the Citation for Outstanding Service for his activities on behalf of the Society. He is presently serving as Governor, Western Region, for the 1983–84 term.

Jerry P. Zaludek is president, VTR Productions Ltd., Toronto, Canada. He is known as a pioneer in the videotape production field, having been involved with the operation and maintenance of television production equipment for over twenty years. Following his graduation in 1959 from Ryerson Polytechnical Institute with a degree in electronics, he began his career in videotape production as a maintenance technician. In 1961, he participated in the development of high-quality broadcast black-and-white kinerecording.

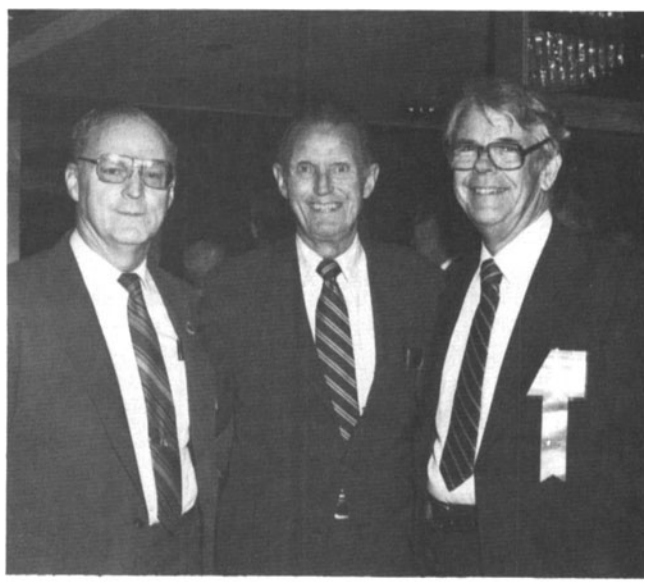
Zaludek developed the first color kinerecording in Canada, and has worked with many generations of videotape recorders and cameras. He has also been responsible for the manufacture and innovative use of mobile television production systems.

A member of the SMPTE for 20 years, Zaludek has worked on several committees, and served as manager for the Toronto Section in 1980–82, and as chairman of the Toronto Section for the 1982–83 and 1983–84 terms. He is also a member of CFTA (Canadian Film and Television Association), and Industrial TV Association (ITVA).

—Joyce R. Hurwitz



(L–R) Canadian Regional Governor Leonard A. Green, new Fellow Fritz Gabriel Bauer, and Governor-at-Large Bengt O. Orhall.



Former Presidents of the SMPTE: (L–R) Robert M. Smith, Kenneth M. Mason, and Charles E. Anderson.

(L–R) Hollywood Regional Governors Roderick T. Ryan, Richard J. Stumpf, Donald C. McCroskey, and Howard T. La Zare.

The Spouses Program

Spouses Program Chairwoman Judy Hunt (Mrs. C. Bradley Hunt) arranged a full week of varied activities for persons accompanying conference registrants, beginning with a Welcoming Tea on Sunday evening. Participants gathered for continental breakfast each morning before embarking on the day's activities.

Assisting Mrs. Hunt on the Spouses Program Committee were Mrs. Herbert Pilzer (Pucki), Mrs. Robert Smith (Edna), Mrs. Richard Sehlin (Deena), Mrs. Harold Eady (Dorothy), Mrs. Irving Rosenberg (Alice), Mrs. Charles Anto (Marge) and Mrs. John Norris (Sandy).

On Monday morning, the group was given the opportunity to sign up for various events. A bus tour departed for the South Street Seaport Museum, followed by lunch at the Coho Restaurant.

On Tuesday morning, bus transportation was available to the Metropolitan Museum of Art, after which the group returned to the hotel for the Honors and Awards Luncheon. The afternoon was left free for shopping, sightseeing, etc. Coffee, tea, cards, and bridge setups were available in the Rendezvous Trianon of the hotel.

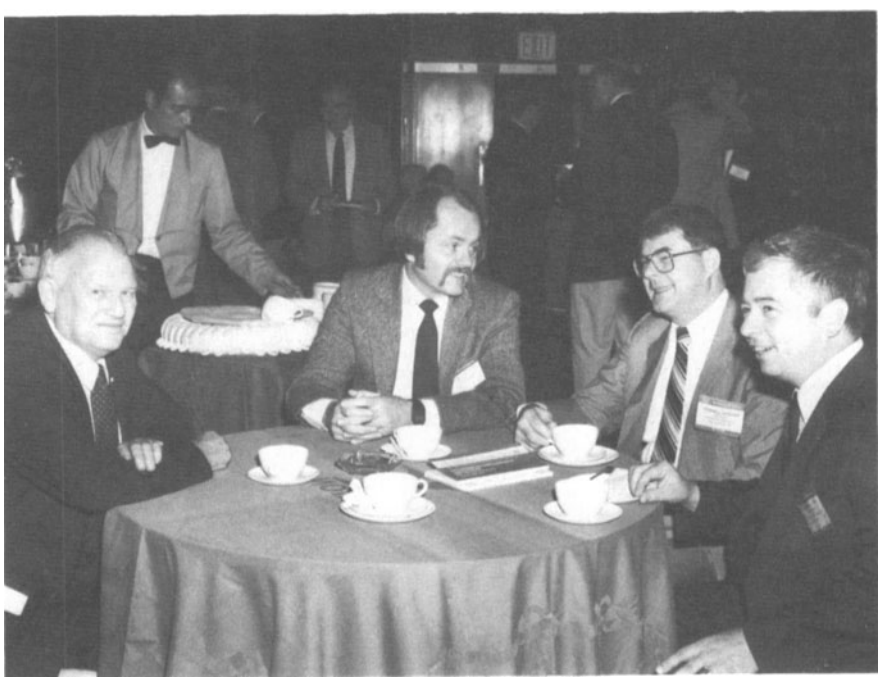
On Wednesday, the spouses were treated to a gourmet luncheon cruise aboard a World Yacht Enterprises vessel.

Some members of the Spouses Committee (standing): Chairwoman Judy Hunt, Alice Rosenberg; (seated, L-R) Sue Messina, Dorothy Eady, and Deena Sehlin.

On Thursday, the group was given a bus tour to the beautiful grounds of Caramoor, in Katonah, N.Y., followed by a gourmet lunch at Le Chateau in nearby South Salem, N.Y. (Westchester County).

Friday's agenda featured a choice of two activities. Interested parties could either tour The New York Times or visit the set of "The Morning Show," WABC-TV. The afternoon was left free to explore the many facets of New York City.

The program was made possible by the sponsorship of the following organizations: Academy of Motion Picture Arts and Sciences, AMP Special Industries, Amperex Electronics Corp., Du Art Film Laboratories, Inc., EECO, Inc., Filmline Corp., Frezzolini Electronics, Fuji Photo Film USA, Inc., Glen Glenn Sound Co., Hollywood Film Co., Eastman Kodak Co., Maxwell Corp. of America, MCI/Quantel, Motion Picture Enterprises, Inc., Motion Picture Laboratories, Inc., Multi-Track Magnetics, Inc. (A Matrix Co.), Novo Communications, Inc., Philips Television Systems, Inc., RCA Corp., Broadcast Systems Div., and Sescom, Inc. The Society wishes to express its appreciation for this support.



Registrants enjoying the coffee club at the conference.

Coffee Club

Conference activities got off to a good start each morning at a coffee club sponsored by Fuji Photo Film USA, Inc. The facilities were available to registrants from 8:00-10:00 a.m. Monday through Friday, at both the Hilton and Sheraton Centre hotels.

A lovely evening of dining and dancing was enjoyed by guests at the SMPTE banquet.

SMPTE Banquet

The annual SMPTE cocktail party, banquet, and dance held on Wednesday evening in the Grand Ballroom of the New York Hilton. After a pre-banquet reception in the foyer outside the ballroom, guests went inside to enjoy a delicious dinner and dancing. In addition, they were treated to a delightful evening's entertainment featuring both a comedian and a singing duo which performed a medley of Broadway show tunes. Music for dancing was provided by the Jerry Jerome Orchestra.

Among those responsible for the evening's success were 3M Co., which sponsored the pre-banquet cocktail party; Technicolor, Inc., which provided the table wines at the banquet; Multi-Track Magnetics, Inc. (a Matrix Co.), which sponsored the banquet centerpieces; and Hazeltine Corp., which sponsored the evening's entertainment.

Blood Pressure Testing

Registrants at the Conference were given the opportunity of having their blood pressure checked through the courtesy of the Will Rogers Institute of White Plains, N.Y. A booth was set up near the registration area at the New York Hilton for the convenience of guests at the Exhibit.

A number of visitors took advantage of the screening program, which may have alerted unsuspecting victims of hypertension. The Will Rogers Institute emphasizes the need for annual checkups to make sure people are free from this dangerous but often symptomless condition.

The Will Rogers Institute ran a free blood-pressure testing clinic for conference registrants.

SMPTE Booth

The SMPTE maintained a booth in the registration area where attendees could obtain information about the Society and its activities, apply for membership, and purchase books and test materials. Membership Chairman Carmine Melignano, Price Waterhouse & Co., supervised the booth and was present throughout the week to recruit new members. According to Melignano, a new record was set for the number of new members signed up at a conference. Assisting at the booth were Headquarters staff Josephine LaVecchia, Ana Pagan, and John Lolis. The membership efforts were under the guidance of National Membership Chairman Burton Stone, Deluxe Laboratories.

The SMPTE booth. Josephine LaVecchia, Ana Pagan, Burton Stone, and Carmine Melignano. (Photograph by Judith Bronowski.)

The Equipment Exhibit

One of the major attractions of the meeting, the equipment exhibit, opened on Tuesday, October 30. The exhibit, one of the year's most important displays of professional filmmaking and television equipment, occupied the entire second floor of the Hilton as well as Albert Hall in the Sheraton Centre. A total of 479 booths were taken, representing a 20% increase over the last New York exhibit, held in 1982.

The exhibit hours were from 2:00 p.m. to 8:00 p.m. on Tuesday; 10:00 a.m. to 5:00 p.m. on Wednesday; and 10:00 to 6:00 p.m. on Thursday. The following is a list of companies which participated in the exhibit.

List of Exhibitors

Aaton
A. F. Associates, Inc.
Abekas Video Systems, Inc.
Adams-Smith
ADC Magnetic Controls
Adcom Communications
ADDA Corp. & Control Video Corp.
ADM Technology, Inc.
A. F. Associates, Inc.
Agfa-Gevaert, Inc.
Alan Gordon Enterprises, Inc.
Allen Products Co.
Amperex Electronic Corp.
Ampex Corp.
Amtel Systems, Inc.
Angenieux Corp. of America
Anton/Bauer, Inc.
Anvil Cases, Inc.
Arriflex Corp.
Asaca/Shibasoku
Audico, Inc.
Audio Master Recording Films, Inc.
Autocue
Belden Communications, Inc.
BHP, Inc.
Robert Bosch Corp., Video Equipment Div.
BSM Broadcast Systems, Inc.
Calzone Case Co.
Camera Mart, Inc.
Canon U.S.A., Inc.
Dwight Cavendish Co. Ltd.
Central Dynamics Ltd.
Centro Corp.
Century Precision Optics
Cetec Vega
Chyron Corp.
Cine 60 Inc.
Cine Pro, Inc.
Cinema Products Corp.
Cinematography Electronics
Cipher Digital, Inc.
CMX/ORROX
Coherent Communications, Inc.
Colortran Inc.
Comprehensive Video Supply Corp.
Compu-Prompt
Convergence Corp.
Corporate Communications Consultants, Inc.
Crosspoint Latch Corp.
Desisti Lighting/Desmar Corp.
Digital Video Systems, Inc.
Digivision, Inc.
Dolby Laboratories, Inc.
DRC Products, Inc.
DSC (Digital Services Corp.)
Dubner Computer Systems, Inc.
Dwight Cavendish Company, Ltd.
Eastman Kodak Co.
ECHOlab, Inc.
EECO, Inc.
EEV Inc.
Electronic Applications, Inc.
Euro Equipment Service
Film Processing Corp.
FOR-A Corp.
Fortel Inc.
Frezzolini Electronics
Fujinon, Inc.
Fuji Photo Film, U.S.A., Inc.
G&M Power Products, Inc.
Goldberg Bros./J & R Film Co.
Grass Valley Group
Grumman Aerospace Corp.
GTE Products Corp.
Harris Corp. Broadcast Group
Harrison Systems, Inc.
Hazeltine Corp.
HEDCO (Hughes Electronic Devices Corp.)
Karl Heitz, Inc.
Hitachi Denshi America, Ltd.
H. M. Electronics, Inc.
ICM Video
Ikegami Electronics (U.S.A.), Inc.
Image Video Ltd.
Interactive Systems Co.
JVC Co. of America
K & H Products, Ltd.

The SMPTE equipment exhibit attracted a record crowd. (Courtesy Einzig Photographers)

A view of the exhibit floor. (Courtesy Einzig Photographers)

Visitors were able to get "hands-on" experience with the latest motion-picture and television equipment. (Courtesy Einzig Photographers)

Kinotone, Inc.
Lab Methods Corp.
Lake Systems Corp.
LE Nelson Sales Corp.
Leitch Video of America, Inc.
Lenco, Inc., Electronics Div.
Lexicon, Inc.
Lipsner-Smith Co.
Listec Television Equipment Corp.
Lowel-Light Manufacturing, Inc.
LTM Corp. of America
Lunar Video, Ltd.
M/A-COM MVS, Inc.
Magna-Tech Electronic Co., Inc.
Martin Audio Video Corp.
Matthews Studio Equipment, Inc.
MCI/Quantel
Merlin Engineering Works, Inc.
Micron Audio Products, Ltd.
Microtime, Inc.
Midwest Corp.
Minolta Corp.
Mitchell Camera Corp.
3M Co.
Mole-Richardson Co.
Motion Picture Enterprises, Inc.
Motorola C & E, Inc.
Nagra Magnetic Recorders, Inc.
NEC America, Inc.
Neumade Products Corp.
NISUS Video, Inc.
Nova Systems, Inc.
Nurad, Inc.
OLDELFT/KLM Associates, Inc.
Osram Sales Corp. c/o SIEMENS
Otari Corp.
Oxberry Div. of Richmark Camera Service, Inc.
Paltex
Panasonic Industrial Co.
Perrott Engineering Labs, Inc.
Philips Television Systems, Inc.
Plastic Reel of America
Q-TV
Quanta Corp.
Quante Corp.
Rank Cintel Ltd.
Rank Precision Industries, Inc.
RCA Broadcast Systems
Research Technology International
Roessel CPT., Inc.
Rohde & Schwarz Sales Co.
Rosco Laboratories, Inc.
RTS Systems, Inc.
Rupert Neve Incorporated
Sachtler Corp. of America
Schneider Corp. of America
Sennheiser Elec. Corp.
Sescom, Inc.
Shintron Co., Inc.
Sigma Electronics, Inc.
Skotel Corp.
Solid State Logic
Sony Broadcast Products Co.
Sound Technology, Inc.
Soundcraft Electronics
Stage Lighting Distributors Corp.
Steenbeck, Inc.
Strand Century, Inc.
Studor Revox America Inc.
Swintek Enterprises, Inc.
Sylvania Lighting
Tektronix, Inc.
Telcom Research
Telescript Inc.
Television Equipment Associates
Tentel
Thomson CSF Broadcast
Tiffen Mfg. Corp.
Union Connector Co., Inc.
Ursa Major, Inc.
Videotek, Inc.
Winsted Corp.
Zellan Enterprises, Ltd.

Due to lack of space on the exhibit floor, several companies displayed their products in suites at the New York Hilton and Sheraton Centre Hotels. The following companies exhibited in this manner:

Leader Instruments Corp.
Gotham Audio Corp.
NTI America, Inc.
Montage Computer Corp.
Minolta Corp./Industrial Meter Div.
Marconi Instruments
Multi-Track Magnetics, Inc.
Datum, Inc.
Telepak San Diego
O'Connor Engineering Labs Inc.
Filmline Corp.
Shure Brothers Inc.
The Real World Technologies Group, Inc.
Sharp Electronics Corp.
TASCAM TEAC Professional Division
Utah Scientific, Inc.

General Electric Co.
Office Efficiency Systems
Tele-measurements, Inc.
Kobold of America Corp.
AMP Products Corp.
ROH Corp.
Vital Industries, Inc.
Alamar Electronics
ANT Telecommunications Ltd.
BIAMP Systems, Inc.
Canare Cable, Inc.
Profit Recovery Systems, Inc.
Amherst Electronic Instruments
Audio Magic Limited
VideoTeleCom
Video International

Editorial Meetings

Three important editorial committee meetings were held on Wednesday morning, October 31. The first was the Papers and Publications Advisory Committee, chaired by SMPTE Editorial Vice-President Maurice L. French. The committee discussed a wide variety of topics.

Next, the SMPTE Board of Editors met, with Chairman Calvin M. Hotchkiss presiding. It is the responsibility of the Board of Editors to pass on the suitability of manuscripts submitted for publication.

The final editorial meeting of the morning was held by the Progress Committee presided over by Chairman M. Carlos Kennedy. The Progress Committee is responsible for the preparation of an annual report on world progress in motion pictures and television. The report will appear in the April 1985 issue of the *Journal*.

The Board of Editors meeting. Seated (L–R) Donald C. McCroskey, Editorial Program/Coordinator Mary Connolly, Editorial Vice-President Maurice L. French, Chairman of the Board of Editors Calvin M. Hotchkiss, Sidney Solow, and incoming Editorial Vice-President Howard T. La Zare.

Participants in the Board of Editors meeting (L–R): Leonard R. Green, Edgar A. Schuller, Pablo Weinschenck-Tabernero, Frederick M. Remley, Joseph Roizen, Edward J. Blasko, Arthur P. Willis, and Donald C. McCroskey.

Engineering Meetings

The week of the 126th SMPTE Technical Conference was most active and productive for the SMPTE engineering committees, their working groups, subcommittees, and study groups, which took the opportunity to hold meetings during the conference. Synopses of the committee work in progress are presented herein, with additional information obtainable from Alex E. Alden, Manager of Engineering, at SMPTE Headquarters.

Committee on New Technology

The committee, under the chairmanship of Dr. Kerns Powers, met on November 2, to receive reports from its three subgroups.

The Study Group on Digital Television, under the chairmanship of Charles Ginsburg, is retained under the Committee on New Technology to continue pre-specification studies in selected areas of digital technology, e.g., the problems of distributing both analog and digital studio signals through hybrid analog/digital common-carrier networks.

Recent developments in bandwidth compression techniques show promise of providing near transparent transmission of composite video signals at a bit rate of 45 Mbit/sec (the North American DS-3 level of the digital hierarchy), as compared with approximately twice that rate without compression. The time has come to initiate work on an interface specification; consequently, this work of the study group will be discontinued. In the interim, the Exchange Carriers Standards Association (ECSA), a new organization established in the wake of the AT&T divestiture, will undertake the specification work. Minutes and reports of the study group will be turned over the ECSA, and the SMPTE group efforts will be directed to other areas.

The Working Group on High-Definition Electronic Production, co-chaired by Robert Stumpf and Bernard Dayton, is addressing a specification for a production standard usable in television and motion-picture applications of electronic production and post-production. The group held its first meeting on May 4, 1984, and has since held meetings approximately every six weeks. Participation by some eminent cinematographers and engineers from the motion-picture community as well as television engineers, permitted an early decision to be made on one of the more critical motion-picture requirements.

A tentative selection of an aspect ratio of 1.77:1 is believed to permit the established tradition of "shoot-and-protect" to be accomplished with full flexibility in film release having aspect ratios anywhere within the range of 1.33 to 2.35, while the framing of the action is in a wide-screen format and the protected area is distributed uniformly around the action. A subgroup on aspect ratio has been organized to study compatibility issues in the film laboratories, cinema projection, and television release for this initial parameter choice.

A Subgroup on Frame Rate was organized under the chairmanship of Kenneth Holland and vice-chairmanship of William Hogan to plan and carry out experiments that will provide data for the frame-rate choice and selection of interlace versus progressive scan.

A Subgroup on Bandwidth is being organized to obtain a technology projection of digital video and to establish a trade-off model to optimize the parameter values for subjective effects, within the constraint of various selected bandwidths. Bernard Dayton will chair this subgroup, which will study bandwidth compression algorithms when applied in the trade-off model.

The Study Group on High-Definition Television is currently confining its study to the areas of psychophysics and transmission. The group identified a critical need for rethinking of questions pertaining to colorimetry and gamma (or nonlinear pre-emphasis and de-emphasis), and to establish whether colorimetry coordinates of the original film are still appropriate for specifying HDTV image-capture standards, and if gamma-correction in the camera itself is desirable.

The Study Group on the Application of DRAW (Direct Read After Write) Video Disc Technology has been inactive during most of 1984. An assessment is being made of the need for, and membership interest in, continuing the work of the group.

The Committee on New Technology is anxious to consider any request for initiation of specific studies or working group efforts when a potential need for standards in this technology is identified.

Committee on Film Technology

In the absence of a quorum at the October 31 meeting, the chairman, Lincoln Endelman, suggested that the agenda items be covered by informal discussions.

A report by the Study Group on Image Steadiness is anticipated to be made available prior to the 12th Plenary Meeting of ISO/TC 36 on Cinematography (International Organization for Standardization) in London, England, during 1985. Mr. Endelman invited those present to attend the international meeting, and asked that they contact Headquarters for further information.

The Working Group on Film in Space Environment completed its assignment, which is documented as SMPTE EG 8-1984, Specifications for Motion-Picture Camera Equipment Used in Space Environment. Copies of this document can be obtained from Headquarters.

Three current standards will be reviewed in 1985, and revised to reflect up-to-date practices: PH22.31M-1980 Specifications for motion-picture safety film; PH22.146M-1980, Method for determining speed of 16-mm and 8-mm reversal color camera films intended for direct projection in motion-picture photography; PH22.184-1973 (R-1980)-Motion-picture raw stock identification and labeling.

Theatrical Projection Technology Committee

The committee, under the chairmanship of John Pytlak, convened on October 29, 1984. Pursuant to a lengthy discussion on problems encountered in theaters, the committee agreed that proper maintenance of equipment be mandatory for both service technicians and projectionists. It was also recommended that polyester base be used for release prints to minimize shrinkage, which is especially true with wide formats such as 70mm.

Meeting of the Working Group on High Definition Electronic Production, co-chaired by Robert Stumpf and Bernard Dayton.

A survey conducted of current screen luminance practices by the Working Group on Screen Luminance, chaired by Robert Pinkston, found that many theaters are capable of meeting the standard with present equipment, although some are operating lower than 16 fL. The group is also conducting a study to find a low-cost meter which is suitable for measuring screen luminance.

The chairman stated that a proposal to modify the 35mm projector alignment and screen image quality test film (RP 40), has been completed and is being circulated to the committee for review.

The Working Group on High-Definition Projection, chaired by Glenn Berggren, is considering factors that result in loss of sharpness during projection; positioning instability in the gate; the tension on the film and thermal affects. A report on the comparison of flat vs. curved projector gates is to be presented at the ShoWest '85 Conference in February.

It was noted that the Working Group on Theater Design, under the chairmanship of Will Szabo, is updating his 1982 paper on this subject for possible publication in the *SMPTE Journal*.

A proposed test film for evaluating picture contrast is being reviewed by the Working Group on Picture Contrast.

A draft of a projection manual intended for projectionists has been made available to SMPTE. It provides a "hands-on" step-by-step guide to film-handling and specific projection equipment. Members of the committee will be asked to review this manual.

In conclusion, Pytlak reported that a new group is to be formed, the Working Group on 3-D Projection, which will work on standardizing film and projection parameters for 35mm 3-D projection such as image area, septum distance, polarizing angle and screen luminance. He asked that those interested in participating contact him.

Television Video Recording Committee

At the November 2 meeting, Ken Davies, the chairman, reiterated the need for a strong emphasis on the use of component video in the studio, the field, and direct broadcast operations. The committee and its subgroups have been very active in the areas of digital and analog forms of component television, and have worked closely and profitably with similar groups in the AES, ATSC, CCIR, and EBU, to produce recommendations for standards and practice international applications. An excellent level of cooperation also exists in related technology groups in the Society. Much progress has been made.

At the October 30 meeting of the Working Group on Lens Interface Parameters, under the chairmanship of Phil Godfrey, it was concluded that manufacturers cannot readily implement a standardization program, although some voluntary bilateral agreements exist to rationalize things between manufacturers. The Working Group will produce a report and tutorial for publication, but sees little chance of establishing standards.

The Working Group on the Colorimetry of Television Color Monitors, under the chairmanship of Charles Rhodes, has circulated for review a draft proposal for modern phosphors, typical of HD/NTSC and standard kinescopes. The committee actions were prompted by the manufacture of projection tubes for both HD and standard kinescopes, and their compatibility with current monitors.

The Working Group on Digital Video Standards, which met on October 30 under the chairmanship of Stan Baron, is continuing its study on serial interface standards and working jointly with other groups on filtering and application components. A draft

The Ad Hoc Group on Audio Characteristics for Digital Tape Recorders, chaired by Ken Davies.

standard will be considered by CCIR IWP 11/7 early in 1985, along with details such as filtering, levels, and ancillary signals. ATSC requested output on EDTV audio standards which closely relate to the work of the Working Group on Digital Video Standards.

The Working Group on Component Analog Video Standards, under the chairmanship of Merrill Weiss, is continuing to work on CAV studio standards and camera/recorder interfaces, and has established a strong liaison with the similar group under the EBU. The demonstration at the 126th Conference on component analog was well received and generated a great deal of interest.

Working Group on Digital Television Tape Recorders

The group held its meeting on November 3 under the chairmanship of Fred Remley. Meetings of the working group and its subgroups have been held regularly, as well as a joint meeting with the equivalent group in the EBU (G-2 MAGNUM), in Manchester, England. Work is progressing rapidly, and in the spring of 1984, an agreement was reached on the mechanical parameters of the tape formats in time to provide a basis for the U.S. contribution of the first meeting of the CCIR Joint Interim Working Party (JIWP 10-11/4) on Digital Video Recording. At the current rate of progress, the DTTR WG should be able to reach agreement on major parameters necessary to define the tape formats for submission to the U.S. CCIR National Committee to aid in generating a U.S. national contribution at the next meeting of the CCIR JIWP 10-11/4, to be held in late February 1985.

Subcommittee on Data Recording and Reproduction of Motion-Picture Films

In the absence of Michael Strong, the eighth meeting of this group was chaired by Harry Howard of Universal Studios on October 29.

A discussion was held on the development of time-code technology for motion-picture film as it relates to camera manufacturers. It was pointed out that while there are limitations in time-code readers, the present generation of units offer solutions to faults previously encountered.

It was reported that two major manufacturers intend to work jointly on the development of specialized equipment and its use in operational applications of low-dispersion magnetic film base time code. Experimental activity with multi-track optical code application to both 16mm and 35mm film is continuing.

Other topics included the possible latent image numbering, complementary to that of the testing of prototype equipment; demonstrating new coding forms; the European desire for 80-bit continuous code on motion-picture film; and the need for greater exchange of information among organizations.

Working Group on Subjective Test Films

The working group, chaired by Janet West-Cyr, met on October 29. It was decided that priority be given to the objective test film, which would replace the current test film supplied by the Society. This subject will, at a later date, be followed by a subjective test film. The group will also consider working on test films and slides for HDTV evaluation as requested by the ATSC.

The Committee on Television Video Technology plans to continue its work in component video; the objective, to establish early recommendations for studio standards which can be reported at the CCIR meeting in 1985. The first set of control dialects (VTR) are expected to be completed and tested in mid-1985, setting the stage for the first complete set of control specifications for all television studio equipment. The group will then investigate network interconnection concerns. Film technology and interfacing will continue to be first and foremost, with the completion of new test films and slides anticipated, as well as HDTV test materials, which will be coordinated with the ATSC.

Subcommittee for Digital Control

The chairman of this group, Tom Meyer, stated that as the result of a joint meeting with the EBU, a document on basic architecture for a digital control network for television is nearing completion. Two other basic documents accepted by the EBU — tributary interconnect and message architecture — are being finalized and will be published in the *SMPTE Journal* in the near future.

Study Group on Station Automation

The group, under the chairmanship of John Schultz, is studying the various aspects of automation of a broadcast station, with emphasis on traffic interface.

A number of items dealing with traffic interface record format were resolved at the meeting, and a proposal will be circulated in the near future for review. Subjects such as supporting protocol, diskette format, and the study on the switcher control will

continue to be investigated by the group.

International Forum Committee

The committee, under the chairmanship of Fred Remley, reviewed the objectives established for this group by the Engineering Vice-President, which specify the following:

- To communicate the engineering activities of SMPTE to other organizations working in the same or related fields in other areas of the world.
- To establish a two-way exchange of ideas concerning technological studies that are needed to meet the future requirements of the worldwide motion-picture and television industries.
- To provide a forum involving both standards developers and equipment manufacturers, following the model long-established in SMPTE engineering committees.

Subsequent discussions led to the following agreements:

- The documents of engineering activities through the SMPTE Progress Report are an important tool in disseminating information and should be continued.
- Presently, the best means of exchanging information is through technical committee meetings. A good example of this is the cross-membership of EBU and SMPTE experts in areas such as digital videotape recording. However, formal information exchanges between the SMPTE and seemingly similar organizations in other parts of the world have resulted in some problems, primarily due to the unique organizational characteristics of the SMPTE.

Although several SMPTE working groups on digital questions and equivalent EBU technical groups have successfully become involved with developers of standards and manufacturers, the objectives are under investigation.

The 27 engineering committee meetings held during the conference week attest to the importance given to the Society's standards efforts by the motion-picture and television industries. It becomes apparent that the economic burden and the many volunteered man-hours devoted to standardization are more than offset when product and performance compatibility is achieved.

The Society is indeed grateful for the cooperation and assistance by the many committee members and participants, as well as by the companies and organizations sponsoring these experts and the facilities for our programs.

Active participation on any SMPTE Engineering Committee or subgroup is most welcome, and is encouraged for those interested in or affected by the standard under development. Pertinent information relating to the scope of each committee, enrollment as a member, etc., is readily available through the SMPTE by contacting Alex E. Alden, SMPTE Manager of Engineering, or Richard G. Streeter, SMPTE Engineering Vice-President.

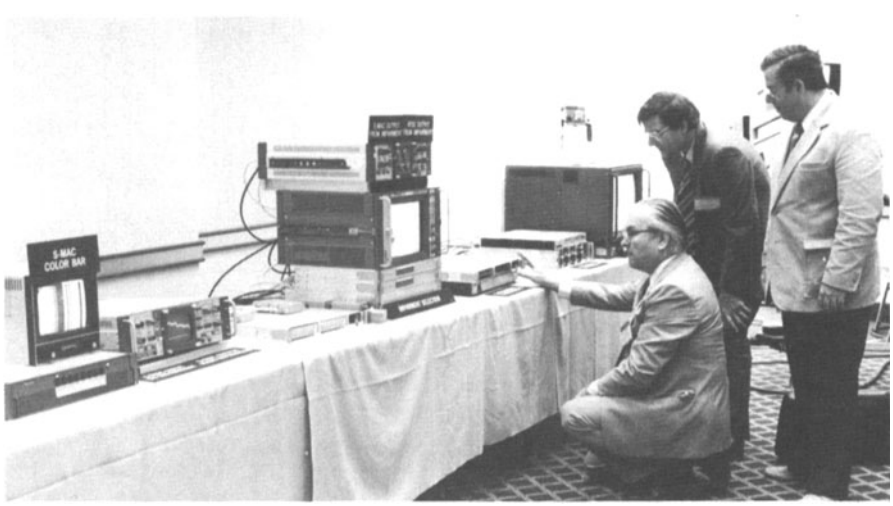
Demonstration of S-MAC

One of the highlights of the 126th conference and exhibit was a demonstration of S-MAC (Studio Multiplexed Analog Components) by the SMPTE Working Group on Component Analog Video Standards, chaired by Merrill Weiss, Imagex. The demonstration took place from 10:00 a.m. to 4:00 p.m. each day in the Dominion Room of the Sheraton Centre Hotel.

According to a report written by Joseph Roizen, Telegen, the S-MAC demonstration consisted of two signal sources: a live RCA color camera for pictures, and a Tektronix multi-test signal generator. S-MAC operates by time compressing luminance and chrominance signals so that the processed luminance signal occupies one-half of the active horizontal line time, and each of the chrominance signals occupies sequential one-quarter active line periods. The compression is done for all three signals on every line, so there is no loss of vertical color resolution as in the original MAC and C-MAC systems developed by the IBA in Great Britain.

Roizen described the equipment setup as follows: "The setup included a switchable demultiplexing system with various simulated transmission path characteristics. These included narrow and wide band filters, and even 'brick-wall' filters, to show the effect of induced ringing and transients. The comparison shown was between NTSC and S-MAC. Picture monitors showed the images at intermediate steps, so the display was very visually comprehensive. Various committee members took turns at explaining the principles involved, and a detailed document outlining the committee's proposal was handed out."

He went on to say that S-MAC is being proposed as the interim analog component system for studio and picture origination use during the period when digital component or all-digital systems are still too far in the future.



S-MAC demonstration.

Conference Opening: Focusing on the Future of Image Technology

Introduction: *Calvin M. Hotchkiss*, Program Chairman

Welcome: *Leonard F. Coleman*, SMPTE President, Eastman Kodak Co., Rochester, N.Y.

Opening Remarks: *Harold J. Eady*, SMPTE Executive Vice-President, Novo Communications, Inc., Fort Lee, N.J.

1. Conference Theme: *Maurice L. French*, SMPTE Editorial Vice-President, Canadian Broadcasting Corp., Toronto, Ont., Canada

Engineering Report: *Richard G. Streeter*, SMPTE Engineering Vice-President, CBS Broadcast Group, New York, N.Y.

International Report: *Bengt O. Orhall*, AB Film-Teknik, Vallingby, Sweden

2. Guest Speaker: *Leo J. Thomas*, Senior Vice-President and Director of Kodak Research Laboratories, Rochester, N.Y.

3. Guest Speaker: *William G. Connolly*, President, Sony Broadcast Products Co., Teaneck, N.J.

Image Technology in Action

4. A Kaleidoscope of Olympic Imagery. *By Roger Goodman*, American Broadcasting Co., Inc., New York, N.Y.

5. A Portable Wireless Camera Utilizing Analog Component Video Techniques. *By Phil Godfrey*, American Broadcasting Co., Inc., New York, N.Y., and *Anthony Cuomo*, Telemetrics, Upper Saddle River, N.J.

In a large building with steel beams and girders, such as a convention hall, transmitting a video signal reliably has always presented a problem for broadcasters. When ABC developed their first portable color camera for the 1968 political conventions, the design incorporated a method of transmitting the components of the video signal rather than the composite NTSC signal.

During the 1968 conventions, and again in 1972, it was determined that the transmission of component video, together with the proper choice of transmitting and receiving antennas, could provide a system with a high degree of built-in immunity to the multipath and reflections of the RF signal.

The success of the component video wireless transmission during those years prompted ABC to develop an updated version in 1976, this time transmitting the Y, I, Q signals from the camera over the microwave link. These cameras were used extensively for the 1976 and 1980 political conventions. In 1984, further improvements and developments were incorporated into a new wireless component system where the various elements involved — color camera, two-way wireless link, and triax camera control units — have been combined into a field-worthy operating system.

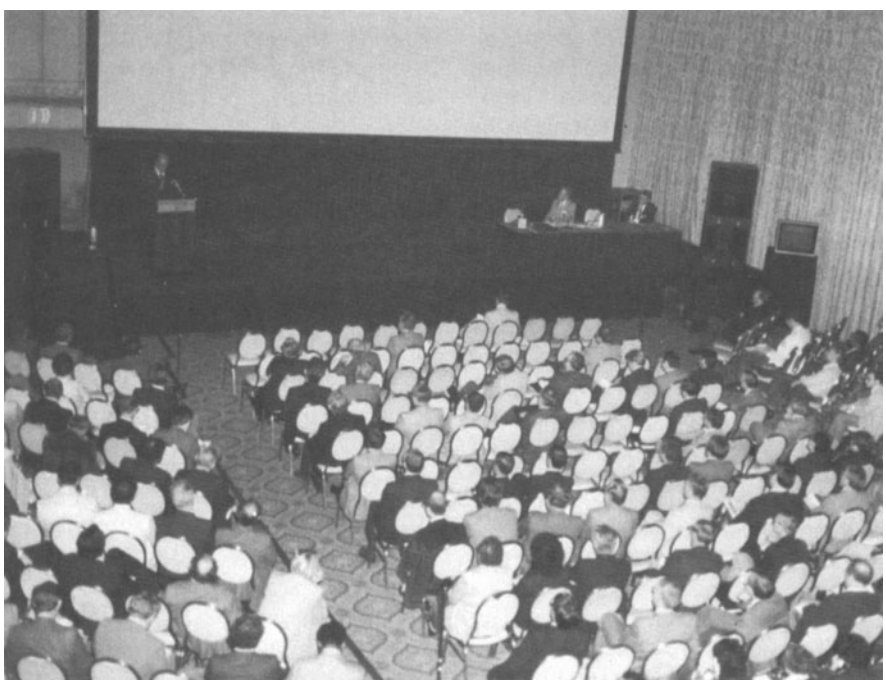
The design of the system and the various components which make up this rather unique transmission scheme will be described and videotapes of the equipment in use at the recent political conventions and summer Olympics will be shown.

6. Super Slo-Mo — High Speed Video Recording. Part A: High Technology Makes Possible Enhanced Temporal Resolution. Part B: ABC's Olympic Experiences. *By Mike Fisher, Philip Godfrey, and Bob Thomas*, American Broadcasting Co., Inc., New York, N.Y., and *L. See, S. Sarafian, T. Nakamura*, and *T. Ninomiya*, Sony Broadcasting Products Co., Teaneck, N.J.

Sony has developed a radically new television field acquisition system specifically designed to enhance the capture of motion. The development program was undertaken a little more than a year ago under a special contract to ABC Engineering. This paper will be presented in two parts: one, given by Sony, describing the fundamental principles underlying the system and the technology employed to implement it; and a second, be given by ABC, describing some of the operational achievements to the first systems.

Part 1 — A Technical Description

The Super Motion System is comprised of a new genre of color television camera and a new VTR system. The Super Motion System can be considered a variation on a theme of High-Definition Television (HDTV). A



A view of the opening session.

wideband camera system is employed to increase the temporal resolution of the camera, rather than the spatial resolution we are accustomed to associating with HDTV. The Super Motion System is specifically designed to overcome the blur associated with conventional TV pictures when played on a standard slow motion recorder. This is accomplished by shooting the scene with a camera whose frame rate is three times higher than that of a normal 525/60 camera. In a given time period, therefore, three times as many TV frames are captured and this allows enhanced capture of motion.

The novelty of the system lies within the means employed to record this high-speed TV picture. The basic stipulation levied upon the system was that the final output should be a standard type-C 1-in. videotape capable of replay on any standard type-C VTR while retaining the enhanced motion resolution. The problem became, therefore, one of converting the high-speed frames to standard 525/60 NTSC, and then finding appropriate means to record all of these frames. An additional interesting system requirement was the provision of a real-time standard 525/60 NTSC output from the high speed camera system. This was important to provide simultaneous on-air capability from the camera while recording the super motion signal.

The BVP-3000 Super Motion Camera scans 525 TV lines at a 90-Hz frame rate (180 fields interlaced 2:1). To record this signal it must first be standards converted. This conversion is accomplished in the remote camera CCU, using contemporary digital technology. The final output of the camera CCU consists of four standard 525/60 NTSC signals with a specific relative time delay between them. Three of these are individual representations of the three high speed frames originally captured by the camera. These three individual NTSC signals are fed to the special BVH-2700 VTR.

The BVH-2700 VTR is a specially modified 1-in. VTR. The drum contains three recording heads spaced 120° apart. The tape, in the RECORD mode, moves at three times normal type-C speed. This combination produces a perfect standard type-C recording on tape. Specifically, each of the NTSC signals are laid down on the tape, according to type-C specifications, and each field of these separate signals are laid down in consecutive order. When this tape is played back on any standard type-C machine, at standard type-C speed, the motion will be reproduced at $\frac{1}{3}$ normal rate, but with three times normal temporal resolution.

The new technologies included in the Super Motion System comprise mixed field pickup tube technology, fiber optic transmission, digital processing and standards conversion, and high-speed CMOS digital CSI chips to encode *RGB* to NTSC.

Left to right: Irwin W. Young, Film Co-Chairman; John C. Norris, Associate Program Chairman; Maurice L. French, Editorial Vice-President; and Calvin M. Hotchkiss, Papers Program Chairman, at the pre-banquet reception.

Part 2 — Operational Experiences With Super Motion System: (Not available at time of publication.)

7. Pacific Bell 1984 Olympics Fiber Optics System. *By Steven R. Copoloff*, Pacific Bell, Los Angeles, Calif.

A fiber optic network with interconnecting "drop legs" triumphed against logistical and financial obstacles, and provided communications coverage of the 1984 Los Angeles Olympics. The images of this spectacle were transmitted to the world through an optical network employing the most sophisticated communications technology available today.

Olympics XXIII qualified as an exemplary test for the potential of fiber optics because of its sheer size and logistical challenges. About 12,000 athletes and their entourages from 140 countries converged upon southern California from July 28 to August 12, 1984.

The telecommunications impact, due to the geographical dispersion of 42 competition and support locations over a 4,500 square-mile area, presented an enormous challenge. For two weeks, it required approximately 10,500 circuits of all types; nearly 100 simultaneous television circuits, 1,600 audio, hundreds of data, private lines, special services, electronic mail, mobile radio and an extraordinary number of standard voice telecommunications.

The extreme distances between Olympic facilities and the centralized broadcast and production studios generally exceeded the performance capabilities of existing analog technology. Fortunately, Pacific Bell's long-range plans already included an extensive digital lightwave network which would be required to meet the 4.5 million population increase predicted for California during the 1980's.

In order to meet the diverse telecommunications needs of each Olympic site in an efficient and cost-effective manner, a novel approach needed to be considered to meet the requirements for temporary building room terminal space additions. The problem was solved by putting central office extensions on wheels, primarily in the form of fiber-optic facility equipment trailers which would contain all the CO-type facility equipment and fiber optics interface equipment. Using

modular digital design techniques for the components of each trailer, Pacific Bell avoided the need to custom-engineer each site it served, while taking advantage of the economies of mass production. The modular approach permits easy expansion of service at the sites when needed, and high reusability of components after the Games.

The digital television lightwave system utilized enabled one National Television Committee video signal (color or monochrome) and two 15-KHz audio signals to be transmitted over the message network at 90.517 Mbits/sec. 15-KHz digital audio was also multiplexed with the video.

As an official sponsor and supplier for the 1984 Olympics, Pacific Bell provided an advanced telecommunications network including a fiber "communications highway" that integrated the various computer systems being used for a multiplicity of services such as scoring and results, mobile radio, electronic mail, security and ticketing. For the first time, the world received television and audio signals sent by digital light pulses.

8. Report from Working Group on the Use of Motion-Picture Film in Space Environment, SMPTE. *By Robert J. Shafer*, NASA, Washington, D.C., and *Lincoln L. Endelman*, Perkin-Elmer, Santa Clara, Calif.

9. IMAX® Cinematography in Space. *By William C. Shaw*, Engineering Operations, Imax Systems Corp., Oakville, Ont., Canada

A discussion of the special criteria which have been met in filming with an IMAX® camera in space, including:

- Use of the camera by astronaut-cinematographers.
- Design modifications required to adapt the camera to the space environment, to suit the shuttle's storage lockers, and to power the camera from the on-board fuel cells.

Special accessories which were built to make the camera easier to use on board the shuttle and to meet safety requirements are described. The program of design, testing, astronaut support and the actual performance of the camera, and results achieved on shuttle flight 41-C, are detailed.

Results from flights 41-D and 41-G may also be available by the time of the Conference.

IMAX® and OMNIMAX® are registered trademarks of Imax Systems Corp.

Laboratory Practices

10. An Ultra-High-Speed, Solid-State Light Valve System. *By Marvin A. Roberts, Joseph C. Wary, and Howard W. Hoadley*, Lab Methods Corp., Canoga Park, Calif.

For several years, LMC has been conducting R&D on solid-state, electro-optical light modulators for use in motion picture printers, projectors, and other photo-optical systems which require a fast turn on/turn off interval or a rapid increase or decrease of light intensity. The result of this project is an electro-optic modulator that is, in effect, a 0–3 variable-density filter whose density is changed electronically at speeds up to 200 times faster than electromechanical valves (up to 1000 light changes/sec.).

Past and current technology has relied on mechanical and electromechanical devices to accomplish valve changes, so all systems in current use are manual, motor driven, or solenoid actuated. Typically, such actuators are complicated, cumbersome, slow, unreliable, have poor repeatability, and require considerable costly maintenance. The usual size of a solenoid valve in a motion picture printer is approximately $3\frac{1}{2}$-in. × $4\frac{1}{2}$-in. × 14-in. and the weight is about 10 lb. All that this big, heavy mechanism does is open or close two vanes that are a few thousandths of an inch by about $\frac{5}{8}$-in. × $1\frac{1}{2}$-in. Since three valves are used in each printer to control red, green, and blue light intensities, considerable space and weight are involved. The new LMC valve measures approximately $\frac{1}{2}$-in. × 2-in.^{2}, weighs only several ounces, and fits into the filter holders of most printers.

For color printing in an additive printer, red, green, and blue (*RGB*) light level settings are needed in addition to the cue point. This information is obtained from a punched paper tape. Electromechanical motion picture printer valves are controlled by the tape or by a printer controller, the memory of which has been programmed by a punched paper tape. Today, most paper tapes contain frame-count cues (FCC), red-green-blue (*RGB*), and fader data. LMC operates the new electro-optic modulator from the same input with a suitable interface between input and the electro-optic device electronics.

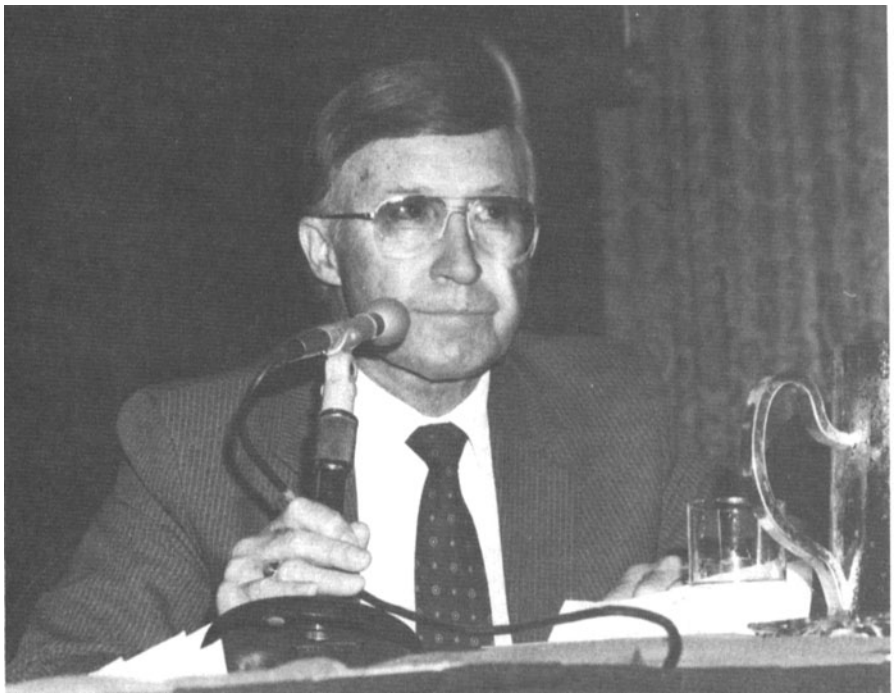
Besides the control interface, the new modulator consists of:

1. A power source having voltage and electrical characteristics to properly activate the modulator component.
2. The modulator itself, which will have the proper physical size for the light beam but which will require no heavy or physically large device to make it function. The modulator can be round, rectangular, or it can be made in a specific configuration or pattern if desired. It can operate as a variable-density device or as a color filter in continuous or optical printers.
3. An electro-optical servo loop which monitors each channel and feeds back values to the microprocessor. The intensity measurements for all three colors are compared to absolute standards called for by the punched tape and corrections are applied if required. The loop feature produces several advantages. First, it accommodates the variations that exist from printer to printer so that all printers in a laboratory are in perfect balance. Second, it automatically adjusts for lamp aging, dust accumulation, and atmospheric hazing on optical components. Third, it can overcome, within limits, a situation in which a lamp, before burnout, has a dramatic color shift. Lastly, it can be the input to failsafe electronics that would shut down the printer and output a visual or audible alarm to the operator in case some parameters exceeded preset limits.

The transmissivity of numerous substances can be varied electrically, as demonstrated by Faraday in 1845. The Faraday rotator used a field coil around a lead glass or other transparent crystal. Since that time numerous other materials that exhibit electro-optical characteristics have been discovered. Kerr cells use nitrobenene, Pockel cells, a potassium phosphate crystal, and LCDs (liquid crystals), a liquid whose molecules arrange themselves in ordered grouping that assume a different grouping when electrically activated.

Some past and present applications of electro-optical modulators include Kerr cells as shutters in high-speed cameras; Pockel cells in laser systems; and LCDs as primarily digital or matrix displays for watches, calculators, and electronic systems, but also used as modulators in laser systems.

The advanced state-of-the-art electronics employed in the LMC mi-



Session Chairman R. L. Pointer.

croprocessor permits the precision control necessary to tailor the valve to each laboratory and its equipment. This versatility allows programming for various films, set points, trims, and fades. All of this is accomplished with a low-cost solid-state electro-optic device, that like any other electronic module can be replaced easily and never has to be maintained.

11. The Recovery of Silver from Fix Wash Water by Froth Flotation Method. *By Lin Jianhong and Zhang Shuqing*, The Research Institute of Film Science and Technology of China, Beijing, China

The silver content in fix wash water from film processing sequence generally varies between 15 and 40 mg/l. For a long time this kind of silver-bearing processing waste was directly discharged to sewer systems, resulting in loss of precious metal and environmental pollution. The environment protection department of the government of the People's Republic of China has set the discharge standard for silver, according to which the maximum concentration of silver in discharged waste should be lower than 1 mmg/l.

To meet the above governmental standards, some film laboratories in China experimented with the ion-exchange method for recovering silver from fix wash water. But there are certain difficulties in using the ion-exchange method, mainly caused by the resin-blocking effect of gelatine dissolved from the processed films.

The froth flotation method uses microporous air distribution material for the recovery of silver from fix wash water. The froth flotation efficiency can be as high as 99.6%. The silver content of discharged fix wash water treated by the froth flotation method has been lowered from 40 ppm to 0.2 ppm.

The treatment process requires only simple low-cost equipment, occupying a small area. Since it has a very rational process sequence, the operations and treating equipment are also very simple. Nevertheless this method can be used in the continuous bulk treatment of silver bearing waste waters, contributing to both environmental and economic benefits.

12. A New Ion Exchange System for Recovery of Silver from Photo Wash Water with Onsite-Online Resin Regeneration and Optional Water and Heat Recycling. *By Robert T. Kreiman*, Pace International Corp., Culver City, Calif.; *Everett Hanson and Richard Grenier*, DeLuxe General Inc., Hollywood, Calif.

The Pacex XR Water Recycling System was designed to combine the advantages of purifying photographic processing wash water with the convenience and control of Onsite-Online resin regeneration and silver recovery. The first unit, with a capacity of 90 U.S. gallons/min, was installed at DeLuxe Laboratories in Hollywood.

In the past, regeneration of the ion-exchange resin and recovery of the silver eluted off the resin in the regeneration process has been done by a specialized facility offsite. The offsite service center allowed economical use of the specialized regeneration equipment and analytical monitoring of the process. However, it required shipment of heavy resin columns. In the case of high-volume cine labs or foreign labs, the shipping time required and freight cost were unacceptable.

Initial installations providing onsite resin regeneration utilized two discrete systems: a water-recycling system and a resin-regeneration system. In order to simplify operation and improve efficiency, the two systems were combined to provide water recycling and Onsite-Online resin regeneration and silver recovery. Standard resin columns were connected in pairs to allow easy replacement or exchange if service was required. In the operational mode, wash water is fed from top to bottom of one column to remove silver and hypo by ion exchange, then from the bottom to the top of the second column to fluidize and backwash the bed. The flow is reversed automatically as required to prevent clogging or channeling in either resin column.

One pair of columns, which will process 15 U.S. gallons (56 liters) of photographic wash water/min is connected to the system with valves and manifolds to comprise a "module." Identical modules are added to provide the flow capacity required. Columns contain strong base anion resin.

To allow regeneration of the resin columns in place, separate feed lines are provided for regeneration solution, water, compressed air and drain. Additional valves, pumps, and manifolds allow any single module to be run through a complete regeneration cycle while the other modules remain in the service mode. Regeneration controls can be either manual or automatic. Following regeneration, the regeneration solution is desilvered electrolytically prior to replenishment and reuse.

Initial testing of the DeLuxe Laboratories installation was to determine silver recovery capabilities only. Water

was not recycled. Because of this single-purpose use, it was possible to test the use of hypo as a regenerant for strong base resin. The use of hypo instead of a chloride regenerant reduced corrosion problems and improved the quality of silver plated out of the solution.

The following is a summary of the test data:

System started in operation:
April 12, 1984

Water processed:
ECP-2 fixer wash
ECN-2 fixer wash
CRI fix wash
B&W fix wash
70 mm fix wash
Total of above washes — approximately 76,000 U.S. gal/day
Cumulative total — June 30, 1984 — 5,505,800 gal

Actual silver recovered through June 30, 1984: 183 lb.

Average silver concentration in wash water processed:
Water in — 6.20 mg/l; water out — 1.38 mg/l
Average recovery — 77.7%

Pollution effect: Monthly analysis of sewer discharge for Ag.
Range before Pacex XR installation — .62 to 2.4 mg/l
Range after Pacex XR installation — <0.04 to 0.19 mg/l

Regeneration and silver recovery procedure:

Resin columns are arranged in six modules. One module is regenerated each working day followed by a plating cycle of about 9 hrs to remove available silver before the next cycle.

This test shows that (1) strong base ion-exchange resin can be regenerated with an ammonium thiosulfate solution, (2) Onsite/Online regeneration makes ion exchange systems more cost effective, (3) removal of silver from lab wash water by ion exchange reduces the silver in total lab effluent to acceptable levels and (4) silver recovery alone, without the available savings from recycling water and heat, can repay the cost of an ion-exchange system in less than two years.

13. Three-Electrode Control Procedures for Electrolytic Silver Recovery. *By Austin C. Cooley*, Eastman Kodak Co., Rochester, N.Y.

A three-electrode cell consists of an anode, cathode, and reference electrode. The reference electrode is used to measure the potential of the cathode in an electrolytic silver-recovery cell. This signal may be used to provide proportional control of the plating current using a potentiostat or may be used to turn the plating current on and off using an ORP controller.

This procedure has the advantages of responding directly to conditions at the surface of the cathode and of being less susceptible to interference from thiosulfate than ion-selective electrodes. Fixer can be reused with greater reliability because chemical consumption is more consistent and the purity of the recovered silver can be improved.

14. Recovery of CD-2 from Process ECP-2A Color Developer and Stop Bath. *By J. L. Burger, H. E. Fowler, and J. E. Smith*, Environmental Technical Services, and *B. A. McPhee*, Photographic Technology Div., Eastman Kodak Co., Rochester, N.Y.

There are several methods available for the recovery or reuse of Process ECP-2A color developer. The most common method is dilution, where the color developer overflow is collected and diluted with water to lower the bromide concentration. Chemicals are then added to the dilute overflow to make a replenisher. With the dilution method, 40 to 60% of the color developer overflow can be reused. Ion-exchange treatment can also be used to lower the bromide concentration in the developer overflow for direct reuse. Finally, the Kodak color developing agent CD-2 can be removed from the developer outflow by treatment with an adsorbent resin.

An optimized method is hereby offered to recover essentially all the available CD-2 from a combination of the color developer overflow and the stop bath. This new technique provides significant benefits over the current technology, since over half of the CD-2 available for recovery is in the stop bath.

This new CD-2 recovery process begins with the collection of overflow from both color developer and the stop bath. The pH of the combined overflow is adjusted to 9.5 and the solution is then treated by an adsorbent resin, where the CD-2 is selectively removed. The CD-2 is then removed from the resin by using a rinse of dilute sulfuric acid, resulting in a concentrate containing at least 50 grams of CD-2 per liter. The concentrate can then be used to make a Process ECP-2A color developer replenisher. This CD-2 recovery method is exceptionally clean, since none of the seasoning products build up in the recycled developer. A small amount of sulfate is added to the color developer due to the sulfuric acid regenerant, but only minor photographic effects have been observed.

This new CD-2 recovery technique is quite easy to perform, is clean, and provides both economic and environmental benefits to the motion picture processing laboratory.

15. A New High-Speed Film Elevator. *By Manfred G. Michelson and Bruce W. Keller*, Technical Film Systems, Calabasas, Calif.

In a film laboratory, film elevators often referred to as film loops, loop cabinets, or loop trees are used to transport film continuously. An elevator consists of two sets of film rolls; one set is stationary and one is movable. Typically an elevator is arranged so that the movable set of rollers will move vertically. By moving one set of rollers, it is possible to change the film capacity of the elevator. There is a difference between a film elevator and a film loop, but this lies only in their application. Once loaded, the amount of film in the loop will remain constant. A film elevator, even though it may be constructed identically to the loop, will, in use, continuously be changing the length of film stored.

In a loop printing system, elevators are used in four ways as follows: (1) as feed elevator — to store film while a splice is being made; (2) as a take-up elevator — to store film while the operator changes take-off spindles; (3) as a picture negative elevator — to store the picture loop; (4) as a sound track elevator — to store the sound negative. The elevator is the key to any loop printing system.

Why do laboratories use continuous loop printers? There are several reasons, among them high productivity, high repeatability and print quality, low labor costs, low maintenance costs, and extremely high film yields. Without question, the most important of the above is high film yields. The reason for this is simply that a loop printer is run on a continuous basis and the raw stock is spliced continuously. This means that there is no loss for thread-up and short ends which inherently occur when printing with conventional printers. The use of continuous loop

printers, depending upon circumstances, has been shown to decrease raw stock losses from a minimum of 5% to 20%.

Technical Film Systems has designed and tested a radically new type of elevator. This elevator overcomes many of the problems encountered in previous designs. The elemental problem in any elevator design is to maintain film tension within specified limits (typically one to two pounds) over a wide set of operating conditions. Insufficient tension will let the film loop-out and can cause scratches, while excessive tension will damage the film base. The two kinds of forces to be overcome are the velocity dependent forces, i.e., friction and the forces due to acceleration.

The velocity dependent forces are due to film friction against the air and bearing friction. The air friction becomes a considerable problem at higher film speeds. The power required to overcome the air friction varies with approximately the fourth power of the film speed. At the input of a feed elevator the speed will vary from zero (when a splice is being made) to up to 6000 ft/min when the elevator is being filled. Additionally, the film drag will vary linearly with the height of the elevator. If ball bearings are involved the friction will vary considerably depending upon the temperature and age of the bearings.

Acceleration forces become considerable when one attempts to increase the speed of an elevator in a very short time. Again these forces will vary with the height of the elevator since the mass of film in the elevator will vary with height.

In large or high-speed elevators it is not possible to simply pull the film out of the elevator at one end. It is necessary to distribute multiple come-along motors along the film path. With all the variation in forces discussed above, TFS has taken the approach of measuring the tension at each come-along motor and using this information to control the motors.

This new elevator is capable of an acceleration of 10 ft/sec/sec or 600 ft/min/sec. Thus the input of the elevator is capable of reaching a speed of 6000 ft/min in 10 sec. In a feed elevator this is extremely important, for this increases the time available for splicing. The above acceleration can be obtained without exceeding the maximum 4 lb film tension. While running the negative elevator 3000 ft/min the film tension varies less than .25 lb from the nominal design tension. This factor is extremely significant for the life of the negative.

Film and Television Production

16. Technology and Technique: How New Equipment and Technology Help the Cameraman. *By Jon Fauer*, 500 East 83rd St., New York, N.Y.

Cameramen are greatly affected by new developments in technology and by the introduction of new equipment. Style is influenced by the tools a cameraman uses. Faster stock, faster lenses, lighter equipment, and innovative lighting devices all contribute to the "look" of a film.

Three recent film assignments will be discussed: a documentary, a commercial, and a theatrical feature. Innovative equipment which solved particular problems will be analyzed. Sequences from these films will be shown on videotape (¾-in.).

Some of the specific equipment and technology discussed will be:

- New Kodak, Fuji, and Agfa high-speed films: getting the most out of them, reducing grain, controlling contrast, and saving time and money.
- Super speed lenses and the new generation of zoom lenses.
- Daylight lighting: HMI vs. arcs.
- Small lighting units and light control media, made necessary by the high-speed films.
- Camera support — innovations in cranes, dollies, and camera movement.

In conclusion, a look to the future will be presented: what equipment do we need, what would help, what could be changed.

17. Evaluating Lens and Camera Image Quality: An On-the-Spot, Filmmaker-Oriented Approach. *By David W. Leitner*, Du Art Film Laboratories, Inc., New York, N.Y.

Cinematographers who suspect their work has suffered a loss in image quality often find it difficult to pinpoint the cause. Most lack either the time to extensively test each set of lenses, the experience to do so meaningfully, or the budget to commit such testing to film. Often, it's unclear if a problem even exists — an inscrutable state-of-affairs that is no less disturbing.

The cinematographer is not to blame. Compared to the video lens and camera, whose direct signal can be displayed on a scope or monitor, the film lens and camera are at best evaluated by indirect means. A photographic test is shot on negative, and the recorded signal, or image, is subjected first to the optical and mechanical attenuations of the contact printer, and secondly, the projector. In the process, subtle but significant differences among lenses are often obscured, as well as shifting levels of optical performance corresponding to aperture, or in the case of a zoom, focal length.

This paper describes an inexpensive method of qualitatively scrutinizing and comparing film lenses and cameras. This method is direct, in that results are obtained on-the-spot, and open; the filmmaker participates in the evaluation.

With the exception of double-exposure registration tests, photographic testing is avoided. A lens test projector, and a collimator coupled to a xenon strobe source are featured. The latter, a special innovation, instantaneously matches film and ground glass focal planes while the camera is running and permits examination of film flatness during exposure. Lenses themselves are examined for squareness of mounting, corner-to-corner resolution at each stop, presence and strength of aberration at near and far focusing distances, contrast as determined by flare, coloration, and evenness of field.

A facility predicted on this approach has been in operation for three years in New York City. In that time, literally hundreds of 16mm and 35mm lenses and cameras have passed muster — or failed to, as the author will relate.

18. The Cinematographers' Computer Program. *By David Samuelson*, dSam Ltd., London, England

19. Simple Equipment for Complicated Camera Moves. *By Eddie Barber*, VideoTeleCom, Burbank, Calif.

In the television and motion-picture industries, there are basically three levels of production; large-budget,

medium-budget, and low-budget. Up until recently, specialized camera support equipment such as cranes, body-mounted camera stabilizers, and helicopter mounts were only affordable to large-budget productions.

Because of this, there appeared to be a need for equipment that was within the reach of even the smallest budget. In developing this equipment, it was found that it not only serves medium to low-budget productions, but large-budget productions as well, in that it accomplishes shots which the existing more expensive equipment will not.

The following three papers compare: (1) existing cranes with the Barber "baby" Boom; (2) body-mounted camera stabilizers with the hand-held Eddie-cam; and (3) existing helicopter camera stabilizer mounts with the Barber Chopper Mount.

The author will show videotapes of each piece of equipment.

The Barber "baby" Boom

We are all familiar with conventional camera cranes — where the camera and the operator ride up into the air on the end of the boom arm. Whee! But the camera operator has no immediate control over height, swing, or speed of movement. He has to rely on two or three grips to interpret his shot and position him in the right place at the right time, at the right speed. Although the desired shot can be achieved, it is basically inefficient, creatively limiting, and in some cases, unsafe.

The Barber "baby" Boom requires only the cameraman for its operation and control. The camera mounts at one end of the boom arm, while the cameraman stands at the other end operating the controls. While looking through a video monitor, he can track the action — fast, slow, or whatever speed is needed for the shot. The "baby" boom's center-of-gravity gimble head and counter-balance parallelogram design allow a single camera operator to vary camera height, angle, pan, tilt, boom, zoom, and focus simultaneously in one smooth continuous motion.

It can perform a vertical boom from 6 in. off the ground to 11 ft in the air. Additionally, the boom arm has a horizontal swing of 14 ft, allowing for dolly-type shots. The camera tilt is 160° and the camera pan is 360°. The operator can servo zoom and focus without ever taking his hands off the controls, or his eyes off the action. And, perhaps even more significant in terms of safety, the operator stands with his feet on the ground at all times.

Set-up time required is approximately 5–10 min and maintenance is minimal, as there are no motors or pumps. Space requirements are 3 ft^2 on a standard tripod, allowing the boom to operate effectively in small tight spaces. The boom can be mounted on any standard camera mount from a High Hat to a Titan crane.

The Eddie-cam

A lightweight, handheld camera stabilizer, the Eddie-cam works on the same principle as existing body-mounted camera stabilizers. These devices were designed seven years ago when cameras weighed between 40 and 60 lb. With the recent developments in technology, there are 35mm, 16mm, and video cameras now available which weigh less than 15 lb. These lighter cameras eliminate the necessity for a spring-loaded parallelogram, mechanical arm. The Eddie-cam has simplified this process by replacing this mechanical arm with the operator's arm, which functions in the same capacity. Allowing for even greater flexibility and creativity, smooth fluid camera moves can be achieved while running, walking, skating or skiing. The Eddie-cam pans 360°+, tilts 360°+, and will perform full cartwheels as well as front and back flips. As the Eddie-cam is not mounted to the operator, the camera can be relayed from operator to operator. Through the use of the Eddie-cam, previously difficult, if not impossible, moving shots, such as handing the camera from an operator who is in a swimming pool to an operator at pool-side, can be easily achieved.

The Barber Chopper Mount

This small and lightweight camera stabilizer mount has several advantages over existing systems. Whereas current helicopter mounts are large and cumbersome and therefore must be transported in a van or truck, the Barber Chopper Mount's compact design allows it to be transported in a car trunk. Existing systems mount in 30 to 60 min and the helicopter door and seats must be removed in order to bolt the mount to the helicopter floor. Mounting time with the Barber Chopper Mount is reduced to approximately 5 min as the need for door and seat removal is eliminated. As it is center-mounted and balanced, the Barber Chopper Mount does not need to be bolted to the floor of the helicopter. With conventional mounts, the ability to pan is limited to 90° left and right, while the Barber Chopper Mount provides the operator with a 360° pan, allowing him to shoot the inside as well as the outside of the helicopter. The Barber Chopper Mount has three sets of spring-loaded parallelogram bars which insulate frequencies of vibration, thus eliminating jitter and bounce.

20. Custom Designing a Unique "Dual Truck" Video Remote Production System. *By Dean Schneider and Jim Furrer*, Film/Video Equipment Service Co., Denver, Colo.

The authors' extensive experience with video remote production projects on location in difficult terrain and weather conditions encountered in the Rocky Mountain States, as well as in congested downtown areas found in major U.S. metropolitan cities, indicated a need for a more maneuverable and flexible mobile video remote production system than those which are currently the norm in the industry. Such a system would ideally be as maneuverable as a standard passenger car, able to travel almost anywhere a car can go and park with ease, yet able to provide the same production capabilities as do 40-ft semi tractor/trailer rigs. The system would also be flexible enough and economical enough to accommodate a whole range of assignments, from low-budget, small scale shoots to full blown, sophisticated TV specials, concerts and sports events requiring isolation and slow-motion recording capabilities.

The F/VESCO "dual truck" video remote production system was developed in response to that need. Custom-built to F/VESCO specifications, and designed for utmost versatility and maneuverability, the unique system features two separate trucks — a self-contained Electronic truck and a Control Room truck — which are capable of turning any available facility (soundstage, warehouse, or exterior location) into a modern video production center that is fully equipped with state-of-the-art recording, switching, monitoring, audio mixing equipment, character generator, and time code capabilities.

The two trucks can be used in various configurations, jointly or apart. They can be parked perpendicular to one another in a "T" or "L" formation, one behind the other forming an "I," or in a split, side-by-side configuration. Where space is at a premium, the Electronic truck can be parked up to 40 ft away from the Control Room truck, with full interconnection capabilities.

The F/VESCO "dual truck" system offers a cost-effective alternative, with customized equipment packages supplied on a step-scale basis.

21. The "Cancer" Eating Away at Film Production. *By Milton Forman*, President, Creative Cinematographers, Inc., Los Angeles, Calif.

Although a great deal of money is being made in the film industry, almost every aspect of the industry faces a "crisis." This crisis is evident in every phase of the process. It includes the financing, the selection of available material, the costs of creative labor and the cost of "below-the-line" labor, the factors related to who controls the creative and other elements of the production, and particularly the factors related to the distribution of the finished product.

Mr. Forman will discuss the "cancer" eating away at the various elements listed above and he will analyze how each element feeds on the other elements.

Basic to the analysis will be the discussion of the influence of electronic technology on the nature of the product and on the cost of production. An attempt will be made to give a realistic evaluation of the future of the "new" technology as it will effect the preparation of the product, the production of the product, and the post-production of the final film.

The author will discuss the present and future relationship of video technology with film technology. An attempt will be made to dispel some of the illusions existing in the industry as to what the future has in store for the entertainment industry.

Film Technology

22. Graininess in Motion Pictures. *By R. C. Sehlin and J. B. Rieger*, Photographic Technology Div., Eastman Kodak Co., Rochester, N.Y.

Factors affecting graininess in motion picture systems are identified and methods to minimize grain suggested. Subjective evaluations of graininess versus density and visual weighting factors describing the relative importance of red, green, and blue granularity are discussed. In addition, practical methods involving scene lighting, camera original exposures, pull-processing, and print balance are suggested to minimize graininess.

23. Improved Fujicolor High-Speed Negative and Positive Films. *By Sadayuki Yamaryo, Shingo Ishimaru, and Kazuhiko Takemura*, Fuji Photo Film Co., Ltd., Minami-Ashigara, Kanagawa, Japan

At the 125th SMPTE Conference in Los Angeles last year, Fuji Photo Film Co. announced a new high-speed film, Fujicolor High Speed Negative Film 8512/8522. This paper will describe an improved high-speed color negative film using Fuji's advanced technology.

An improved Fujicolor Positive Film will also be described.

24A. XT Crystal Technology for Speed Increase with Preservation of Overall Image Quality in Color Negative Film. *By Erwin Steeman*, Agfa-Gevaert N.V., Mortsel, Belgium

24B. Agfa XT 125 and Agfa XT 320 — Two New Color Negative Films with Outstanding Pictorial Characteristics. *By Antoine Vervoort and Emiel Verdonck*, Agfa-Gevaert N.V., Mortsel, Belgium

24C. Demonstration — Projection of Images Photographed on Agfa XT 125 and Agfa XT 320.

25. In-Camera Pre-Flash on Eastman Color High Speed Negative Film. *By Vernon L. Kipping*, Consultant, San Francisco, Calif.

In-Camera Pre-Flash was first introduced by the author at the 120th and 121st SMPTE Technical Conferences. The papers were received with considerable interest. Using 5247/7247 Eastman Negative Color Film and Eastman Video News Film, an increase in sensitivity to shadow areas and dark color regions of approximately two lens stops was achieved. Density of highlight areas was virtually unaffected.

This phenomenon occurs because pre-exposure of film to controlled minute levels of light overcomes the initial inertia of film to recording light. Shadow areas and dark colored regions in scenes reflect weak levels of light so that much of the reflected light reaching the film is expended in overcoming the initial inertia of the film to

John Shaw (l) and William Shaw (r) during their presentation.

light recording. This leaves little light energy available to record detail.

Pre-exposure of film immediately prior to exposure to the scene overcomes the initial inertia of the photographic emulsion and results in an image with enhanced detail in shadow areas and dark color regions. Pre-flashing is a valuable tool to control scene contrast.

An improved technique enables demonstration films of scenes to show side-by-side comparisons within the same film frame of the effects of pre-flashing. The new technique pre-flashes only one-half the film frame rather than the entire frame. A split-frame film results in which one-half of a scene is pre-flashed and the other half is not. This provides an immediate comparison within a scene of the results of pre-flashing. Prior demonstrations used sequentially viewed samples of non-flashed and pre-flashed scenes making comparisons more difficult to evaluate.

Nature photography is an area where pre-flashing is particularly useful. Here scene contrast is not usually controllable and pre-flashing provides an effective means to control contrast.

When employed on motion-picture sets, pre-flashing can markedly reduce the light levels needed for proper exposure. This can provide a substantial reduction in power consumption in an energy-short era, while providing economical savings and more comfortable working conditions for actors and crew.

26. Filming Practical Monitors. *By Kirk E. Paulsen and William C. Nusbaum*, Victor Duncan, Inc., Chicago, Ill.

The incorporation of video displays into film sequences has, for many years, presented difficulties for the cinematographer. Current technology has made available several devices which, together with a proper understanding of the relationship of film to video imaging, can be used to successfully minimize or eliminate these problems.

The authors initially present an overview of the frequencies associated with the formation of NTSC raster scan fields and frames versus the relative exposure times produced by various combinations of motion-picture camera shutter openings and framing speeds. These discrepancies in relative timing account for the familiar black or white "roll bar" that appears to strobe through to video image. Four different devices, along with methodologies for their use, are given as a means to eliminate this effect. The apparatus includes Panavision's field-to-frame and video/film synchronizers and Cinematography Electronics' HMI and T.V. Crystal Control and Precision Speed Control used to control the Panavision and Arriflex 35mm cameras.

Special consideration was given to the non-standard nature of most raster and vector computer displays and the special problems inherent in filming this type of output. The resulting conclusions are as follows:

The NTSC video frame rate, used as the North American broadcast and playback standard, is 29.970 frames/sec. By crystal-driving the motion-picture camera to that frame rate while using a 180° shutter, the roll bar can be phased off the screen and locked off, resulting in a clean picture. A 180° or greater shutter opening are the only shutter selections that may be used at this frame rate. This frame rate is used when the end product of the shot will be a direct sync transfer to video or for an MOS 24 frames/sec projection.

There are two ways to shoot a practical monitor when the exposed film is intended as a 24 frames/sec sync projection. The first, and best, is contracting with a 24 frames/sec video transfer company. Their on-location engineers can sync the video frame rate to the film camera's, thus producing a clean video screen at 24 frames/sec crystal.

The other way to shoot a monitor for a 24 frames/sec sync projection is to run the motion-picture camera at 23.976 frames/sec crystal with the shutter set at 144°. The 144° shutter will minimize the bar into a thin line but won't completely eliminate it, while the 23.976 frames/sec frame rate will lock the bar on the screen where it can be phased into a favorable position. With this system at a frame rate of around 24 frames/sec, a virtually imperceptible roll bar will be present on the screen at all times.

Panavision's Field-to-Frame and Video/Film Synchronizers may be used to perform the 29.970 frames/sec and 23.976 frames/sec functions. The Panavision units run the camera at these speeds utilizing a composite video signal from the video source. Larry Barton's Cinematography Electronics HMI and T.V. Crystal Control and Precision Speed Control regulate Arriflex cameras to these speeds. These units use internal crystals to govern the camera's speed and require no contact with the video source whatsoever.

Video games and computers run at unorthodox frame rates. The Precision Speed Control and the Field-to-Frame Synchronizer may also be used effectively on these more difficult applications. Extra steps may have to be taken to acquire a proper composite video signal for the Panavision units.

27. Development of the Cinema-360 Spaceworthy Motion-Picture Camera System. *By Don Warren*, Cinema-360, Inc., Jackson, Miss.

On February 3, 1984, Cinema-360, Inc., became the first non-NASA motion-picture producer to successfully film aboard the space shuttle. With funding from the Gannett Foundation of Rochester, N.Y., the production of a 30-min hemispheric film entitled *The Space Shuttle: An American Adventure* was begun.

Cinema-360 is a relatively new motion-picture format designed expressly for showing on hemispheric screens, such as planetarium domes. Films are made using fisheye optics which cause a natural circular distortion. However, when projected back through a matching lens onto a hemispheric screen, the scene appears in true-to-life perspective and proportion. Cinema-360, Inc., is a non-profit corporation dedicated to producing and distributing these educational films.

Two Arriflex 35 III cameras equipped with Nikon 8mm 2.8 fisheye lenses were prepared for space flight by Cinema-360, Inc., with engineering support from NASA and its contractors. One camera was manifested in the flight deck of the shuttle for handheld operation by the astronauts. A more sophisticated camera package was placed in a self-contained environmentally safe getaway special (G.A.S.) canister, and bolted into the payload bay of the shuttle for remote controlled filming in the hostile environment of space.

This paper will detail the design and development of both camera systems, and highlight the results from two space shuttle missions.

28. Issues and Status of 1/4-in. Videotape Recording Standards. *By Robert G. Thomas*, American Broadcasting Companies, New York, N.Y.

Early in 1983, two manufacturers of ENG camera/recorders submitted separate documents to the SMPTE Committee on Video Recording and Reproduction Technology (VRRT) proposing substantially different 1/4-in. cassette videotape recording formats. This prompted VRRT to form the Working Group on 1/4-in. Cassette-Based Video Recording Format with the author as Chairman. The Working Group is charged with the development of electrical and mechanical draft standards for a video recording format utilizing 1/4-in. cassette tape for professional ENG applications in the 525/60 television system. Primary consideration is to be given to a compromise between the two formats already submitted to VRRT, and a goal of one year was set for establishment of agreement in principle.

Working Group meetings have been held at four- to six-week intervals since June 1983. At present, membership is composed of about thirty-five engineers from broadcasting organizations and manufacturers of cameras, recorders, tape and cassettes.

Effort by the Working Group has been directed to three principal areas:

- Development of a user specification. A subcommittee of engineers from North American networks, broadcasting groups and technically advanced individual stations, has compiled a report which serves as a unified guide to broadcasters' requirements for ENG recorders and field editing equipment.
- Development of a common interface between camera and recorder. Because 1/4-in. recorders represent a significant departure from existing products, the Working Group has a unique opportunity to standardize mechanical docking arrangements and electrical interface, virtually unencumbered by restraints imposed by equipment already in use. The important elements of the mechanical interface have been established by a cooperative effort of the manufacturers in response to broadcasters' recommendations. Attention will now be placed on remaining mechanical details and a common electronic interface. The benefits of this effort will be shared jointly by broadcasters, who will enjoy the flexibility of matching any new ENG camera to any 1/4-in. VTR, and by equipment manufacturers, who will be able to release new products with the assurance of continued compatibility in the future.
- Standardization of recording format. Achieving a single format is the most important (and the most challenging) aspect of the Working Group's task. Because each of the proposed formats is based on different system concepts, it first appeared that a compromise format would be very difficult to achieve. Subsequently, however, a test conducted by the Working Group showed one of the formats to be a viable ENG medium.

That finding, in conjunction with the fortuitous development of a new tape oxide formulation, raised expectations in early 1984 that a common format might indeed be attainable. There followed a period of intensive discussions during which both manufacturers demonstrated their dedication to compromise. As a result, in April 1984, it was possible for the Working Group to issue a press release announcing adoption of a tentative common format. For the tentative format to be fully accepted, however, it must be shown to satisfy performance requirements of the user report. Plans are being formulated for a performance demonstration upon which a judgment of format acceptability will be made by the Working Group.

The paper will describe, in detail, the technical considerations involved in selection of an appropriate format and will recount the events that have led to adoption of the tentative compromise format. Procedures employed and the results obtained in the demonstration to evaluate the tentative format will be available in mid-October and will be reported in full. Finally, a description will be given of anticipated future developments in the ongoing standardization program for a 1/4-in. ENG record format and the related issues.

29. 1/4-in. Format — A System Concept. *By F. Scott, M. Inatsu, and S. Kasai*, Hitachi Denshi America, Ltd., Woodbury, N.Y.

The 1/4-in. recording format will provide broadcasters with a medium that allows total system integration.

Since the inception of electronic news gathering (ENG), news crews have been striving to combine the advantages of video with the weight and operating characteristics of film cameras. The 1/4-in. recorder-camera system promises to meet that goal.

System flexibility will allow origination, composition, and presentation without changing formats.

The 1/4-in. system concept will enable TV stations to make the transition from present ENG formats to 1/4-in. at their own pace. Initial field recovery can be transferred to 3/4-in. or 1-in. using editing equipment already on hand. As operating budgets permit, the 1/4-in. format can be extended to handle all stages of program processing, from field recovery to news and commercial playback.

30. Recording Time — 21 Minutes on 1/4-in. Recorder Camera. *By M. Inatsu, T. Kirino, T. Tominaga, S. Kasai, H. Ogihara, and T. Kawamura*, Hitachi Denshi Ltd., Tokyo, Japan

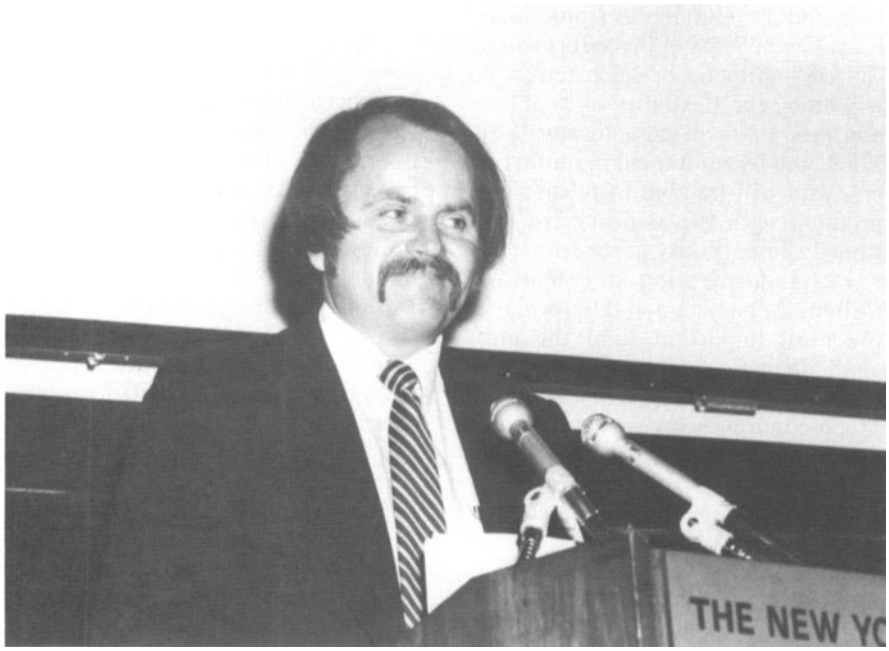
In 1983, the authors had developed a recording camera using 1/4-in. tape for ENG use. This system was designed to provide superior mobility and picture quality as compared to a conventional ENG system, using a separate camera and recorder. One of the advantages in this system is that it uses a cassette that is the smallest on the market, utilizing 1/4-in. magnetic tape with high coercivity, to insure high-quality performance.

As for video signal recording, *YC* (Luminance/Chrominance) separation onto two video tracks has been adopted. On the *C* channel video track, two color difference signals are recorded by utilizing a time-compression, time-division multiplexed technique.

The recording time of this VTR was 10 min. However, in 1983, the SMPTE Working Group on the 1/4-in. cassette-based VTRs began standardization work. They had requested that the recording time be increased to 21 min.

In order to extend the recording time, the following steps were taken:

- Increase the quantity of tape in the cassette by reducing the thickness of the tape and making the reel hub smaller.
- Increase the recording density by making the video track width narrower.



R. C. Sehlin presenting his paper.

The results of the above listed items are as follows:

- The tape thickness was changed from 18 μm to 13 μm, and the reel hub diameter was changed from 30mm to 25mm in order to increase the quantity of tape in the cassette.
- In order to increase the recording density, development work on head material resulted in the use of metal heads for recording and playback of the video signal.

In conclusion, the authors have finalized the completion of the extension of recording time to 21 min. Listed below are the performance specifications.

Bandwidth	3.6 MHz (−3 dB)
Signal-To-Noise	*Y* Signal 48 dB
	C Signal AM 48 dB
	PM 46 dB

31. Comparative Considerations About the Application of 1/4-in. or 8mm Tape in TV Broadcasting. *By H. Zahn*, Robert Bosch GmbH, Darmstadt, W. Germany.

In the broadcast industry some confusion has been generated by publications about the standardization of 8mm tape for video recording. This confusion results from the not clearly defined application: professional or home use.

This paper will compare mechanical, electrical, and magnetic properties of 1/4-in. VTRs as well as proposed 8mm VTRs for broadcast use. Special attention will be given to cassette design and capacity with reference to professional application. The tape and its future development and the head-to-tape interface will be discussed and conclusions stated.

32. High-Speed Beam-Splitting Prism for Small-Format Color Cameras. *By Shiomi Kanie and Kiyoshi Fukami*, Canon Inc., Kawasaki, Kanagawa, Japan

In most of three tube color TV cameras, the beam-splitting prism, which will separate the light through an object lens into three colors, red, green and blue, is supplied.

As the maximum relative aperture of the prism for current small-format cameras with 2/3-in. or 1/2-in. pickup tube is f1.4, sensitivity and depth of field are insufficient for many broadcasters.

To make a faster prism than f1.4, it is necessary to change from three to four pieces of glass block. However, there are no practical examples of four prism sections, due to various problems such as difficulty of production technology, and larger dimension of prisms.

In order to conquer these technical difficulties of producing a faster beam-splitting prism, Canon has developed an epoch-making design program (software for computer similation), and by using a high performance computer, an f1.2 prism has been realized.

We have found the optimum solution of eight variable factors such as the index of glass material, the length of optical path of four pieces of blocks and the vertical angle of each block, which minimize the prism dimension (to interchange with present models), to remove the ghost, shading, etc., and to keep better polarization characteristics.

Canon has now developed an f1.2 beam-splitting prism for 2/3-in. and 1/2-in. cameras. It is advantageous for small-format cameras to use lens and prism of f1.2 at the point of sensitivity and depth of field. An f1.6 lens is used in present 2.3-in. pickup tube cameras. If a prism of f1.2 is used with them, sensitivity will be improved 5 dB and depth of field will be 28% shallower. The sensitivity of small-format cameras will be almost equal to present 1-in. or 1 1/4-in. tube cameras. It is now possible to shoot under darker light conditions and to create artistic images. If a prism of f1.2 is applied to 1/2-in. three pickup tube cameras, sensitivity will be similar to present 2/3-in. pickup tube cameras.

The size and weight of an f1.2 prism are nearly the same as the former f1.4 prism in spite of the maximum relative aperture of f1.2. Accordingly, not only new-developed f1.2 zoom lenses but also existing lenses can be used with this prism.

33. The BVP-360 — High Technology Introduces a New Era Field/Studio Camera. *By L. Thorpe, T. Iwasaki, T. Ishii, and Y. Yasokuchi*, Sony Broadcast Products Co., Teaneck, N.J.

This paper describes the design approach adopted by Sony Broadcast to produce our first field/studio camera chain. It also discusses some of the technologies employed in the area of pickup device, optics, and the electronic system to realize a mid-1980's design.

Capitalizing on a solid foundation established over the past six years with a range of innovative portable field cameras, and utilizing advanced techniques developed during our work on advanced high-definition color cameras, Sony has, in the BVP-360 design, brought to fruition a widely accumulated experience. Close dialogue with international broadcasters and production houses established a

matrix of recognized "problems" encountered by users of today's field and studio cameras. The spearhead of the BVP-360 design effort was an objective assessment of these end-user difficulties, which were then systematically solved using the best of today's design ingenuity and high technology.

The issue of the pickup device for the BVP-360 constituted a major topic in the early design phase. Recognizing that while we are poised to enter the era of solid-state pickup, it was still judged to be perhaps five years before true full specification, studio broadcast quality, CCD imagers would be possible on a production basis. The 2/3-in. pickup tube meantime had taken major technical strides. The new mixed field technology developed as a part of Sony's HDTV research has been successfully implemented in producing a smaller and higher performing 2/3-in. tube. Coupled with a new breakthrough in optical design, producing *f*1.2 optical speed, a 2/3-in. image format camera has been produced with specifications exceeding that of the larger format systems.

The extra degree of freedom afforded by the utilization of small pickup tubes permitted unusual innovation in the mechanical design of the BVP-360. Considerable attention was paid to achieving an optimum size, shape, and weight for the most demanding field work. Extensive use of computer-aided design was employed to analyze many interactive aspects of this design. The viewfinder, mechanical mounting, and control were major elements within the overall design.

The paper discusses the special front end FET employed, which achieves a very high signal-to-noise ratio. The details of the video processing are briefly described. The particular approach adopted by the BVP-360 in the provision of automatic setup is compared with special emphasis on its implications for interface to future systems, both analog and digital.

The BVP-360 system employs individual microcomputers in the camera head, CCU, video operational panels, and the master setup unit. Digital automatic registration is implemented with special Sony LSI chips and powerful software.

Finally, the unusual system flexibility offered by the "building block" approach of the BVP-360 total system is explained. The flexibility of catering to different philosophies in technical setup and video operations is described for single and multiple camera installations.

34. Newsmaker — New Technology Adds Flexibility to the Betacam Field Acquisition System. *By Jerome D. Cohen, Nobu Sato, A. Takeuchi, and M. Takano,* Sony Broadcast Products Co., Teaneck, N.J.

Combination camera-recorders were first publicly introduced in 1981 at the National Association of Broadcasters convention. Since that time, the concept has gained ever-increasing acceptance not only for electronic news gathering but also surprisingly for field production where highest quality and mobility (film style) are required. These camera-recorders, while they function electrically and physically as a single unit, can also separate into their respective halves and operate via an interface cable for traditional video style shooting.

Sony had early recognized the diverse requirements in field acquisition equipment. We thus provided the lightweight, compact, BVW-1 camera-recorder for ENG, and our very high-performance BVW-3 camera-recorder for EFP, etc. It soon became apparent, however, that ENG coverage has become very specialized, and often physically taxing, in certain environments. There is a variety of shooting applications today which place unusual demands on size, weight, and power consumption of the field acquisition system.

An almost natural evolution of the camcorder design philosophy is to combine both functions, camera and recorder, into a single integrated unit which cannot be separated. The advantages of this approach are numerous:

a. Interconnections are minimized which increases reliability
b. Internal space is more efficiently utilized resulting in a more compact unit
c. Signal flow is better integrated, eliminating many duplicated functions, hence fewer circuits which means less power consumption, less heat and further size reduction.

Sony is the first manufacturer to introduce a single-piece camera-recorder. Dubbed the Newsmaker, the model BVW-2 goes well beyond traditional engineering thinking of repackaging existing components. For example, it incorporates a radically new tape transport using an ultra-compact, high-speed drum with a single record head for each component channel. By altering the scanning system within the camera, the resultant recording on tape is completely compatible with the Betacam format. The technical details of this system will be described in the main body of the paper.

Working with some major broadcasters Sony has, with the new BVW-2, developed a further dramatic refinement of the combo camera-recorder to flank the already existing Betacam field acquisition systems.

The criteria for the design of this unit were carefully worked out to meet the needs of special ENG coverage and they are summarized as follows:

- Low cost.
- Absolute minimum weight and size.
- Single-piece system to minimize interconnections and enhance reliability.
- Adequate performance to capture a usable picture under reasonable lighting conditions.
- Minimum facilities to maintain absolute simplicity.
- Complete compatibility with Betacam recording format.

The Newsmaker was produced following intensive value analysis to optimize its feature/cost ratio. In addition, there always remained the overriding influence of very low size and weight.

Conclusion

The integration of camera-recorder functions as a single unit along with radically new developments in tape transports and camera designs results in a unit which is approximately 50% of the size, weight, and power consumption of existing, as well as recently proposed, small-format camera-recorders. This opens up new possibilities for the use of video in today's fast-paced world, such as:

- Low-cost emergency backup to conventional BVW-1/BVW-3 Betacam system.
- ENG coverage in high-risk environments such as war zones, politically sensitive areas, etc.
- Stringer applications.
- Handheld coverage of events requiring minimum size/weight acquisition equipment (such as dense crowds, etc.)

- Video assist to a variety of production projects.
- Training tool for cinematographers, reporters, etc.
- Wide variety of institutional applications.

Film/Tape Interface I

35. Recommended Practices in Production of Films and Videotapes for Television Transmission (A Tutorial). *By Edward P. Ancona, Jr.*, National Broadcasting Co., Burbank, Calif.

This paper is tutorial in nature and is an approach to bridging the difficulties of dialogue between nontechnical creative groups and television engineers regarding those factors which influence the effectiveness of reproduction on home receivers of the dramatic and artistic content of television presentations. The effect of the telecine and of home receiver adjustment on image contrast is discussed.

There appears to be a common misunderstanding of the meaning and utility of the SMPTE Safe Action Area, and there are specific situations where safe action projection masks should or should not be used. Sound recording "contrast," or dynamic range, should be restricted, considering typical home listening conditions.

36. The Interface of Motion-Picture Films and Video. *By S. J. Powell, R. C. Sehlin, and R. J. Zavada*, Photographic Technology Div., Eastman Kodak Co., Rochester, N.Y.

Factors affecting the final television picture quality of motion-picture films interfaced with production telecines are identified. Optimum spectral quality is discussed in terms of the film/telecine transfer interrelationship, color correction, and dynamic range. Practical methods are presented to empirically optimize spectral quality. Image structure is discussed as a function of film system, format, and type. Methods are suggested which optimize the final image structure.

37. Resolution Requirements for HDTV Based Upon the Performance of 35mm Motion-Picture Films for Theatrical Viewing. *By Arthur Kaiser, Henry W. Mahler, and Renville H. McMann*, CBS Technology Center, Stamford, Ct.

Commencing with the early efforts of the television engineering community to define "High Definition Television," theatrically viewed 35mm motion-picture film has been the standard of quality for determining resolution requirements. Data on exactly how much resolution in 35mm films can be delivered to theater audiences has not been readily available.

Consequently, the CBS Technology Center undertook the production of a test film using state-of-the-art equipment, materials, and practices. Subject matter was chosen to be suitable for measuring the resolution achieved in a theater with the highest quality projection equipment. The entire project was intended to yield repeatable results from the "live scene" to the "large screen."

The test film was shot at CBS Studio Center in North Hollywood using a professional film crew. The subject matter consisted of exterior scenes into which a standard Marconi television resolution test chart was inserted. Following the processing of the negative, a print was made from which it was determined microscopically that the resolution predicted from film technical data and equipment performance was, in fact, achieved.

The print was subsequently delivered to the East Coast where it was viewed on a 12-ft.-high screen in a theater using high-quality projection equipment. The performance of the projector was initially established using the SMPTE 35-IQ Projector Alignment and Screen Image Quality test film.

Although the original plan called for measuring the projected MTF using a 1/4 degree spot photometer positioned very close to the screen, this proved impractical at the higher spatial frequencies due to the frame unsteadiness of the moving film. It, therefore, became necessary to use photographic methods for assessing and documenting the projected film's performance.

This was accomplished with a 35mm single-lens reflex camera using Kodachrome reversal color film exposed for 1/4-sec, a procedure intended to simulate the performance of the human visual system. The resulting slides were studied, and it was confirmed that they did indeed capture what had been perceived visually on the moving film.

This paper describes the details of producing and measuring the test film and associated equipment. It reviews the highlights of previous work performed and published relating to the subject of frame positioning errors in film. It concludes with a presentation of the results achieved.

38. Single-Telecine Transfer of 16mm Negative A&B Rolls to a 1-in. Type-C Master. *By David W. Leitner*, Du Art Film Laboratories, Inc., New York, N.Y.

In the U.S., 16mm original negative is routinely conformed by an A&B roll checkerboard technique to conceal splices. As luck would have it, this conforming technique renders the original negative unsuitable for direct transfer to a first generation 1-in. master by conventional means. Instead, a single-strand duplicate of the original negative, such as a low-contrast print, must be substituted.

In an effort to preserve the broad, linear tonal range and superb reproduction of fine detail characteristic of original negative, some producers transfer uncut negative to tape, then edit or conform a second generation 1-in. master. But this is a complicated option for those whose original is locked into the A&B roll format, because video editing systems are not designed to follow or maintain the 3-2-3-2 field reproduction pattern inherent in the conversion of 24 fields/sec to NTSC.

This paper details an ongoing experiment in synchronizing a single Rank Cintel flying-spot telecine to 1-in. Type-C VTRs; color correcting and transferring A&B rolls in sequence to a first generation 1-in. Type-C master; and overcoming the special problems introduced by rudimentary effects like dissolves. The significance of liquid gate technology and digital "grain reduction" to A&B roll negative transfers is noted, as well.

39. Consistency in Telecine Transfer. *By R. E. Bartow and R. J. Zavada*, Photographic Technology Div., Eastman Kodak Co., Rochester, N.Y.

Variability in telecine transfer has caused concern for many years. The attempts to develop a reference tele-

cine were not successful, thus leaving the burden for consistency and repeatability of transfer to test materials. In 1977, Dr. R. W. G. Hunt of Eastman Kodak Co. proposed the use of "film color bars" as an effective telecine set-up tool. Kodak introduced the Telecine Analysis Film (TAF) based on this principle two years ago.

Prior to the introduction of TAF, a survey was made of 20 production houses to document the variability in transfer. This year a resurvey was made of the production houses to assess the contribution of TAF to improved consistency.

Although TAF has made a major contribution to telecine setup, inconsistency in monitor setup, phosphor characteristics and viewing environment continue to be a major obstacle to fully consistent telecine transfer.

40. Electronic Detection and Concealment of Film Dirt. *By Richard Storey*, British Broadcasting Corp., BBC Research Dept., Kingswood Warren, Tadworth, Surrey, England

Film, as an image source for television, has a number of inherent imperfections, all of which can, at least in theory, be minimized electronically. The list of imperfections in order of importance includes color errors, film grain, dirt, unsteadiness, and motion portrayal. Color errors and film grain have already been minimized by specialized electronic processing equipment. Dirt is the next item on the list.

There are two methods for detecting the presence of dirt on film passing through a telecine. The first is optical, requires a specialized telecine, and can only detect dirt particles adhering to color film stock. The second, totally new method, which forms the subject of this paper, is entirely electronic and operates directly on the coded video signal from a standard telecine. It can detect and conceal dirt particles, printed dirt, or scratches on both color and monochrome film stock.

The ideal approach to solving the problem of dirt detection and its subsequent concealment is to model the behavior of the human visual system which, through scene understanding, identifies dirt as being "out of place" in an otherwise orderly scene. Building this type of understanding into a machine operating at real time video rates is impracticable and does not represent a good engineering compromise.

A much simpler approach has been adopted. A prediction for the signal values in each film frame is calculated from those in both the preceding and the succeeding frames. This prediction is accurate for stationary scenes, but contains errors in the presence of motion, unsteadiness and film grain.

A second signal describing the likely prediction error trend is calculated from the surrounding motion, unsteadiness and grain content. If any of the actual signal values differ from the corresponding predicted values by more than the "error trend," they are deemed to be dirt.

Optimizing the error trend signal for best dirt detection over a wide range of source material proved to be extremely time-consuming, due to the difficulty of cataloging random occurrences of dirt. This problem was overcome by calculating the optical density profiles of a large set of randomly sized and positioned dirt particles, to simulate dirt on otherwise clean pictures. The effectiveness of the dirt detection system could then be calculated, allowing the error trend signal to be optimized relatively quickly.

Concealment is achieved by substituting a simple interpolation from the two adjacent frames. Motion does not cause an inappropriate substitution because the detection system tends not to detect dirt in rapidly moving areas. The failure to detect and conceal dirt in these areas is largely masked by the motion.

The equipment is capable of detecting the majority of dirt in typical 16mm film with negligible motion impairments, missing only the largest pieces. A second choice of error trend signal allows detection of all dirt sizes but with occasional motion impairments during rapid motion. The equipment is currently being field-tested by the BBC's television service.

109*. Videographics Go to the Ballet. *By Donna Foster-Roizen, Darryl Sapien, Thomas Hahn, and Richard Shoup*, Telegen and Aurora Systems, Palo Alto and San Francisco, Calif.

The San Francisco Ballet takes video animation into the theater. Electronic scenery for a new ballet was created by Darryl Sapien using the Aurora/100 videographics system. Computer-animated backgrounds were transferred to 35mm film for rear projection on a 30 × 40 ft screen on the San Francisco Opera House stage.

* Paper presented out of sequence.

Image Sensors

41. Some Considerations in Using CCD Imagers in Broadcast-Quality Cameras. *By Thomas M. Gurley and Carl J. Haslett*, RCA Corp., Gibbsboro, N.J.

The arrival of the CCD camera for broadcast applications marks a major milestone in the transition from tube to solid-state camera technology, which began 20 years ago. With the inclusion of CCD imagers, all components of the camera now have the solid-state advantages of long life, stability, and low-voltage operation. In addition, the freedom from lag and high contrast-range inherent to CCDs provides a look close to that of film.

These characteristics, coupled with greater sensitivity and graceful handling of highlights, make CCDs particularly well suited to the needs of Electronic News Gathering in available-light situations. In sportscasting, shorter effective exposure time and lack of interframe image retention permit blur-free "snapshots" of fast-action events. For the first time, shuttering is a practical way to achieve very short exposures. In applications such as these, CCD cameras offer distinct advantages over their tube counterparts that outweigh the limitation in static resolution imposed by the present state of the art in CCD technology.

Improvement of static resolution, required for higher-quality field production and studio work, will be realized as ongoing refinements in manufacturing techniques permit greater yields of devices having higher numbers of picture elements. In the interim, an acceptable alternative may be the multiplexing of several lower-resolution devices, at some expense in optical and signal-processing complexity.

The opportunity to achieve "film-look" video and to benefit from the many advantages of CCDs presents a new challenge to television engineers. For example, the issue of resolution is not clear cut. Conventional techniques and terminology for specifying static resolution are misleading when applied to a sampled imaging device, since they have been optimized for tubes

employing continuous scanning of an electron beam across a photoconductive surface. Moreover, since real television pictures move, dynamic resolution is at least as important a parameter. The resolution of tube cameras deteriorates rapidly when scene content moves. Other factors, such as registration and deflection accuracy, which further limit the overall resolution of a tube camera's encoded video, are reduced to insignificance in a CCD camera. In the absence of lag and these other factors, vertical resolution is primarily a function of the number of lines per field and the quality of interlace. On the other hand, "aliasing," which the scanning of a tube can generate only on vertical details, can occur both horizontally and vertically with a CCD.

Unquestionably, solid-state imaging technology will proliferate in broadcast-quality cameras, not only for ENG but for EFP and studio applications. Simultaneously, the industry is moving toward enhanced- and higher-definition television systems. For both of these reasons, we must reexamine the long-standing concepts of static, dynamic, and temporal resolution that were predicated on the use of photoconductive tube imagers.

R. J. Zavada delivering his paper.

42. SP-3 Three-Chip CCD Color Camera. *By S. Ikeda, H. Inoue, A. Kohono, T. Tanahashi, T. Kamata, and M. Mitsui*, NEC Corp., Fuchu City, Tokyo, Japan

Recently, solid state image pick-up devices, especially CCD, have improved their performance rapidly and tend to be used in many fields. In the broadcasting field, the CCD camera seemed particularly suitable for electronic news gathering, because it promised to be considerably more rugged and reliable in operation as well as lighter in weight and lower in power consumption.

Video cameras utilizing solid state CCD image pick-up devices were expected to provide performance superior to that available from most conventional $^2/_3$-in. pick-up tubes. However, until recently, their use was confined mostly to industrial application because their resolution was still inferior to that of pick-up tubes.

One of the problems that needed an immediate solution was the blooming phenomenon. The application of an overflow drain and barrier placed beside a photoconductive area has made it possible to suppress the blooming phenomenon in CCD image sensors. However, this method was found to sacrifice photosensitivity and dynamic range.

To produce its first broadcast quality CCD color camera, we developed a totally new interline CCD image sensor. The feature of this CCD is vertical overflow drain (VOD) construction under rather than beside the photo-diode, thus effectively increasing the cell area that can be used as photo-diodes and CCD registers.

The sensor features a photo-electronic conversion system which consists of an array of 490(V) × 384(H) photo-diodes with $^2/_3$-in. image format, a transfer gate region (TG) controlled with a vertical pulse, a buried channel vertical register (V-CCD), a horizontal register (H-CCD) and a gated charge detector for the output signal.

Three of these interline vertical overflow drain (VOD) CCD image sensors are used in the SP-3 Color Camera, two for the green channel alone, and one for the combined red/blue channels. This dual green system, which can only be realized with a mechanically locked registration system, provides much higher resolution and camera performance than can be obtained from a conventionally structured system.

The SP-3 Color Camera uses a unique prism optics block to split the incoming light beam into three beams: two greens for the two green CCD sensors and one magenta for the red/blue CCD sensor. One half of all incoming green light is reflected at the first dichroic surface and the remaining one half of the green light is reflected at the second dichroic surface. Only magenta light passes straight through the prism without any reflection.

The SP-3 CCD Color Camera is designed to be used as a broadcast quality ENG stand-alone camera as well as in camera/recorder combined systems using on-board component VCRs for ENG applications. We confirmed that the SP-3 CCD Color Camera offers several distinct advantages compared with the conventional 3-tube camera such as being completely free from burn-in, sticking, and comet-tail.

43. A 488 × 430-Element CCD Image Sensor with Exposure Control. *By R. H. Dyck, Y. T. Chan, and O. R. Barrett*, Fairchild Camera & Instrument Corp., Palo Alto, Calif.

A 488 × 430-element CCD image sensor has been developed which provides both exposure control and blooming control. One of the difficulties in developing such a device has been the large amount of additional structural complexity associated with an added exposure control gate. This device does not use an exposure control

gate. Instead, the height of the potential barrier between each photoelement well and the common overflow drain is controlled by the bias level of this overflow drain. This design provides fast exposure control and offers the possibility of relatively high yield in production.

The device itself has been described previously.* The present paper gives a description and also presents performance results and discusses the performance limits that are expected.

The device is an Interline Transfer CCD image sensor with a $^2/_3$-in. vidicon format (11.0mm diagonal). The unit cell size is 13.5 × 20.5 μ. As is common in the Interline Transfer architecture, approximately half of the horizontal dimension of the unit cell is taken up by a CCD register stage and its associated sidewall structures, and more than half of this dimension is taken up by an opaque stripe that must cover the CCD register. The actual light sensitive portion of the unit cell is approximately 30% of the area. The width of the special drain and barrier structure that provides the exposure control and blooming control is not much more than that of an ordinary CCD channel stop. A representative channel stop in current CCD technology is 3–4 μm wide; this total structure, including the drain stripe and two special barriers, is 4–5 μm wide. As a result, there is virtually no loss of light sensitive area because of the presence of this special exposure control structure.

In operation in the exposure control mode, the photoelements cannot integrate signal for more than one field period, i.e., $^1/_{60}$-sec in NTSC operation. Therefore, the only modes of operation that can be used are: (1) interlace with pairs of pixels being read out each field, and (2) non-interlace, where the resolution is limited to 244 × 430 pixels. At the start of each field period all pixels are in the "dump" state. The exposure time is the time between the end of the "dump" period and the end of the Photogate clock phase that transfers charge to the registers.

Exposure times of 1 μsec or less should be possible with this device. The major limitation to the exposure time of this device will not be the electronic speed, however, but will be the accumulation of register crosstalk signal in the vertical registers. If the register crosstalk factor is, for example, 5%, and if the scene is more or less uniformly bright, then one would obtain a fairly poor quality image for exposure times of less than 5% of the field time (0.05 × 16 ms = 0.8 ms). This is because the vertical smear effect produced by the register crosstalk would be of equal amplitude to the signal, and this would lead both to a loss of contrast and to some possibly objectionable artifacts in the image.

For some applications the signal level can sometimes be enhanced by making use of the infrared content in the scene. This is done by removal of an infrared filter that is common in silicon sensor cameras. In the device described here, the infrared sensitivity is relatively high among silicon image sensors because the device has no secondary deep *pn* junction. (Image quality in the infrared is somewhat worse than in the visible band due to vertical smear.)

For the recording of events that contain moderate image velocities, the ability to adjust exposure electronically allows rapid reoptimization of video amplitude for changing scene brightness; this can be done while providing close to 488 lines of vertical resolution. For the recording of events with higher image velocities, the device can be operated in the non-interlaced mode which gives 244 lines of vertical resolution.

In summary, a CCD image sensor has been developed which has exposure control capability. Operating the device at an ordinary field rate and using an ordinary video recorder such as the VHS type, high-speed events can be recorded without the usual blur. In fact good quality images can be obtained with exposure times as short as 2 msec.

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* "A 488 × 430 Interline CCD Imager with Integrated Exposure and Blooming Control," Y. T. Chan, O. R. Barrett, C. W. Chen, Y. Abedini, and D. D. Wen, *Digest of the ISSCC '84*, Paper WAM 2.3, San Francisco, Feb. 1984.

44. KCF 1 — Using the Leading Edge of Technology in a Small Broadcast Camera. *By U. Reimers*, Robert Bosch GmbH, Darmstadt, W. Germany

The KCF 1, a top-quality three-Plumbicon camera for Bosch's QuarterCam system and for standalone ENG/EFP-operation, has been designed to become one of the industry's smallest and lightest in weight, yet most reliable, pickup elements.

A volume of roughly five pints, weighing approximately 2.5 kg, carries beam splitter, tubes, and all the electronics are needed to produce a component video signal of full broadcast quality including 2-line details.

What are the technological prerequisites for such a quantum-leap in miniaturization while keeping the full performance of much larger cameras and in addition enhancing camera-reliability? This paper will survey Bosch's approach by discussing in detail the steps that have been taken to achieve this leap.

The consequent decision for $^1/_2$-in. pickup tubes has been the first major one of these steps. A number of papers have reported about the superior stability and overall performance of these tubes; therefore only a few highlights will be summarized.

Video signal processing is performed in two proprietary, custom-intergrated, bipolar integrated circuits (ICs) for each of the three colors. These components include all the features that are needed, e.g., gamma-correction, additive and multiplicative signal modification etc., while giving a full 7-MHz bandwidth. The use of ICs gains a host of advantages. Black-level stability is so extraordinary that no external adjustment is needed. The number of components that may be defective is drastically reduced. Finally, the service of the video processor is extremely simplified.

A full 2-line vertical contour enhancer needs analog or digital storage media to store two lines of video information. The KCF 1 uses charge coupled devices (CCDs) instead of the common ultrasonic delay lines for this task. One of the major advantages of this approach is the possibility to change the storage time from NTSC line duration to PAL line duration, e.g., with a simple switch. More than 5.5 MHz of signal bandwidth with a signal-to-noise ratio of 66 dB has been achieved.

To avoid the usual tangle of wires often found in other cameras, all interconnections within the housing, even to the lens, viewfinder, and interface, are realized as flexible PC boards directly integrated into the camera's mother-board. Hybrid PC boards, designed with the aid of computers, automatically manufactured and tested in in-circuit testers, are used for the non-video-processing tasks in the camera. Their extreme reliability enhances camera performance and helps to make the KCF 1 one of the smallest, lightest-weight, highly reliable cameras in the industry.

45. Solid State Imaging Device for Broadcast Camera Applications. *By Koichi Sadashige*, Matsushita Electric Corp. of America, Secaucus, N.J.

Although line-structured CCD image sensors are currently in use in telecine camera systems, raster-structured solid state sensors are just about entering the broadcast camera market place. The acceptable replacement for high performance image tubes, such as Plumbicons and Saticons, must first match the video performance parameter, i.e., SNR, MTF, colorimetry, etc. It must also be capable of offering features not currently available in tubes, such as extended high light-handling ability and exceptionally low lag characteristics, in order to establish its place in competition with camera tubes.

An overview is given of the current material technology and circuit techniques for the solid state imaging devices intended for broadcast applications. The trends of near term development activities are also discussed.

46. Plumbicon Camera Tubes with New Technology for Superior Broadcast Cameras EFP/ENG. *By Ad Franken*, N. V. Philips, Eindhoven, The Netherlands

Several years ago, Philips and Amperex introduced the diode-gun Plumbicon camera tube. Two versions of the new tube became available: an 18mm version used mainly for ENG and EFP, and a 25mm version chiefly for studio applications.

Later, at the SMPTE Television Conference, Nashville (1982), the 11mm XQ4087 high-stability (HS) diode gun Plumbicon tube was introduced. This tube was based on a completely new electron-optical system, incorporating an accelerating-focusing lens (magnetic deflection and electrostatic focusing). With its low power consumption and low weight, this new tube was ideal for ENG cameras (especially for camera-recorder combinations). The success of the XQ4087 led to the new electron-optical system being incorporated in a larger 18mm tube to produce the new XQ4187 HS diode gun Plumbicon tube. The excellent registration and sharpness of this tube, combined with its extremely low lag, low weight and low power consumption, means that it is ideal for both EFP and for high-quality field and studio applications.

This paper will discuss the technology and properties of the new HS diode tubes, and will compare them with the 18mm XQ3457 mixed-field (HF) Plumbicon tube (which incorporates magnetic focusing and electro-static deflection).

47. Using Small Diameter Pickup Tube for High Quality Television Production. *By N. V. Rao and A. Franken*, Amperex Electronic Corp. and Philips, Slatersville, R.I.

The requirements of high quality television production cameras are discussed in detail, together with the performance characteristics of small format (18mm diameter tube) tubes. Also described are 18mm tubes with electrostatic deflection-magnetic focus and magnetic deflection-electrostatic focus and their performance. A comparative study is made of tubes with a lead oxide photo-conductive layer and selenium photo-conductive layer. The advantages and limitations of the small format are also presented.

Film/Tape Interface II

48. Projection — Tape or Film — Which Method? *By Lawrence Kreeger*, Positive Transfer, Ltd., New York, N.Y.

Video monitor and video projection are at present the most widely used methods of viewing program material finished and released on videotape, but there are limitations based on the number of the viewing audience and the size of the room or auditorium. How many people can you comfortably crowd around a 25-in. monitor? Or how large an audience can view a video projection image without a dramatic fall-off in picture brightness and clarity for side to side and at a distance from the viewing screen?

Multiple color monitors have a problem with matching colors from monitor to monitor, thereby causing the viewers' attention to wander from set to set, comparing colors and not concentrating on the subject. Also, a decision has to be made on how many viewers can comfortably view a 25-in. monitor without reduction in their attention span.

This leads us to the next alternative — video projection. There you have choices about image size and clarity for the viewers, depending on the number of viewers and the size of the auditorium. Let's start with the minimum video projection requirements, ranging from the Sony or Advent, priced at around $1500, to the Eidophor, priced at around $50,000. Purchasing the high end of video projection, either the Eidophor or the G.E. Light Valve, doesn't make economic sense. However, you can rent an Eidophor or G.E. for $2500 to $5000 per day, which would include an operator, maintenance and screen, thus ensuring the best available projection quality.

The less expensive method is the three tube color projectors with focused screens that are sold by better video outlets, which are acceptable as long as the audience is not too large and is in a direct line to the viewing screen. As soon as you go from side to side or increase the distance between the viewers and the screen, the picture quality and brightness drop off dramatically. These projection units are primarily designed for home use and comfortable viewing for family and friends for sporting events, etc.

Remember that the larger the screen is, the less brightness there will be and the more reduced the viewing angles. This means that very careful seating arrangements must be made beforehand to ensure satisfactory viewing for your audience.

Today's video production, whether originated on tape, or shot on film and finished on tape with all the electronic special effects, enables us to make excellent tape-to-film transfers, either on 16mm for non-theatrical use, or on 35mm for theatrical screenings. This of course presumes that broadcast-quality equipment is used and that the material is finished on 1-in., 3/4-in., or Sony 1/2-in. Betacam.

Kinescope recording has traveled a long and arduous route since it was first introduced by the major TV networks as the only means for delayed TV broadcast. It was crude, but it was the only method available at that time. When 2-in. Quad videotape was introduced, "kines" for delayed broadcast were dropped and tape became, and remains, the most desirable method for delayed broadcast. Kine was then relegated to overseas distribution of program material until standard conversion was introduced, allowing foreign distribution regardless of the original standard, e.g., NTSC, PAL, or SECAM.

Kines now had to improve so that film projection from videotape would become commercially acceptable in color and clarity. Image Transform was the first to introduce a color kinescope system in both 35mm and 16mm that fits the above requirements. One of their strengths was the ability to reduce tape noise to a minimum. Because of this and other research and development in the kine field, their product was considered the best by film producers, advertising agencies, etc. The problem though, was the high cost and the time factor.

Since the introduction of Type-C 1-in. tape, and the tremendous improvements in the video camera, tape deck, and electronics, picture quality has improved to the point that noise and lack of clarity are no longer problems. Eastman Kodak and later Teledyne Corp. worked very closely in developing a three-tube triniscope system for recording 16mm color film from tape, giving both clarity and color, that has met the standards of the film and video industries for top film projection. In the last two to three years, Teledyne has developed a method to go directly from tape to 35mm 5247 color camera negative for theatrical release in art theaters, as well as to 16mm 7291 color camera negative for non-theatrical commercial and industrial use.

In conclusion, transferring from tape to film offers a more viable and satisfactory method of presenting a large audience with a screening of material that has been originated on tape.

49. Improved Tone Scale for Television Applications Through Modified Process VNF-1. *By John D. Croft, C. Didier, and W. C. Doody*, Eastman Kodak Co., Rochester, N.Y.

A modification of Process VNF-1 is described for reducing the contrast of Eastman Ektachrome camera films to better meet the needs of television broadcasters. The lower contrast, which is obtained with simple process chemistry change, provides an improved tonal scale for telecine input.

50. An Electronic Laboratory. *By Emory M. Cohen*, Pacific Video, Hollywood, Calif.

This paper describes the current status of electronic post-production for single camera productions, particularly those originating on film. With some reference to the history of recent experiences, successful and otherwise, some projection into future technique and technology, the realities of electronic post-production are disclosed by an examination of the following issues:

Shooting: How to decide between film and tape? Does anything have to be done differently on a film shoot to be post-produced on tape?

Processing: How and what do I tell the lab?

Syncing: How do I get the action and track synced-up?

Telecine: How do I get my film transferred to tape, looking good, on time, without spending my entire post-production budget?

Editing: What is the difference between film and tape editing? What system works best: CMX, Montage, Editdroid, or something else?

On-line conforming: Drop, non-drop, field one, field two, 3:2, EDL, what should I worry about?

Optical effects: How to get the most out of expensive toys.

Color correction: Electronic timing — how and why?

Sound: Can I cue, spot, build, Foley, ADR, fix, score, and dub just as I do in film?

Back to film: If I have to, can I?

Every producer is enthusiastic about saving time and money, every tape facility is enthusiastic about gaining new revenues, every engineer is enthusiastic about new technologies. This enthusiasm can only be made productive through the matching of technical realities with production needs in a systems approach. Experience has shown that anything short of this continues and widens the break between film and tape.

Session Chairmen Ed Ancona and James Gibbings.

51. Scanning Requirements for Motion-Picture Post-Production. *By R. Furth, L. DeMarsh, and R. Sehlin*, Eastman Kodak Co., Rochester, N.Y.

A major effort is now under way to define a single worldwide HDTV production standard. One likely application of HDTV technology is in the post-production of motion pictures — that is, film origination, electronic post-production, and film release. This electronic system should be designed so that the quality of its film output is not significantly degraded from that produced in the current all-film system. Our analysis suggests that a scan standard with 2200 scan lines is a minimum requirement for film post-production.

52. Understanding Film Dynamics on Continuous Motion Telecines. *By George Soluk*, VAMP, Inc., Hollywood, Calif.

With the widespread use of continuous motion telecines, special care of transport mechanics and associated electronics must be administered to insure film transfers with the greatest stability and lowest distortion. This paper will review the various factors which affect film flow, horizontal and vertical registration, and any resultant distortions in the output picture. Also

discussed is what can be done to isolate and possibly minimize these problems.

53. The Panaflex 16 — Doing More With Less. *By Jac Holzman*, Panavision Inc., Tarzana, Calif.

The author describes the philosophical design considerations for a new, state-of-the-art 16mm camera especially suited to high-quality studio production work. A new electronic drive system with precision crystal control at all speeds between 4 and 50 frames/sec, extra-large optical viewing system, dual pin registration, super-quiet drive, and numerous convenience features and benefits are fully detailed.

The Panaflex 16 System is a top-of-the-line rental-only camera primarily designed to film original productions intended for video post-production and delivery. It provides for a continual series of retrofits and upgrades conforming to the Panavision philosophy of providing a constantly evolved and improved system of cinematography.

54. Improved Wet-Gate Systems for B&H Model-C Printers and Bosch or Rank-Cintel Telecines. *By Joseph Wary and Andreas Schmitzer*, Lab Methods Corp., Canoga Park, Calif.

An advanced state-of-the-art, total immersion wet-gate system that can be installed quickly on Bell & Howell Model-C printers and Bosch or Rank-Cintel telecines is now available from Lab Methods Corp. (LMC). Installation, maintenance, and spare parts are available locally.

The low-cost Model-C printer model is available in 65/70-, 35-, 35/32-, S16-, R16-, and S8mm formats. Printing speed is in excess of 240 frames/min. Options for the printer model include single or four-way aperture, provision for printing edge numbers, and RF and/or notch cueing.

The NKS/LMC system uses less solution than any other competitive wet-gate unit. The solution reservoir holds 3.5 liters (1 U.S. gal). Filling time is approximately 30 sec. Safety features include failsafe interlocks to prevent printer startup before the print head is full; and prevention of the print head door from being opened until the system is automatically drained and dried.

Because of the minimal amount of perchlorethylene solution consumed, the built-in seals, safety features, and the exhaust system offer exceptional freedom from hazards to personnel and the environment. After printing, the head is automatically drained, blown dry, and exhausted. In fact, the lab is free of the offensive and dangerous odors normally associated with wet-gate operation.

Installation requires a minimum of time and can be done without disrupting production schedules. The printer operator does not have to be retrained — a few instructions are all that are required, since the new unit retains the basic Model-C configuration. A daylight magazine for rawstock is furnished as standard equipment, thus facilitating threadup. The overall size of the Model-C is not enlarged by the conversion to the wet-gate system.

The NKS kit is available for conversion of a Model-C printer to wet-gate printing; or a completely remanufactured Model-C printer is available with a new NKS/LMC wet-gate system installed. Other new LMC items in the latter package include an ultra-high-speed reader, solid state electronic light valves, soft start, multi-speed, dynamatic main-drive motor, and torque takeup motors.

The NKS/LMC model wet adapter for Bosch and Rank-Cintel telecines is a simple, straightforward retrofit available in 16- and 35mm sizes. A simplified control system enables operators to quickly thread and operate the system. Scratch, blemish, and dirt-free transmission is assured, and the wet feature also provides the highest quality still frame capability. In addition, the unit can be used wet or dry.

Like the printer model, the telecine model is available with local sales and services. The system is drip-proof, and there are no fumes or unpleasant odors.

Lighting and Batteries

55. The Objectives of Lighting. *By E. Carlton Winckler*, Imero Fiorentino Associates, Inc., New York, N.Y.

The value of lighting to good communication is usually underestimated by communicators. What we call lighting is really a combination of directional light plus the varied brightness values of the subject plus the relative reflectance values of the subject's surrounds and background, as observed by a camera. Many people think that a fine camera alone will assure good communication with a viewer, but the finest camera only reproduces what it sees, exactly the way it is. Sometimes lighting can correct a bad composition and allow the camera to see it more effectively.

The question is raised as to what is "good" and "bad" lighting. The answer is "good" lighting is explained and illustrated through a close examination of the objectives of lighting as compared to mere illumination. The objectives include separating picture elements from each other and from background, modeling for dimension, accenting for pictorial interest, illuminating for camera needs, and directing viewer attention which is the prime function of lighting.

The often forgotten ingredients of cooperation, understanding, and interdependence of the various crafts and arts are explained and explored because they are major components of good lighting.

The question of the importance of hardware to good lighting is explored, and a detailed example of a complex lighting job done entirely with inadequate equipment is used to illustrate the importance of understanding and cooperation in attaining a good result in spite of difficulties.

The discussion closes with the admonition that you are never demonstrating a lighting technique — your aim is to achieve a pleasing picture that communicates effectively and you do whatever is necessary to bring that about.

56. Performance Characteristics of HMI Type Lamps. *By Robert E. Levin*, GTE Lighting Products, Salem, Mass.

Color temperature meters are inappropriate instruments for measuring light from HMI and BriteArc™ type lamps, since the spectral power distribution of these lamps differs significantly from gray body radiation. Nevertheless, such instruments are commonly used in practice. This paper demonstrates the range of error in such measurements. Further, the discrepancy between different meters when measuring a single lamp is shown.

In general, color temperature is not a particularly appropriate photo-

graphic metric for these lamp types. This is due to the fact that color temperature is on a one-dimensional scale, while photographic response to lighting must be evaluated on a two-dimensional scale, e.g., the power ratios of the red to blue and the red to green spectral regions. Color temperature is a visual metric describing the chromaticity of the light. The relative spectral power distributions of these lamps can have photographically significant differences at a given color temperature.

Color temperature can be used as an indicator of color quality differences between various lamps. The proper method of its measure is by spectroradiometric determination of the spectral power distribution of the light and subsequent calculation from the spectral power distribution. Chromaticity coordinates developed from the spectral power distribution are a better, albeit still imperfect, measure of color quality.

An appreciable variation in color quality is expected between samples of a given lamp type. The typical range of variation is demonstrated in terms of chromaticity coordinates. Use of chromaticity coordinates is informative because of underlying similarities in the spectral power distributions of these lamp types. The color quality of light from luminaires using these lamps is not a function of the lamps alone. Color quality also depends on such factors as the luminaire design, the specific ballast used, the applied line voltage, and similar factors. These aspects are discussed and supporting quantitative data are presented.

The arc tubes of HMI-type lamps generally start to devitrify about 100 h into operating life. This can affect beam spread and beam lumens of luminaires. Whether it does or not depends on the type of optical system used. It is shown why this occurs for stop-limited systems such as narrow beam projection devices but does not occur for source-limited systems such as fresnel lens spotlights. Color separation occurs across the projected area of the arc due to stratification of the radiating species. This causes a color separation in the beams of certain luminaires. The effect is explained and analyzed.

The beam characteristics of integral reflector versions of the HMI-type lamp, i.e., the BriteBeam™ lamp, go through certain characteristic changes in beam spread and color homogeneity during the life of the lamp. The changes range from significant for narrow beam spread lamps to negligible for wide beam spread lamps. These characteristics are described and explained in terms of the arc tube characteristics.

57. A Comprehensive Overview of Ballast and Igniter Systems for Metal Halide Lamps in Film and Television Applications. *By Riccardo Croce*, IREM, S.p.A., S. Antonino di Susa, Turin, Italy

Metal halide lamps are by now widespread in the motion-picture and television fields. Their large-scale application is due to the quantity of light produced in relation to the electric energy consumption, compared with tungsten lamps. Contrary to the latter, the metal halide lamps need some aids for their operation.

This paper aims at clarifying the relative ignition and powering problems. Its realization has been possible thanks to almost 40 years of experience in design and manufacture of igniters and rectifiers for short arc Xenon lamps. Moreover, IREM S.p.A. has been involved in the metal halide lamp business since their first appearance on the market, supplying some of the main lamphead manufacturers in the world with the ignition and powering devices.

This paper will not deal with the lamp output photometric characteristics; it means to be an easily comprehensible description of the metal halide lamp requirements as far as suitable ignition and powering go.

After a brief introduction on the ignition and powering characteristics of these lamps, a closer look will be given to the igniters and standard ballasts. The parameters these igniters must comply with, to be in accordance with the lamp manufacturer requirements, will be explained along with discussion on the following points: minimum voltage for proper ignition; minimum number of sparks per half-cycle; phase position of ignition pulses; load capacity; and minimum operating time.

The paper will also include a discussion on the proper safety distances between the high voltage cables and the lamphead, the radio frequency interference protection and the ignition support circuit.

The same approach will be adopted for the ballasts which, as well, have to comply with the strict requirements of lamp manufacturers, which may be summarized as follows:

- Minimum lamp supply voltage
- Choke voltage at nominal lamp current for straight choke (voltage-current) characteristics
- Maximum peak value at half-wave rectification
- Power factor improving capacitor for compensation parallel to the power supply

For a proper design of the power supplies, it is not enough to consider the electrical characteristics, but it is important to develop a simple and easy-to-handle unit.

A section of the electronic ballasts will explain the main problems arising in design of such units. Besides meeting the typical lamp requirements, these ballasts must have a very high degree of reliability. A particular feature, typical of electronic ballasts, is the dimming facility, which will be evaluated according to the electrical lamp characteristics.

Since the introduction of these lamps in the motion-picture and television fields many steps have been taken, but it is understood that, for a correct design of ballasts and igniters, it is always necessary to consider two important things: lamp requirements and market needs.

58. Advances in Battery Charging for Portable Video: Low Cost, Microcomputer Controlled Fast Charging for Nicads. *By D. C. Hamill and B. R. Parker*, PAG Ltd., Raynes Park, London, England

This paper is divided into three sections.

Market Considerations

The background and reasons for developing new battery charging techniques are described. The requirement for fast-charging video batteries was investigated. Problems with existing technology were identified. Outline proposals for a new approach were produced and were validated by consultation with users and equipment manufacturers. A target specification was written in collaboration with the research and development department.

As work on experimental models proceeded, new possibilities emerged and were included in the specification. An outstanding feature of the charger

is its ability to fast charge a wide range of different batteries totally automatically. This makes it very cost-effective for use with the variety of batteries encountered in portable video equipment.

After field trials, the resulting fast charger and sequencer unit were put into full commercial production. The many practical benefits of the system are now being realized.

Technical Considerations

The problems with fast-charging nicad batteries are described. The need for accurate, reliable control of the fast charging process and its termination is explained. Existing charging termination techniques and their failings are briefly reviewed. The characteristics of an ideal fast charger are set out; not all of these are achievable in practice. Others are possible, but to achieve them, large quantities of data must be gathered and processed. This creates the need for microcomputer control.

A program was developed for controlling and terminating fast charging; this is outlined. A side effect of using a microcomputer is that extra features can be added at very little cost. For instance, the charger has been made to adjust itself automatically to a wide range of battery capacities and voltages. This and other features are described.

The power section of a charger should be small, lightweight, efficient, interference-free and reliable, but at a low cost. An optimum must be reached through engineering trade-offs. The resulting power circuit is described.

The separate 8-channel sequencer contains its own microcomputer. This monitors and supervises the fast charger, connecting it to each battery in turn. The charger's flexibility allows a mix of different battery types with no operator intervention.

Future Possibilities

The charger and sequencer can be combined into a single unit, giving a reduction in overall cost. Further improvements in the size, weight, and cost of fast chargers will be possible as technology advances. Similar techniques to those described may be used for fast charging other types of battery, for example silver-zinc, which has a greater energy density. Further applications include battery-testing and management systems.

The systems can be custom designed to specific requirements. This is particularly useful in military, government, and industrial areas outside the video market.

59. 6-In-1 Battery Sleuth — CASP with ReFLEX-2000 — The Ultimate Answer to Battery Problems. *By Fred Benjamin and Ray Martin*, Christie Electric Corp., Torrance, Calif.

Batteries are the key to reliable portable electronic equipment, e.g., electronic newsgathering (ENG) cameras, recorders, and lights. But they create many problems.

At the October 1976 SMPTE Conference, the author presented a paper (subsequently published in the April 1977 *Journal*) on a system for 20-min recharging of sealed nickel-cadmium (nicad) batteries using the ReFLEX® charging technique now commonly known as "burp charging." That paper examined five problems encountered with sealed nicad batteries and chargers and how the system solved each of these problems.

Since that time, additional problems with rechargeable batteries for professional portable electronic equipment have come to light. This paper explains how a new, small, lightweight, ultra-fast, all-in-one, battery charger/analyzer/sequencer and power supply with microcomputer, keyboard, and screen not only improves on the original solutions, but also how it overcomes each of the following problems:

Problem 1: Batteries which have been seemingly fully charged may unexpectedly go dead prematurely, often during a critical instant. *Solution:* The Battery Sleuth has two battery capacity analyze options to detect such problems; furthermore, assuming the capacity loss is due to battery "memory," it will also cure the problem.

Problem 2: How can one find out the results of the capacity analysis performed unattended on each of the connected batteries. *Solution:* The test results can be easily recalled on the built-in screen, or automatically printed out on the optional printer.

Problem 3: Various makes of nicads, as well as lead-acid and silver-zinc batteries, need to be charged, but this requires various types and makes of battery chargers. *Solution:* This unit will not only charge everyone's nicads in their respective optimum manner, but also lead-acid and silver-zinc batteries.

Problem 4: There are many batteries to charge every day. It is not cost-effective to have an operator present, nor to have a charger for each battery, nor to have charging take much time. *Solution:* The Battery Sleuth is fully automatic, and will process up to six intermixed batteries ultra-fast.

Problem 5: Tomorrow's batteries, e.g., rechargeable lithium, may require a different charging regime and make present chargers obsolete. *Solution:*

Arthur Kaiser at the podium.

With this new microcomputer controlled charger, any charging regime for future batteries can easily be added to the software repertoire via the built-in keyboard.

Problem 6: It is not unusual that the charging equipment must be taken to places which do not have a 115 V, 60 Hz power source, e.g., operate from a voltage as low as 90 V in Japan and as high as 265 V in Australia, or from a car, truck, or aircraft battery. *Solution:* The Battery Sleuth works not only with an input from 90 to 265 V and frequencies from 50 to 400 Hz without resetting or reconnecting, but there is also an optional plug-in module available to allow operation from 12 to 24 V dc in lieu of ac.

Problem 7: Power outages or interruptions can cause batteries to be over or under charged, or cause analyze data to be inaccurate. *Solution:* The Battery Sleuth retains all data and maintains status quo during a power outage. Once power is restored it continues automatically, and everything is exactly as if there had been no outage.

Problem 8: In many instances it is desirable to operate the equipment without a battery; however a battery eliminator or power supply may not be readily available. *Solution:* The Battery Sleuth, powered from ac or dc, can provide regulated 12 or 24 V dc on six output ports simultaneously.

Problem 9: A unit with all these features might be too difficult to operate. *Solution:* Every normal function is a well-marked single key operation.

Problem 10: A unit with all these features might be too bulky and heavy. *Solution:* The whole unit fits in a 4-in. briefcase; it also adapts to a standard one-half rack.

Many of the features of the Battery Sleuth are unique. Together they create a real breakthrough in processing of rechargeable batteries. At the heart is a pre-programmed user-friendly microcomputer with keyboard and LCD screen. It controls the universal and ultra-fast ReFLEX battery charger, two battery analyzers, the battery sequencer, and the power supply. High-frequency switchmode power circuitry makes the small size and weight possible.

59A. A Historical Perspective on Televising the Olympics. *By Joseph Roizen*, Telegen, Palo Alto, Calif.

Olympic Games not only bring out the best in athletes, they also foster effort by the technologists to improve the audiovisual coverage and the widespread distribution of the sights and sounds of the athletic competitions, as well as the colorful ceremonial events.

Although television was in its earliest infancy in 1936, the Summer Games in Berlin expedited development of three separate television cameras to cover them. One was built around a Zworykin Iconoscope, one utilized a Farnsworth Image Dissector, and one used a 90-sec film processor and a Nipkow disk mechanical scanner to put television images on the air. Jesse Owens recalled being invited to a "Fernsehtube" to see black-and-white electronic images of the events at the main stadium.

The BBC in London in 1948 and Channel 2 in Melbourne in 1956 both used the Summer Games of those postwar years to expand or inaugurate public television, and to give the Games a larger domestic audience. By 1960, the videotape recorder had been invented. Its instant playback facility and ability to rapidly edit Olympic events greatly enhanced the TV coverage of the Squaw Valley Winter Games (where Walter Cronkite was a sports commentator) and the subsequent Summer Olympiad in Rome, which were still in monochrome.

By 1964, when the Summer Games moved to Tokyo, color television cameras, banks of VTRs, and communications satellites began to affect the coverage, and served to greatly expand the potential audience. NHK, the host broadcaster, even experimented with crude slow- and stop-motion tape machines to offer non real-time images in black and white. However, it was in 1968, when ABC was awarded both the Winter (Grenoble) and Summer Games (Mexico City) that some major innovations were tried out for the first time at the Olympiads. These included portable color cameras with backpack microwave links, rigid disk slow- and stop-motion recorders, and even portable VTRs that permitted on-site recordings. Geosynchronous satellites were now in constant use, and an estimated 800 million people watched what was being televised from Mexico.

Munich in 1972 and Montreal in 1976 each saw the host broadcaster add new elements of size and mobility to the TV coverage. Cameras soared to new heights, special mobile vehicles were built as camera platforms for long races, and all the gear got smaller and lighter, permitting wider ranging access and remote coverage.

Since Montreal, technical progress in imagery and sound, in video recording and editing, in transmission and communications has accelerated. As a result global interest in the Olympics has increased, global audiences have become gargantuan (2.5 billion for the L.A. Summer Olympics) and with the new technology, the average television Olympic fan gets a better view of the events than from the most expensive seat in the stadium.

This paper will cover the historical advances made in the television coverage of past Olympiads with the use of slides depicting each technical innovation.

59B. The Desirability and Recommended Methodology for Establishing Exposure Indexes for Video Cameras. *By Harry Mathias*, Consultant, Los Angeles, Calif.

The author discusses a production-tested method for determining exposure indexes for video cameras. Also discussed is why this procedure is important in practical production situations.

Post-Production (Film and Television)

60. The EnVision Editing System. *By Jack Behrend and Bruce Rady*, Syncrvision Inc., Chicago, Ill.

The EnVision Editing System has been developed as a complete editing system for material shot on either film or videotape, and released on either film or videotape.

The editing medium is 1/2-in. or 3/4-in. videotape, transferred from the original tape or film. Software developed as part of the system controls the 24 frames/sec film to 30 frames/sec tape conversion. After editing is completed, a floppy disk or punched tape controls an on-line system for auto assembly; or if the end product is film, a list of film edge numbers, showing + and − frames is printed.

Central to the design of the system is a touch-screen with graphics depicting the components of a flat-bed film editing table. The touch-screen,

together with a speed control similar to that used on a conventional flat-bed table, represents the total control functions. No pushbuttons, no keyboard, no edit list display. Tape decks are interlocked so that editors have the same audio capability they are used to when editing film.

A great deal of emphasis was given to the problem of editing audio. In a survey of film editors, most felt restricted by the limitations of current video editing systems. Sound is transferred to the same type of VCR cassettes as the picture. Since tape decks are interlocked at every speed, frame accurate, the audio tracks are built up just as they normally are when editing film. When editing is completed, original audio source material is transferred to a multitrack recorder in preparation for the mix. This transfer is also controlled by a floppy disk generated by EnVision.

61. The History, Design, and Architecture of Editdroid. *By Ralph Guggenheim, Rob Lay, and Andy Cohen*, Lucasfilm Ltd., San Rafael, Calif.

Computer-assisted editing systems have traditionally been designed by and for the video engineer to organize time-code information into an edit decision list and to control machines. Editdroid, the result of a joint venture between Lucasfilm Ltd. and Convergence Corp., includes a number of innovative features that make the technical aspects of editing transparent to the user. It is a flexible tool for film or video post-production.

Editdroid's design emphasizes fluid interaction between the editor and the image or sound being edited. This is achieved by "hiding" most of the numbers and other technical details, permitting the editor to concentrate on the program material and the editing process. To accomplish this, all edit information is maintained by a database management system (DBMS) that stores and cross-references a variety of information. The database captures film key and code numbers, time codes, lab and sound roll numbers, and scene descriptions. This makes it possible to edit a video workprint of film material and generate a film cutting list at the completion of an edit session.

Human engineering in the system design extends to Editdroid's packaging as well. The Touchpad provides a simple interface for common machine control and editing functions. Control knobs and buttons are positioned with the intent of placing the most commonly used functions at the editor's fingertips. The system's work station completes the system design by creating an editing "environment" for creative work. Its layout places the greatest emphasis on the edited image and sound, with secondary emphasis on textual and numeric information.

The option of configuring Editdroid as a videodisk-based system is yet another unique aspect of the system design. The high-speed random access available with disks offers the flexibility to rearrange edited sequences in a manner similar to conventional film editing. Trims and other changes to a sequence can be specified and reviewed quickly, without resorting to the time-consuming recording typical with videotape. This film-style approach to the editing process is reflected not only in the use of videodisks, but also in the user interface itself.

Though Editdroid was initially designed to suit the needs of feature film editors, it is not limited to film production alone. Instead the system's design and implementation are suitable for film or video production. Editdroid marries film and video technology while simplifying the creative editor's task.

62. Editdroid: The Design of an Editor's Interface. *By Andy Cohen, Rob Lay, and Ralph Guggenheim*, Lucasfilm Ltd., San Rafael, Calif.

Lucasfilm's Editdroid is a video editing system which is designed to make picture editing as straightforward and simple as possible. In the past, learning to use a video editing system has meant learning to deal with computer keystrokes, time-code interpretation, and "video-style" editing.

The Editdroid allows the user to use the power of an automated log-sheet, edit-list management, and real-time preview of edits, primarily by doing things that are a part of conventional editing skills: pointing at a log-book entry, cutting the head and tail of a desired shot, and splicing that shot into the workprint. These interactions are handled primarily through two video monitors, one for source material and one for the edited workprint, and a small console called the Touchpad. A graphical display, called the Notepad, is available to display secondary information about the editing process, and to provide access to less frequently used operations.

The Touchpad's most prominent and frequently used feature is a speed controller very similar to those found on a flatbed editing table, and it is used in exactly the same way. Within a finger's reach of this knob are four buttons, which are used to make head and tail cuts in the source material or edited workprint, and to splice shots in the workprint.

The Notepad is divided into two main regions: In the automated log-book, raw footage is catalogued and selected for viewing. The main editing area contains a "workbench" area for laying out a clip from the source material, and a graphical representation of the current state of the edited workprint, complete with splice, wipe, and dissolve marks.

Through the use of a small number of familiar symbols (the log-book, workbench, and edited workprint) and a small number of familiar operations (cut head, cut tail, splice, modify), the Editdroid brings the power and flexibility of computer-assisted editing to film editors. In addition, it can allow video editors to work in more of a "film style," with the emphasis on the pictures to be cut, and not on the numbers.

63. Editdroid Machine Control — The Invisible Layer. *By Rob Lay, Ralph Guggenheim, and Andy Cohen*, Lucasfilm Ltd., San Rafael, Calif.

The Editdroid demonstrates a new approach to the design of machine control for editing systems. Editing systems of the past have been designed primarily for controlling videotape. In those systems videodisk machines are substituted for the tape machines to create a "videodisk editing system." The speed of searching and preroll prior to performing an edit increases but the true potential of the videodisk in the assembly and preview functions is never realized.

The Editdroid has been designed primarily as a videodisk editing system. Emphasis has been placed on those features essential to this type of system (lookahead preview, etc.). The result is a system which allows the user to create and to experiment quickly with different versions of a sequence. The videotape version of Editdroid is configured by substituting tape ma-

chines for videodisk machines. The resulting system has all the same flexibility as the disk system and is only limited by the search and preroll times of the tape machines.

The machine control section of the Editdroid has two main characteristics:

1. A variety of different types of machines can be controlled. Machines are classified as either transports or switchers. Two models representing these classes have been developed — a transport model and a switcher model. These models meet two design criteria:

- All critical real-time control of the machines occurs within the model. This is important because the operating system (UNIX) selected to run in the central computer (SUN) lacks the real-time performance characteristics required.
- The models are "wonder machines," i.e., they have an idealized set of performance characteristics. In the real world transports have capabilities that are a subset of the model's capabilities and thus can be controlled by Editdroid.

The central controller assumes that all machines under its control are model machines and thus it remains immune to the differences between the actual machines. In order to bring each actual machine up to the specification of a model machine, an interface computer is placed between the central controller and the actual machine. This interface computer adds the real-time features to the machine and translates the commands from the central computer into the specific machine's commands. The Ethernet is the communication link between the central controller and the interface computer. The high-speed data transfer achieved from this link is essential for some of the data transfers which occur while scheduling a lookahead preview.

2. The machine control section must provide the Editdroid user with the capabilities in machine control required in the editing process.

There are three basic requirements:

- Immediate speed control of transports (tape and disk).
- Immediate switching of audio and video to the monitors and record machine.
- Scheduling of all or part of an edit decision list for lookahead preview or auto assembly.

64. Utilization of Multiple Work Stations for Videotape and Film-style Editing. *By Eloy G. Chairez*, EECO Inc., Santa Ana, Calif.

The process of editing on film or videotape has many variations unique to the respective media. An editing system designed for a specific editing style does not satisfy all editing needs. A solution to the problem is to utilize work stations that are optimized for the editing styles of film or videotape editing. The EMME™ (EECO Multi Machine Editing) system was designed on a multiple work station concept.

The Independent Creative Work Station uses an active edit decision list (EDL) concept and is designed to meet daily editing requirements in a straightforward, easy to learn, and logical style. A dedicated keyboard is utilized to minimize button-pushing, thereby increasing the speed of the system. Edit list management techniques are used extensively in the Independent Creative Work Station approach to enable the human editor to manipulate the edit decision list to exactly reflect his or her creative decisions.

The Cinemagraphic Creative Work Station is designed for the unique needs and creative style of film editors. This work station does not display time code numbers and allows the human editor to edit totally with pictures and sound using a minimum of keys. The techniques used in editing with the Cinemagraphic Creative Work Station are very similar to those used by film editors in their day-to-day editing sessions.

This paper will discuss the various design considerations of the Independent and Cinemagraphic Creative Work Stations and highlight the system variations in meeting the demands placed on the editing system by the differing styles used in film and videotape editing.

65. High Level Switcher Interface Improves Video Editing Techniques. *By Bruce Rayner and David White*, The Grass Valley Group, Inc., Grass Valley, Calif.

This paper takes a look at conventional keyboard editors and examines what improvements in editing techniques might be made by providing a more sophisticated interface between switcher and editor. It is acknowledged that 90% of editing is done with a minimum of requirements for the switcher interface, however, the remaining 10% of editing involves the creation of complex effects and sequences, and requires not only a complex video switcher but a large investment in digital video effects, graphic equipment, still stores and title cameras. Thus, an improvement in editing techniques in producing effects could make better use of several major pieces of equipment. Because a number of pieces of equipment are involved, developing better approaches to produce effects while editing is difficult and not usually undertaken by a single manufacturer.

The Grass Valley Group has developed a serial interface that allows better communication between the editor, switcher, and digital video effects equipment. The interface allows the switcher to report manual operations on the switcher back to the editor and dumps effects memory register contents to the editor as well as allowing editor control of all switcher functions. The protocol has been made available to other manufacturers in hopes that this additional capability might make improvements possible in editors.

A report is given on work in this area that has been done and operating experience with an editor using a number of new switcher based features is described. Suggestions are made for further use of the interface based on testing in an operating environment. Operation of the interface is described and proposed new features are discussed.

66. Film Data Track — SMPTE Code on Film: A Working System. *By Les Zellan*, Zellan Enterprises, Ltd., New York, N.Y. and *Jean Pierre Beauviala*, Aaton, Grenoble, France

67. Working Group Report and Test Results on S-Mac for the Studio. *By S. Merrill Weiss*, Imagex Corp., Emeryville, Calif.

The Working Group on Component Analog Video Standards has been moving forward rapidly on three fronts since the last report to the Society. Included in its works are both the parallel and the serial interconnection of analog component equipment in the studio and the interconnection of cameras and recorders. Each of these is now at a point where a standard will be proposed shortly.

The greatest amount of effort has

gone into creating a system for the single-cable interconnection of equipment using analog components. As has been described previously, the signal devised for the purpose conforms to the basic characteristics of the CCIR 601 digital video specification. The signal uses time division multiplexing of time compressed signals carried on a synchronizing waveform developed for the purpose. The signal is designed to be passed through existing plants with a minimum of modification and to survive severe distortions with little degradation. The signal, now called S-MAC for Studio Multiplexed Analog Components, has undergone substantial testing and has lived up to the expectations held for it. Most of the discussion will be devoted to the tests conducted and their results.

The parallel interconnection of analog components of the studio utilizes three coaxial cables with signal levels specified for each signal type. Channel characteristics will be such that any of the various forms of analog components can be carried, e.g., *RGB*, YP_BP_R, *YIQ*, and the like. It is anticipated that a single connector will be specified to carry all three signals and that a single cable assembly with three coaxial cables bundled together will be used.

It recently has become apparent that most of the problems and many of their solutions relating to the implementation of component facilities and to the filtering required for component systems are the same for both the analog and digital versions. Consequently, the Working Groups on Component Analog Video Standards and on Digital Video Standards have formed two joint sub-groups to study component studio implementation and filtering requirements.

The specifications for the interconnection of cameras and recorders will include the connectors, cable characteristics, and the functions to be carried on each pin and wire. The functions comprise three video signals from the camera to the recorder, a video monitor signal back to the camera, four parallel control and tally signals, two pairs of serial data, one in each direction, a pair for audio, an audio monitor signal back to the camera, power, and ground. While principally intended for cameras and recorders in the field, the standard will be applicable any time it is desired to directly interconnect such devices.

Graphics and Digital Techniques I

68. Application of Computer Graphics in Television Production. *By Yoshihiro Fujita, H. Tamegaya, S. Suzuki, and S. Kunishige*, NHK (Japan Broadcasting Corp.), Shibuya, Tokyo, Japan

The progress in computer technology is remarkable, and many kinds of applications have been made in the field of image processing and creating by use of computer techniques. The computer technology that has been used for industrial design and scientific simulations has recently begun to be applied for image production.

Many television producers are deeply interested in the new image creation which is provided by computers, and they expect it to give television programs a new versatility. Several kinds of computer graphics system for television production have been developed. There are five kinds of functions in computer graphics for television in NHK as follows:

- Graphics by personal computer
- Character Generation
- Drawing and painting for still pictures
- Two-dimensional (2-D) real-time animation
- Three-dimensional (3-D) animation

The computer graphics system for television can be classified by image generating functions and computers which are used in the system. This paper will describe the characteristics and applications of the practical computer graphics systems in NHK.

2-D Real-time Computer Animation System

The high-speed video signal generator and the mini-computer have realized real-time image generation. A standard NTSC color television signal can be taken out. This system, named CANVAS, has been developed for television production.

For election programs, this system is connected to another on-line host computer system, and displays graphs in real-time. It is also used for live weather programs, title animation of the usual television programs, explanatory and educational programs.

3-D Computer Graphics System for Animation

Three-dimensional computer animation makes one of the best uses of computer graphics. It is almost impossible to draw pictures for 3-D animation directly, so complicated bodies are described approximately, joined together with simple 3-D primitives such as polyhedra. More realistic and high-quality 3-D images are generated by using the model which is made of mathematical surfaces. The computer calculates algorithms according to given conditions of position, size and rotation of the model, and generates the 3-D images.

The image-generating abilities of the computer graphics system is determined by the ability of the host computer and graphics terminal, and the software for image generation. The cost of the computer graphics system becomes higher according to image capability and speed in drawing. In NHK, 3-D computer animation systems and effective techniques for television production are being developed.

Small-scale 3-D Graphics System

This system has been developed for broadcasting purposes so that the capacity of image generation is middle level, and the system configuration is simple. This system consists of a 16-bit microcomputer as a host computer and an intelligent graphics terminal based on an 8-bit computer.

The resolution of this system is 640*483(pixel), and a range of more than 16 million colors is available and a selectable 256 color range is available in a picture.

Many applications have been made using this system to satisfy various program needs, such as real 3-D graphics like simulations of physical phenomena, some parts of the illumination of musical shows, and 3-D title animations.

High-Definition 3-D Graphics System

This system has a 32-bit mini-computer as a host computer and a graphic controller base on a 16-bit computer. The resolution of the display is 1280*1024(pixel) with 256 colors in a picture. Calculation speed and software capacity of the host computer of this system and graphics generation speed are much higher than in the before-mentioned system. The NTSC television signal is taken out from the TV camera which shoots *RGB* monitor, and records by step-recording on a 1-in. Type C VTR.

This system is used now for production of the animation in TV special programs, which are the first in the world to use an image robot anchorperson. To create animation, the artist inputs image data to make key-frames, and then the computer interpolates each key-frame automatically.

The software which gives dynamic camera work typical in 3-D graphics has been developed in NHK. This animation is also combined with the other special effects images to refine the total image.

Conclusion

Computer graphics technology has expanded its sphere of expression more and more with technical progress, and its applications in the field of television production are increasing. Owing to the progress of hardware and software, better image processing and creation is becoming possible, and the graphic system in which the artist, who knows nothing about computer techniques, can operate easily, has been realized. In addition, the cost of computer graphics is expected to become lower and lower.

Under such circumstances, the need for computer graphics in the field of television production is increasing, and the computer graphics system will become indispensable equipment in a broadcasting station.

However, attention must be paid to the fact that there are many kinds of systems, so appropriate systems should be chosen from among these. The important know-how in post-production is that effective images are generated by a combination of graphics techniques and video processing techniques.

Technology in this field is making rapid progress and the needs of the times are changing every moment. It is important for us to obtain appropriate information continually, and to consider the effective introduction of the system.

69. Production Modeling Procedures Employing Dedicated Real-Time Hardware. *By Evan C. Ricks*, Robert Bosch Corp., Salt Lake City, Ut.

Interactive modeling of complex solids has always been difficult due to several factors, such as arduous digitization and inadequate visualization schemes. The author suggests several object construction methods which, together, require a minimum of non-real-time processing. The hardware used is a commercially available system utilizing bit-slice processors arranged into a pipeline. Central processing and pipeline control is afforded by an M68000 architecture. Most object construction is done with three programs; an interactive editor for polygonal surfaces of revolution, a boundary-oriented definition language known as RCL, and an interactive object integrator utilizing multiple viewports and various visualization aids. It is suggested that these, along with some other aids, constitute a minimal set of object construction methods for an environment such as television production and post-production where schedules are often very short. The dedicated hardware used is detailed as it pertains to the real-time modeling task.

70. New Slide Techniques for Computer Graphics and Television. *By R. Andrews and W. Gray*, Eastman Kodak Co., Rochester, N.Y.

This paper describes novel uses of the 2 × 2-in. slide in computer graphics and motion picture and television production, as well as in broadcast television. The paper discusses a systems approach to slide production that can be done in-house inexpensively for both simple broadcast and sophisticated graphic and text preparation. It describes ways to incorporate both artwork and computer graphics into slides capable of either projection or video transmission with techniques that are easily utilized by existing television and studio personnel.

71. Art Direction in Colorization. *By Wilson Markle*, Colorization Inc., Toronto, Ont., Canada

The introduction of Colorization as the process of reproducing black-and-white motion-picture material into a color television presentation was made at the 125th SMPTE Technical Conference in Los Angeles. This was published in the July 1984 *Journal* and outlines the technical aspects of the process along with a detailed description of the methods used to accomplish Colorization.

In this paper we will show how the art director performs the task of coloring a black-and-white motion picture that will be seen for the first time in color on television. With demonstration material from a black-and-white motion picture we will outline the step-by-step procedures of choosing the colors for the appropriate shapes. Many factors are involved, such as the original cinemaphotographic considerations for black and white and how they now influence the art director's decisions. The Colorization process generates most colors found in the NTSC system, but the art director is limited to choosing 4096 increments of hue and some saturation from the computer. The remaining saturation and all the luminance are obtained from the original black-and-white material. While this would seem to limit the available choices, the demonstration will show that there are more than enough variations to satisfy the viewer.

While it is impractical to examine in detail all of the implications of the Colorization art director's options, this paper will present an overview which will be the basis for an understanding of the process.

72. Computer Graphics and CBS Sports. *By Douglas E. Towey*, CBS Sports, New York, N.Y.

Relative to other techniques, the world of computer-generated graphics is very much in its infancy — at least to those of us on the production side of television. We at CBS Sports are rather proud of the fact that we have been in the vanguard in the use of this new tool. In fact, there are many who describe our on-air image, our "look," in terms that describe state-of-the-art technology. It might be interesting to examine how we have approached a graphic representation of sports on television, and how computer-generated graphics have become a part of that approach.

The most highly sophisticated production techniques on the air today are seen on a network sports program. Multiple instant replays, pictures from a camera inside a car travelling at 200 miles/h, dazzling digital video effects, camera angles that bring you as close to the quarterback as a lineman — you see them all live. With the caliber of the product that high, the challenge of producing the show's opening animation is no easy task.

From the very first moment we are on the air, we want our product to have a distinctive and appealing look. We want to capture in a show-opening the

excitement of the event, and the uniqueness of the CBS Sports presentation.

Our first effort in that regard relative to computer-generated pictures was the 1983 NBS World Championship Series opening. Designer Bill Feigenbaum and I sat down and went through the mental gyrations from which we determined what we thought to be the essential images of NBA Basketball. We then needed to translate these into three-dimensional terms. What we arrived at first was the realization that not all images translate into 3-D, and not all 3-D maneuvers correctly represented the image of CBS Sports. Especially important to me was the avoidance of 3-D for the sake of 3-D. "Cute" and "gimmick" became descriptions of anathemas. Then we faced the task of translating our specific views to those people who would interpret them into that bizarre world of CRTs and megabytes — in this case, the Computer Graphics Laboratory of the New York Institute of Technology.

Perhaps more than any other process I have ever experienced, the making of computer graphics requires what might be called a leadership circle. The producer, the designer, and the animators are all major contributors and major concession makers. I have my specific and unalterable demands which change immediately upon seeing new software developments. The designer must scrap his meticulous color scheme when it conflicts with broader CBS plans. The animators must deal with the most inflexible of all the elements — time.

It is this cruel monster that rules network television with an iron hand. We had an air date and it had to be met. We approached it like a screaming freight train. Somewhere in my nightmares was the image of a live network television special beginning with a black-and-white slide that said: Imagine you are watching a spectacular computer-generated opening... But we beat the clock, we met everyone's demands, and we were more than thrilled with the results. Indeed, the industry thought so much of the effort that it was awarded the Emmy for outstanding graphic achievement.

With each successive animation we do, we learn more about the computer, and it learns more about us. We have become somewhat more tolerant of the time it takes to complete a project, and our animators have begun to be more accepting of the vagaries that make a producer.

When we made our plans to produce openings for our coverage of Super Bowl XVIII, we wanted them to be more than spectacular. With over 100 million viewers, we wanted them to be better than anything anyone had ever seen before! (We like the idea of a challenge.) I think we succeeded.

"The NFL Today," our pre-game show, is a combination of sports information and entertainment. It is unique. Once again Bill Feigenbaum and New York Tech delivered. The opening combines a remarkable running football player with the elements that make up a television studio. We have now started to address acceptable human motion generated by the computer.

"Super Bowl XVIII" was one of the highest rated television shows in history. Paul Sidlo and Cranston Csuri Productions of Columbus joined us to provide a very special combination of footage from previous Super Bowls with spectacular animation that befits the enormity of the event.

Each of these projects is unique. Each sets a standard for the next, and each presents problems of its own. The animators are constantly being asked to deliver more "warmth" and less "robotics." We are constantly reminded that changes take time; that just because one can verbalize an idea does not imply that the idea can be created. The give-and-take of procedure is difficult, but rewarding. The creative process of television is like any other art form — there are ideas and there are tools. Sometimes the tools inspire the idea, sometimes the idea refines the tools. And so we learn.

73. VISA: Video Imaging Systems Area Utilizing Video Effects Devices at NBC. *By Eric Pohl*, NBC, New York, N.Y.

VISA (Video Imaging Systems Area) is a sharing facility that allows any of the centrally located video imaging devices to be accessed from multiple control locations. There are two rooms to this facility, an equipment area and an effects development area.

All of the shared effects devices are located in the equipment area. The room has its own redundant air conditioning system sufficient to handle the large cooling requirements. There is also a dedicated power conditioner, because many of the present and anticipated video imaging devices use hard disks as the storage medium. The routing system consists of serially controlled routing switchers which send the video and key signals to and from the chosen effects devices. There is also an RS-422 matrix to route control. In the final implementation, there will be a computer which accepts commands from the edit or control room as to which device is requested. The computer will then command the routers to switch all signal paths required for interfacing the particular device to the facility. Some possible future options for the control system are access and account codes for device selection and a tracking system to record device usage.

The effects development room is an area for training and programming of effects. It is a flexible work area consisting of cubicles created by movable partitions. Individual work spaces for various video imaging controllers can be set up as needed. These work spaces make the device accessible for effects development, even if the edit rooms are in use. This is especially important for complex devices such as the mirage, where effects development is time consuming. The work spaces can also be used for operator training and client familiarization.

The concept of the VISA facility came out of an examination of present and anticipated imaging device utilization.

Benefits of VISA

- Makes devices available for use independent of edit or control room.
- Simple procedure for device selection.
- Central location aids maintenance.
- Conditioned power and environmental control.
- The ability to put a device into service as soon as it is available.

This paper will describe the facility in detail, and discuss the design decisions including the interface to the edit rooms.

74. Omnimax Animation by Computer: Making Raster Omnimax Frames from Multiple Perspective Views. *By Ned Greene and Paul S. Heckbert*, New York Institute of Technology, Computer Graphics Lab, Old Westbury, N.Y.

In an Omnimax theater, film is

projected through a fisheye lens onto a hemispherical screen. Synthesizing Omnimax format digital images of a three-dimensional scene requires generating a fisheye projection of the scene, the geometry of which depends on well-known characteristics of the projection lens. This projection will be referred to as the Omnimax projection. The authors present a method for obtaining raster format Omnimax projections of three-dimensional scenes from multiple perspective views.

In computer graphics, by "rendering" we mean determining the color and intensity of each dot or "pixel" in the image on the basis of a geometric description of the scene, lighting information, etc. Normally, rendering programs perform a perspective transformation which simulates a pinhole camera: straight lines are transformed to straight lines and planes are transformed to planes. The Omnimax projection of a three-dimensional scene is a non-linear transformation that cannot be generated by standard rendering programs. Although some types of rendering programs can be readily modified to produce Omnimax projections (e.g., ray-tracing programs), in many cases this is very difficult to do.

As an alternative to modifying rendering programs to perform the Omnimax projection directly, a method is presented for creating an Omnimax projection from four standard perspective views. The perspective views required are the projections of the scene on four faces of a cube centered at the (virtual) camera — the front, left, right, and top faces. These projections are obtained by pointing the camera in the proper direction and rendering the scene with a 90° view angle.

These four "cubefaces" are then processed by a mapping program that distorts and filters them to make an Omnimax projection. Each pixel in the Omnimax projection corresponds to a ray through the projection lens which intersects the cube yielding a point on one of the cubefaces. The simplest approach is to read one pixel from the cubeface which is closest to this point of intersection and then write it to the Omnimax projection, but this "point sampling" approach causes aliasing. To minimize aliasing, an elliptical region of the cubeface centered at the ray intersection point is filtered (because of distortion, circular regions in the Omnimax frame correspond to approximately elliptical regions on the cube). A Gaussian-weighted average of the pixels inside the ellipse is computed incrementally. This filter requires more computation than a box filter, but performance is superior, resulting in a sharper picture.

This method requires writing only one program, the mapping program, and rendering software needn't be modified. The method is completely general in the sense that an Omnimax projection can be produced for any scene that can be rendered in perspective.

In response to a call for participation by Nelson Max of Lawrence Livermore Labs, about 20 individuals and groups from around the country contributed to a compilation of Omnimax format computer animation sponsored by ACM Siggraph called "The Magic Egg." Two of the animation sequences in the compilation were produced at the New York Institute of Technology Computer Graphics Lab using this technique. Cubefaces were rendered at a resolution of 1024 × 960 and Omnimax frames were generated at a resolution of 1966 × 1436, 24 bits/pixel. At this resolution the mapping program took about 1 h/frame on a VAX 11/780.

Audio Technology and Projection Practices

75. The Role of Computer-Assisted Post-Production in the New Era of Sound. *By Robert D. Predovich*, The Master's Workshop Corp., Toronto, Ont., Canada and *Andrew Staffer*, Yamaha Canada Music Ltd., Toronto, Ont., Canada

With the classic excuse, "It's only going to be heard on a small speaker!" audio for video has been historically neglected. This rationale is rapidly becoming invalid, as new high-fidelity stereo delivery systems bring the capability of excellent sound to the home consumer. To fully realize this potential, both creatively and technically, audio's new status must be echoed at the production level. This paper examines concepts and systems developed at The Master's Workshop Corp., Toronto, Canada, in the last few years in anticipation of these needs, and discusses new techniques for the future.

The concept of synchronizing a multi-track audio recorder with a videotape machine via SMPTE time code dates back a number of years. However, while the creative interaction of time code and computers was under intense development with regard to videotape editing, the lack of motivation for good sound quality and content has slowed the pace of development towards similar systems for audio. Firmly believing that the time had come for audio production for video and film to move from the 1950's to the 1980's, but lacking appropriate "off-the-shelf" technology and concepts, the decision was taken by Master's to internally develop the system's "palette" and artistic expertise to allow us to effectively "paint" a sound picture.

The design concept was to fully utilize the extra capability that computerized time code-based systems could add to the efficiency, quality and precision of the art, while still being receptive to sound scoring concepts of the past, especially tried and proven techniques developed over many years in the film industry. In fact, traditional practices such as Foley, Automatic Dialogue Replacement, music and sound effects editing, as well as final mixing were upheld in principle, but technologically and conceptually advanced. Furthermore, experience we had gained as a music recording/mixing studio would be used in conjunction with time-code based systems to complement music video production.

A proprietary software system specifically configured toward audio for video applications was developed for the IBM PC. Not only allowing rare flexibility in meeting our initial challenges, it has proven invaluable in its adaptability, as new production demands can be quickly turned into operating solutions. The computer functions as a control center for up to four machines, and supports the type of time-code manipulation and management systems available in the video editing world. The BTX Corp.'s "Shadow" synchronizer is utilized as an intelligent interface to the tape machines via RS 232 data ports. Hardware modifications to commercially available equipment were also undertaken to allow for efficient systems interfacing.

The system concept and technology have been used for over two years, and has provided high-quality stereo sound tracks for international drama, variety,

nature, and music programming, as well as cost-effective industrial and corporate productions. It has proven reliable and accommodating, and has been instrumental in upholding the company's reputation for quality.

Although the audio production systems described may be considered state-of-the-art, the authors feel they might be more appropriately called "state-of-the-archaic." Indeed, future systems will reflect a much greater involvement by computers in the overall concept. However, to realize the true potential that modern technology has to offer, systems design engineers cannot neglect to utilize, wherever possible, both the human and technical assets of the existing industry. The development of expensive control systems that are sophisticated, yet that cannot interface with current equipment and concepts, may well limit the products' immediate acceptance. The design must also reflect the fact that the quality that it produces varies directly with the human input. After all, what is a Steinway, with no one to play it?

To this end, The Masters's Workshop Corp. is presently developing a distributed intelligence hardware/software system that will uphold the work ethic established for decades in the video, audio, and film industries. The use of contemporary digitizing techniques will allow for instant audio/video lock, random audio access, and sophisticated editing and digital audio effects that can be realized regardless of the audio format source or storage medium. The system will readily accommodate current state-of-the-art technology in popular use, such as analog or digitally encoded audio, digital control of analog systems, and the recently developed Musical Instrument Digital Interface System, (MIDI). Throughout the entire system, SMPTE time code will evolve from its invaluable role as an electronic sprocket hole and address to a comprehensive index for this digitized information.

76. Automated Testing of Recording and Dubbing Equipment. *By Michael Drolet*, National Film Board of Canada, Montreal, Que., Canada.

The National Film Board of Canada (NFB) has recently updated its film-sound transfer and recording facilities with 12 recorders and more than 30 dubbers. A total of 250 channels must now be maintained within operational standards. The traditional method to verify a playback channel is labor-intensive and time-consuming.

To utilize the technicians' time and energy more efficiently, the Engineering Div. set out to automate the verification and simplify the record-keeping processes. Three critical aims for the system were:

Traceability

Earlier work by the Engineering Div. had provided a reliable method of evaluating the accuracy and consistency of commercially available test materials. Initially, it was felt that an automated system should make use of these commercial test tapes. However, since in addition to cost their major drawback was running time, it was considered that an automatically generated but shorter-running copy of the commercial film could be the basis for the new system.

Non-technical Implementation

The automated system needed to be designed in such a way as to allow operational personnel to perform the testing with confidence and minimal training, freeing engineering personnel to perform more critical technical work, such as the repair of defective tape machines. It was decided that the testing system could be operated by Machine Room personnel under guidance of a "menu" of instructions generated by the system controller. The hackneyed term "user-friendly" seems appropriate here.

Hard Copy

In order to maintain a long-term record of the status of each machine, it would be desirable for the system to generate hard-copy output of test results, with data such as date, machine identification, format, etc.

This paper describes the conception and realization of an automated audio-testing system which meets these criteria and has been in operation at the NFB for the past year. The system uses a Hewlett Packard HP85 computer to control an HP8903R Audio Analyzer. Commercial test tapes are used as a reference, the system can be operated by non-technical personnel, and it can evaluate one audio channel in 40 sec. Output can be in both tabular and graphical form.

77. SMPTE Time Code Applications of the Master Click Program. *By Shelton Leigh Palmer and James D. Kafadar*, Shelton Leigh Palmer & Co., Inc., New York, N.Y.

Now that finishing on tape has become a common practice, music producers and composers have had to develop techniques using SMPTE time code. To help the composer make the hundreds of calculations necessary for a post-score, the Master Click Program was written for the Apple II+ and IBM PC.

The Master Click Program is divided into eight modules that perform the various functions described below.

The first module is a data base of video "counts." The composer is given a videotape with time code. The program asks the user for a description of the event, (e.g. "John kisses Mary") and where the event occurs, using SMPTE code or any film format. The program stores this data, and if there are any changes in the video, the program updates all other counts as the editing progresses. The data is stored in a format that is completely compatible with every telecommunications program, so that information can be transmitted anywhere in the world.

Now that the information about the videotape is stored in the computer, the first question that must be answered is: "What click track should I use for my music?" The program tells the user how many events occur on a downbeat for any tempo range, using beats per minute, Urei metronome settings, or 500 ms clickperiods.

After the tempo has been selected from the previous module, the composer gets a printout of his input, with information on where each event occurs in Beats and user-selectable Measures. The printout also times the duration of each event.

At this stage, the composer often wants to hear the click against the video, to get a feel for the piece he is about to write. When the computer is wired into a console, the program has a metronome that allows the composer to hear the click track against the video.

Once the composer has performed the above steps, there is still other data needed for the project. For example, it is customary for a composer to carry a "click track book" when dealing with a post-score. The program can duplicate these books, using the exact beat number, and converting it to time, SMPTE code, and film counts. An-

other useful piece of information is knowing the note values of a particular tempo, so when a composer programs synthesizers, the absolute time of each note is known beforehand. The program outputs the time, SMPTE code, and Film Count for each whole note, half note, dotted half note, triplets, etc., for the tempo chosen.

If at this point the composer needs to make simple calculations, the computer can be used as a calculator. The computer uses labels generated earlier for each event ("AA" for the first event, "AB" for the second event, etc.). The calculator uses these labels to save time in input, and the composer can calculate offsets, or durations between various events stored in computer memory.

Since many editors are still uncomfortable with SMPTE time code, the program can convert all data into any format, from 70mm film to Super-8.

The writing of the Master Click Program has opened the door to a new era in SMPTE-based music production. When these algorithms are incorporated into a computer-controlled music synthesizer, there will be virually no technical limitations to audio synchronization.

78. Synchrotone: A World Standard. *By Georges E. Quellet*, Stellavox, Hauterive, Switzerland

Sounds (or other signals) were recorded in the past as a simple mono track, either on ¼-in. tape or on perfo-tape, and later as two or many parallel tracks for stereo or multichannel applications. Then came the need for a cue track allowing any magnetization up to a time code, with the lowest crosstalk.

Stellavox designed the configuration of such a track 15 years ago, which configuration is the international standard of today. Figures and applications will be shown.

79. The Academy's New State-of-the-Art Loudspeaker System. *By John Eargle*, JBL Inc., Northridge, Calif., *John Bonner*, Warner Hollywood Studios, Hollywood, Calif., and *Daniel Ross*, AMPAS, Beverly Hills, Calif.

During April 1984, a new multichannel loudspeaker system was installed in the Samuel Goldwyn Theater of the Academy of Motion Picture Arts and Sciences (AMPAS). The design aim was to provide sufficient acoustical power bandwidth to handle the demands of current and future six-channel films. For our discussion, we will consider the three sections of the system: the five channels behind the screen, the surround system, and the sub-woofer system.

The Goldwyn Theater was built in the mid-70's and Gordon E. Sawyer and Paul Veneklasen were responsible for the acoustic design of the space. The theater seats 1100, and the volume of the space is approximately 5660 m^3 (200,000 ft^3). Reverberation time in the mid-frequency band is about 0.5 sec. Under these conditions, the direct sound field predominates over most of the room. The benefits of this are excellent speech articulation and accurate reproduction of the intended multi-channel sound field. The price paid for this is increased electrical power input to the loudspeakers for a given acoustical level in the room.

The five behind-the-screen systems are built into a wall that is 16.5 m (55 ft) wide and 2.4 m (8 ft) high. These systems are biamplified, with a crossover frequency of 500 Hz. The low-frequency (LF) portion of the system consists of four 380mm (15-in.) transducers, each pair mounted in 225-liter (8 ft^3) enclosures tuned to 40 Hz. The high-frequency (HF) portion of the system is handled by a 90° × 40° constant coverage horn powered by a compression driver with a 100mm (4-in.) titanium diaphragm. The combination of these LF and HF devices results in smooth pattern control, and when equalized for flat power response, the on- and off-axis pressure response is quite uniform. Flat power response is in fact the prime design goal, inasmuch as it ensures that both direct and reflected sound reaching the listener will be relatively flat with respect to frequency.

The electrical power input to a single screen loudspeaker required to reach a reference level of 85 dB-SPL two-thirds of the way back in the house is 5.0 W for the LF section and 0.5 W for the HF section. Electrical and acoustical power reserve is sufficient to provide peak levels in the house of 110 dB, driving all five screen loudspeakers. Each of the five screen loudspeakers provides quite uniform response throughout the house, and component orientation was determined using JBL's Central Array Design Program (see *SMPTE Journal*, August 1984).

System measurements with and without the screen in place detail on- and off-axis behavior of the HF elements to a degree not previously discussed in the literature.

The surround system consists of 12 two-way loudspeakers. Each consists of a single 380mm (15-in.) LF transducer crossing over into a small constant directivity 90° × 40° horn powered by an HF compression driver with a 100mm (4-in.) titanium diaphragm.

Four of the surround loudspeakers are mounted across the back wall. Each side wall contains a pair, and an additional pair on each side are flown from ceiling girders and are positioned between the reflective clouds which hang from the ceiling. The intention is to create as diffuse a sound field as possible so that listeners do not localize sound sources at any one of the loudspeakers.

Wire pairs for the surround loudspeakers are individually run back to the booth so that the ensemble of loudspeakers can be reconfigured for future demands. Rarely has such a massive array of surround loudspeakers been specified for a motion-picture theater.

The sub-woofer array consists of eight 460mm (18-in.) LF transducers mounted in 225-liter (8 ft^3) enclosures. The array is placed below the center screen loudspeaker at the intersection of the floor and back wall. While each system is individually tuned to 30 Hz, the ensemble of eight units exhibits a collective resonance about one-half octave lower. Because of mutual coupling effects between the transducers, the efficiency of the sub-woofer array is on the order of 16%. Levels in excess of 115 dB-SPL can be produced in the 20–40 Hz octave.

Comprehensive system measurements have been made, and performance data will be presented.

80. The Design of Audience Spaces with Predetermined Visibility Performance. *By Mert Cramer*, Computer Graphics Laboratory, University of Waterloo, Waterloo, Ontario, Canada

In the past, the designer of a theater had only "rule of thumb" recommendations culled from the literature as a guide to the proper design of audience seating. It is now possible to provide the planner with a quantitative "figure of merit" (probability of viewing) for

a proposed design. The "viewing criterion" is defined as being able to view a specified critical point on the stage with a defined probability. Using the anthropometric data for seated adults, and a probabilistic model, the floor heights of the rows can be calculated.

This new technique produces a set of row elevations which meet the criterion with the figure of merit. Thus, a designer can "tune" the shape of the room to meet size constraints or to favor some part of the audience by establishing a contour with a selected probability of viewing for each seat, or by adjusting the viewing probability for each row or group of rows. Validation of the resulting floor contours was supplied by use of a Monte Carlo simulation of the audience.

81. A Practical Way to Expand the Audio Capacity of Videodiscs. *By George C. Treneer*, EECO Inc., Santa Ana, Calif.

The ability of the videodisc to store up to 54,000 quality still-frames of video, and to replay any one under random access interactive control, has always held tremendous potential for training and simulation, point of purchase merchandising, and information publishing applications. The missing element has been the ability to accompany each still picture with enough sound of sufficient quality to enhance the visual presentation without greatly reducing the picture store capacity of the videodisc.

Still-frame audio provides the missing element. It allows videodisc programs to be prepared with as much audio as desired while retaining more than ample capacity for still or motion pictures. Typical applications include voice, music, and sound effects in combination with still-frame and full-motion video images. Still-frame audio is of greatest value to courseware developers whenever interactive video programs require many still-frame pictures with audio captions, with the added advantage of having all the program content, audio and pictures on one medium.

The EECO EECODER™ system offers the ability to record virtually unlimited amounts of audio on videodisks and also makes it possible to use the same video program in multiple languages without repeating the pictures. The amount of still-frame audio can be varied to match the requirements of each still picture — from 1 sec to 40 sec using the EECODER system. EECODER Still-Frame Audio offers the user flexibility, simplicity, and economy during both production and playback as compared to alternative still-frame audio methods.

This paper describes the process of producing and playing back still-frame audio using the EECODER Still-Frame System and its effect on vidcodisc applications.

Graphics and Digital Techniques II

82. Mirage — The Production of an Illusion. *By Richard J. Taylor*, Quantel Ltd., Newbury, Berkshire, England

Mirage represents a major step forward in technology and capability to give an operator complete freedom over his effects.

This paper gives a background to Mirage, describes its structure, and introduces the concept of Floating Viewpoint Control. This control mechanism permits an operator, in real time, to move in three-dimensional space around and inside a three-dimensional shape with stunning results. The impact of this control mechanism on other effects machines and their interaction with Mirage is also discussed.

83. Singular Value Decomposition of an Image. *By Wang Tsung-hai*, Dept. of Radio-Electronics, Shanghai University of Science and Technology, Shanghai, China

In digital image processing, due to the vast quantity of image data, it is necessary to elevate the speed of processing. In addition to constructing high-speed hardware, different fast algorithms were being developed. For this reason, appropriate mathematical representations or mathematical models for the given image are of great importance, since they will influence directly the complexity, and even the feasibility, of the algorithm.

The singular value decomposition (SVD) expression for an image presented in this tutorial, from the viewpoint of energy packaging or condensation, is the best form of orthogonal expansion of an image. By choosing appropriate orthogonal basis vectors, we may express the image matrix $[F]$ with dimensionality $N \times N$ by a summation with fewer finite, say R, terms of eigenimages instead of the usual orthogonal expansion of an image $[F]$, in which $N \times N$ terms of eigenimages were needed to express the original image.

This tutorial covers some of the fundamental and applied aspects of singular value decomposition expression of an image. It is intended for engineers and technical managers who need to familiarize themselves with different aspects of the emerging digital image processing techniques.

To facilitate the comprehension of the essence of singular value decomposition expression, we started from fundamental concepts and derived the conclusions step by step along with some interpretations of physical ideas. Finally the potentialities and difficulties of practical applications were discussed.

84. Adaptive Image Histogram Modification by TV Technique. *By Zhang Wen-long and Wang Tsung-hai*, Department of Radio-Electronics, Shanghai University of Science and Technology, Shanghai, China

Histogram modification is an enchanting and effective technique in enhancing the quality of an image. In image processing such artifice was usually implemented by digital methods. But in some cases, such as quality control by TV camera over a production conveyor belt, where only rough sorting is needed but not the accurate specification of the products, difficulties arise when the processing is wanted in real time.

The motivation of our work was to design an image histogram modification facility that could meet the requirement of real time processing. The facility proposed in this paper shows that an adaptive image histogram modification by analog method is feasible and pragmatic.

The idea of image histogram modification may be described briefly as follows. In fact, histogram modification is one kind of point operation, by which each pixel's gray level of the processed image depends solely on the gray level of the corresponding input pixel. In other words, histogram modification does not change the spatial relations within an image. Mathematically speaking and com-

bined with physical concept, image histogram is a function reflecting the relation of probability density of the occurrence of pixels with certain gray level against that gray level. In order to transform a given image with condensed gray level into an image with flat histogram, it can be shown that the transformation function should be a cumulative distribution function of the gray level. But the crux of the matter is how to realize such transformation by analog method. The scheme of circuit design is introduced as follows.

The facility we designed includes three main parts, i.e., the processing channel, the adaptive bias forming circuits, and circuits for providing auxillary signals. The principal parts of the processing channel were the image histogram shifting and expanding circuit (HSEC), and the histogram equalization circuit (HEC). The function of the HSEC was to shift the gray level with maximum probability density to a position with half the maximum gray level and expand a prior histogram into one with a broader gray level range, in order to facilitate the succeeding processing. The function of HEC was to set up a transformation characteristic that is self-adaptive to the output of HSEC.

In order to accommodate various image inputs, we must furnish HSEC and HEC with biases that should be self-adaptive to the input image. To meet this requirement, the input signal was processed successively by quantizing circuit, integration, and peak holding circuits, and then sent to the corresponding adaptive bias forming circuits from which their outputs were led to HSEC and HEC respectively.

The auxiliary channel includes synchronizing signal separation and clamping pulse-forming circuits. There was also a field synchronizing pulse integration-delay circuit which guaranteed the statistics of image histogram corresponding to each TV frame.

Based on the above scheme of circuit design, but with a little modification, some manual controls could be attached to the facility so that it could work in an interactive manner, i.e., meet the requirement of histogram specification.

The main circuit configuration used in the facility were differential amplifiers. It made good use of the potentiality of differential amplifiers, which may be used repeatedly. The circuits could thus be integrated easily or integration circuits may be used extensively.

J. C. Wary delivering his paper.

Experimental Results

One of the most attractive functions of image histogram modification was to reform an image that was poor, and difficult to be recognized by the human eye, into an easier one.

After analyzing our experimental data and comparing the photographic results with those of other authors who are dealing with digital methods, the experiments illustrate that our facility is reasonable in design and effective in practice.

Comments and Conclusions

Although our design is still a prototype, it is stable and reliable. As compared with digital facilities, it reveals some strong points such as real-time processing, simplicity in manufacture, low cost, managing ease, etc. In addition, the accuracy of processing is comparable with that obtained by microcomputer. The definition and fidelity of the image do not depend on our facility but on the performance of the TV system we are using. As is the case in computer methods, the quality of processing is dependent on the performance of the hardware.

85. Cost-Effective Digital Video Products — A Low Price May Not Be Enough. *By Phil Bennett*, Abekas Video Systems, Inc., Foster City, Calif.

Manufacturers of digital video products have several choices to make as available technology improves. One possibility is the advancement of sophisticated, expensive systems. Typically these have been post-production oriented special effects and graphics systems of increasing power.

We at Abekas chose an alternative philosophy: products that are less expensive than their predecessors but offer better picture quality, more features, and very user-friendly control systems. We are fortunate that continuing dramatic improvement in all areas of semiconductor and mass storage technology overcome product cost-performance limitations. Lower-priced components in established system architectures do not, however, meet our objectives. A careful evaluation of product application was required to give users maximum value for their money.

The overall cost of a product is defined by factors other than the number of components. A powerful yet simple-to-use control system can produce large savings in time spent operating the unit. Elimination of specially selected components and critical adjustments produces obvious savings for manufacturer and user alike. Poor cooling and critical system timing requirements can complicate operation

compared with "black box" units. A very important factor is long-term utility. Clearly an approach that remains useful over its full design life will be more successful than one which becomes rapidly obsolete. We feel picture quality is the key in all digital video products. Image degradation will stay with video all the way to the receiver, and successive product generations will offer significantly smaller impairment footprints as key areas of technology improve.

In special effects, we have engineered a system to exploit such improvements. Our configuration offers near-perfect picture quality for the range of effects and features most in demand. The quality of the images and power of the control will guard against premature obsolescence. Special effects system design may be divided into two main problem areas: image processing and control system. These are quite separate, though connected by the address generation system.

The image processing problems broadly relate to clean decoding of the composite signal, filtering and interpolating, storage, then encoding back to composite. There is a choice between digital and analog for most of these operations. We chose the maximally digital approach as optimal. The desire for excellent quality, ease of manufacture, and minimum adjustments combines with rapidly falling LSI component costs. The incoming composite signal is digitized and converted to 4:2:2 components using an all-digital adaptive comb filter. This eliminates expensive quartz delay lines and critical analog adjustments, while improving picture quality.

Filtering and interpolation are combined using digital finite impulse response (FIR) filters, which are well suited to image processing. These condense much circuitry and reduce digital rounding noise over filter-interpolate or hybrid analog-digital approaches. The extensive use of cheaper LSI digital multiple elements meets cost objectives for the interpolation system.

The frame storage system makes use of second generation fast 64K dynamic RAMs. These allow a complete 4:2:2 framestore on one circuit card. This could not meet our overall requirements for the system. The memory control/RAM interface becomes very time-critical with these new components leading to store crashes at marginal voltages and temperatures, especially in extender board operation. The solution is clearly to simplify memory timing and addressing circuitry to the point where it may be combined with the memory as one module.

The final element is the digital conversion to composite video. Here the chroma signal must be carefully band-limited to avoid spurious spectral components after sub-carrier modulation. As with analog coders these would otherwise result in excessive "dot drawl" on vertical chroma edges.

Address generation is the bridge between the fast digital video processing system and the software-based control system. This has traditionally been a complex and critical area in special effects systems, often forcing compromise in processing and control to meet cost objectives. We use an extremely fast bipolar processor to eliminate traditional multi-card addressing schemes. This permits all address generation functions to occupy the same circuit board as the multiprocessor based control system. Microprogramming of the bipolar processor permits 32-bit address generation accuracy while allowing more flexibility for enhancement than hardwired approaches.

Our approach to the control system is to specialize functions on a processor-by-processor basis. Three MOS CPUs, two with arithmetic enhancements, are used to feed the bipolar processor. The configuration is somewhat unexpected in view of the cost objectives. A single larger processor might at first sight appear cheaper. The time-critical nature of the picture manipulation calculations does not, however, combine well with the requirements for human interface and machine control. This becomes even more of a problem given the desire to use a high-level programming language to simplify development and maintenance. The control panel is crucial; in a special effects system a compact, reliable user-friendly module is essential. For the control panel we have made component cost secondary. The indirect user-cost savings, through reliable, precise controls and a compact, built-in display, combined with powerful software, are deemed more important.

The design establishes new cost-performance levels which will set a standard for future systems. The trend is for a particular level of picture quality and control sophistication to become standard. Attempts to further reduce cost without improved component technology degrade performance below the norm, leading to poor user acceptance.

86. Picture Processing for the 4:2:2 Digital Video Tape Recorder. *By T. Eguchi, K. Tatsuzawa, J. G. S. Ive, and J. H. Wilkinson,* Sony Corp., Teaneck, N.J.

Digital videotape recording has been the subject of research studies for the past ten years or more. There are definite signs that the experimental work has now achieved a mature enough stage for specific format parameters to be defined. The final product will be a complex combination of mechanical, magnetic recording and digital signal processing technologies offering performance levels well in advance of any existing analog systems. In particular the wideband component coded signal and multigeneration performance extending to many tens of generations will not only noticeably improve the picture quality, but also enhance post-production flexibility.

This paper analyzes the results of more than five generations of experimental hardware in terms of the fundamental tape format parameters and the picture processing required to achieve optimum performance from those parameters. Consensus exists amongst most researchers on the major elements of the track dimensions; the next issue to be decided is the recorded data structure. It is therefore appropriate to converge thinking on the following items: channel coding, data block structures, error protection, and audio recording. Practical experience and theoretical analysis are combined to explain the advantages and disadvantages of various approaches.

Clearly it is the intention of all participants in the various standardization committees to achieve agreement on the major digital videotape recorder format parameters before irreversible commitments are made by manufacturers. This initiative is most welcome, and it is hoped that a free exchange of views and experimental data will increase the chances of success in what is an extremely short time scale.

87. Color Correction Techniques — Analog and Digital. *By David E.*

Acker, FOR-A Corp., W. Newton, Mass.

The need to correct or change the color content of television pictures, after encoding, has existed since the first color television broadcast. Before color correction techniques became available in hardware, the only opportunity was in setting the black-and-white balance of the camera.

Color correction systems allow the operator to change the hue quality of the picture to compensate for several conditions that may have existed when the program originated. These include re-balancing of black and white levels, changing the gamma characteristic, compensating for lighting conditions, and even modifying the overall scene colorimetry to create a particular mood for the viewer. Further, the hue in the pictures from different cameras can be matched to present a more color-consistent and pleasing program to the viewer as well as match the colorimetry between VTR, camera, and film chain sources.

The basic theory used in many color correctors is based on control of *RGB* signals that have been generated within the system by separation of the encoded input video signal into components. The *RGB* signals are processed to permit control of gain and black level as well as the gamma characteristic. The separation and reconstruction of the signal, as well as the processing steps within the system, must be done very accurately to maintain highest signal quality with minimum added distortion. Whether an analog or a digital implementation is used, these considerations are the same.

Analog systems and hardware existed before digital ones for obvious reasons. With the advent of lower cost digital IC building blocks, it has become practical to use digital techniques to achieve the same basic results.

This paper will present the theory of operation for a color corrector system and a detailed implementation for both an analog and a digital approach will be discussed.

The analog approach processes the incoming video to generate *RGB* signals which are operated on to create a "correction signal" which is added to the main signal path.

The digital approach separates the input analog signal into components which are digitally encoded and further operated on in the digital domain to effect the desired color correction. The digital signals are then converted back to component analog, and added together to reconstruct the encoded analog video output.

A specification for both will be presented and a comparison of the practical aspects of analog and digital systems will be made.

88. Integrating Computer Animation Into the Realm of Videotape. *By Charles D. Heuer*, Modern Telecommunications Inc., New York, N.Y.

Until recently, the general state of the art in computer animation has been embodied in systems that are less than optimum for direct high-quality television output. Television graphics, on the other hand, have been functioning in a narrow, albeit gradually expanding, corner in the known universe of computer graphics. Recent developments have substantially extended the evolutionary convergence of the television and computer graphics mainstreams.

The application of these developments within the larger domain of television production and post-production has provided the opportunity to define new picture-making facilities, presenting unique opportunities and problems in television systems analysis, design, implementation, and operations integration.

Computer hardware and software systems of a wide variety have been employed for the production of animated pictures over the past quarter-century. A review of the nature and applications of a selection of these systems provides the conceptual framework for evaluating and selecting those technologies and techniques which are best suited for integration into the existing videotape production/post-production environment. The developments traced and commented on cover techniques used for both 2-D and 3-D animation, including early analog and hybrid approaches, run length encoding, framebuffer-oriented systems, real-time texture mappers, and polygon-oriented systems.

The interactive creative plasticity possible with electronic image synthesis and the real-time immediacy of videotape are cornerstone concepts explored in terms of their impact on systems architecture and usage considerations. Some of the pitfalls in realizing the promise of computer animation in practical, viable systems are reviewed.

The hardware and software requirements of computer graphics systems intended for integration in high-quality video facilities are considered both from the engineering and operations viewpoints. Engineering issues covered include video image quality in terms of spatial, temporal, and color resolution, aliasing and compositing considerations. The points of both commonality and divergence between the requirements of good television and the general marketplace for sophisticated computer graphics are explored. Operational concerns involving both the operator/artist/animator and the business interface are considered.

A specific recent implementation addressing the goals and concepts presented in this paper is described, and samples of the animations it has produced are shown.

Future Trends in Image Technology — Photographic and Electronic I

89. The Producer's Guide to Special Visual Effects Production. *By Percy Angress*, Apogee, Inc., Van Nuys, Calif.

This paper outlines the process by which a script is analyzed and budgeted for special effects. The script breakdown process is described, along with factors considered when choosing between alternate shooting techniques such as bluescreen and front projection. Matters bearing upon production costs are described, and certain cost controlling measures are suggested. The subsequent processes of storyboarding, scheduling, shot coordinating, and cost tracking are presented, along with a general description of the workings of each effects department. A sample production schedule is laid out, and a production history of several real shots is given.

Finally, the paper discusses the effect of changes in special-effects technology (including computer-generated imagery) upon the budgets, production schedules, and imagery of future science fiction films.

90. Front Projection and Tessellating the Screen. *By Jonathan Erland*, Apogee, Inc., Van Nuys, Calif.

This paper explores front projection as a method of motion-picture compositing, with particular reference to the problems encountered in constructing screens of Scotchlite material. The history of the front projection process is outlined and some of the more unusual techniques are discussed, including a reverse front projection approach.

In the fabrication of a retro-reflective front projection screen for motion-picture composite photography, the variations inherent in the manufactured screen material are diminished by homogenizing. This is accomplished by dividing the stock material into small, symmetrical pieces or tiles, and thereafter tessellating (or tiling) a substrate plane. The shape of the tile is designed to reduce to a minimum the number of conjoined segments and to entirely eliminate straight lines, thus diminishing the evidence of the mosaic pattern.

Developed in the late 1940's, principally for sign and highway marker applications, Scotchlite has since found extensive applications in the motion-picture business. Some of the more novel and sophisticated techniques have permitted Superman to fly and Hitler to stroll through the Reichstag 40 years after it was destroyed.

The usefulness and versatility of the material can be better appreciated if it is regarded, not as a projection screen material, but instead as an optical element, rather like a lens or a reflecting collector. This view can lead to other applications for the material such as that introduced here, in which the material is required to perform the function of a consenser far too large to have been constructed in the conventional way.

91. Blue Max High-Power Luminous Flux Projector for Large-Scale Bluescreen Composite Photography. *By Jonathan Erland*, Apogee, Inc., Van Nuys, Calif.

In the seven years that have elapsed since the release of the motion picture *Star Wars*, the compositing technique known as "bluescreen" has enjoyed a phenomenal growth. Greater sophistication in the application of this technique has, in turn, led to greater demand for it. One of those demands, heretofore difficult to meet, has now been satisfied: bluescreen on a large scale — 50 ft × 150 ft or larger.

Until just recently, bluescreen size was limited, for all practicable purposes, to 40 ft × 90 ft, this being the maximum size that Stewart Filmscreen, the only seamless transmission bluescreen filter manufacturer, could provide. The requirements of recent productions, notably *Dune*, have called for screens considerably larger than that. To obtain these large screen sizes, it was found necessary to resort to front projection.

Front projection bluescreen was probably first done by L. B. Abbott on the motion picture *Tora! Tora! Tora!*. Abbott also noted a serendipitous benefit of great importance obtained by this method of carrying out the bluescreen process: blue spill, the bane of bluescreen compositing, is largely eliminated by virtue of the fact that the projected blue light is of necessity a coherent beam, and this is further enhanced by the retro-reflective screen's faculty for returning the beam strictly along its own axis. Therefore, there is essentially no scattered blue light remaining to fall upon foreground subject matter from whence it would be reflected back to the camera with the consequent degradation of the matte image. A problem that confronted Abbott, and subsequent practitioners of this technique, is that the white light source lamps commonly used for front projection of full color plates are relatively deficient in the blue region of the spectrum, requiring the use of very large wattages and commensurately large lamphouses, with the resulting severe inhibition of camera flexibility.

The obvious solution was to design a dedicated luminous flux projector capable of producing the pure spectral lines needed for color difference matte compositing. Though not often called for, it is desirable to be able to switch from bluescreen to greenscreen or redscreen. A study of the emission lines of various gas discharge lamps, when compared to the spectral sensitivity curves of Eastman 5247 color film, revealed that a mercury-xenon lamp was virtually ideal for the purpose. It then remained to design the filters that would isolate the required spectral line in the most efficient manner possible. Abbott had resorted to a liquid cell approach in order to avoid having his gelatin filters burn up. We turned to dichroic coatings, both reflective and transmissive, to reduce the losses experienced with the absorptive filters that Abbott had used.

Two more major problems remained: how to effectively dispose of the "spent" light (that is, the light that has passed through the 50/50 beamsplitter); and how to eliminate the necessity to light the foreground scene one whole stop hotter than the camera required in order to overcome the one stop loss at the 50/50 beamsplitter. The first of these problems was dealt with by reflecting the spent beam off a smoked glass surface at 45° onto a black velvet surface, the second, by the ingenious design of a 50/50 beamsplitter effective only at the spectral region used for matting, so that light from the rest of the spectrum passed unhindered through the glass. In essence, the new beamsplitter comprises a narrow band 50/50 interference filter for the selected wavelength.

In summary, what we have produced is an efficient, sophisticated, dedicated luminous flux projector for color difference compositing, providing greater versatility and convenience than has previously existed, and on a scale heretofore unavailable. Blue Max has not had an idle moment, having worked on three major feature films: *Dune*, *2010 — Space Odyssey* and *Life Force*. Ongoing development of the Blue Max is aimed at increasing its efficiency as well as reducing still further both the size and weight of the unit.

92. Motion Control: The History, Current State of the Art, and Future of this Electronic Black Magic. *By Paul Johnson*, Apogee, Inc., Van Nuys, Calif.

"Motion Control" is a general term which covers a wide variety of processes and techniques in use today throughout the motion picture industry. Fundamentally, it is a branch of robotics. Specifically, it involves moving cameras, projectors, and/or models in precise synchronization with the camera shutter to produce the illusion of reality for objects which could never be created or manipulated at full scale. The motion control systems of today typically employ computers and/or microprocessors combined with custom electronics, motor drivers, and the necessary mechanical system.

The key requirement for a motion control system is repeatability. Due to the need for multiple photographic passes on a given model to encompass such techniques as Bluescreen, Ulta-

matte, Reverse Bluescreen, Rear and Front Projection and Stop Motion Animation, it is essential that the motion control system be able to reproduce the same move hundreds of times at varying speeds in perfect registration. Of equal importance is the methodology employed to program a move into the system.

The author is head of software development at Apogee Inc., a special effects studio in Van Nuys, Calif., and a general partner in Motion Systems, an electronics/software design firm servicing the motion picture industry. The author was the first person to apply computers to motion control in conjunction with Apogee for *Star Trek: The Motion Picture* in 1979. This paper will cover the history and state of the art of motion control and look at what might lie ahead in this rapidly growing field.

93. EBU Activity in Developing Specifications for Film and Television Camera Lenses. *By Max Rotthaler*, Institut für Rundfunktechnik, Munich, F.R. of Germany

The technical quality of a transmitted television picture is dependent on several factors, of which the quality of the lens of the camera is of considerable importance. A complete objective assessment of the optical and mechanical performance of a lens demands the measurement and evaluation of a large number of different parameters. The results of such tests, however, are critically dependent on the test methods and conditions employed. In order to enable inter-comparisons of the results obtained with different types of lens testing instruments, uniform measuring conditions have to be specified which take into account all the factors that may influence the measurements.

In 1980 the Steering Committee of EBU Working Party G decided to charge a small Specialist Group (G/LENSES) with the examination of appropriate methods for measuring the characteristics of film and television camera lenses. The preparation of standardized specifications on the level of the EBU should facilitate the contacts with the lens manufacturers. Furthermore the Group should study the possibilities for using synthetic parameters such as indices which would express the combined effect of several characteristics or the performance of a lens in comparison to a reference lens.

First of all, inquiry was conducted on the facilities which already exist among members of the Broadcasting Union for carrying out measurements of lens characteristics and to find out the exact requirements concerning lens quality in operational practice. From the replies it could be deduced that all organizations carry out fairly extensive optical measurements. The wide variety of equipment in use indicated that the test procedures followed are equally varied, and the establishment of standard test procedures so that results can be directly compared would be of value. Much of the equipment in use could be adapted to meet new test procedures simply by a change of test slides or filters, etc.

In the next step, a document was drafted indicating the major optical and mechanical specifications for film and television camera lenses. These are mainly based on relevant broadcasting specifications that have proved to be useful in operational practice in the past. Apart from giving definitions and descriptions of all important lens parameters the main sections deal with standard measuring conditions for each single parameter. This takes into account that the performance of a lens must be determined under conditions that duplicate, as far as possible, the intended use of the lens under test. As a consequence, specific measuring conditions for certain parameters of film and television camera lenses were defined separately. Wherever possible the EBU specifications are kept within existing ISO standards.

When describing the optical and mechanical performance of a lens by objective means, it is useful to reduce the number of measurements taken to a minimum, but still be able to get the essential information. In the draft document, proposals are made for a suitable presentation of the measured parameters, which are obtained for the different applications of lenses in television. It is recommended to present these data preferably in the form of graphs, as these enable an easy survey and quick inter-comparisons of data from different sources. For each single parameter specified in the document appropriate equipment is described which is now available and can be recommmended (partly after minor modifications) for measuring the optical performance of lenses under these standard test conditions.

Part II of the EBU document, "Specifications for Film and Television Camera Lenses," is intended to recommend for each lens parameter specified in Part I the minimum values which should be aimed at in acceptance testing.

94. Future Applications of Electronic Technology. *By Paul D. Mareth*, Consultant, Jersey City, N.J.

95. Vertical Interval Encoding for the Recordable Laser Video Disc. *By Don Hayes*, Optical Disc Corp., Cerritos, Calif.

Lincoln L. Endelman, an author, presenting his paper.

The introduction of the recordable laser video disc has brought the full process of video disc technology into the user's hands. Along with the playback power of fast access on low cost players, he can now record the disc in his own facility in real time. The burden of properly formatting and encoding the material for disc is now in-house. A brief description of the LaserVision video disc is presented along with that of an encoder/generator that encodes the vertical interval to the IEC specifications in the LaserVision standard.

The laser video disc was introduced to the public in 1978 as a means for distributing recorded entertainment to be played on a low-cost player. The player/disc combination had unique features such as stop motion, fast search, and high fidelity audio and video. It soon became apparent that these capabilities could be exploited by combining a smart player with computer control and a disc to yield a highly interactive system. As the disc quality has improved throughout the years, so have player capabilities increased. Applications have expanded to include learning centers, sales aids, video games, document storage, and catalogs. The introduction of the ODC recordable laser video disc has added film and video editing to this list. Since the ODC recorder and disc yield a disc that is fully compatible with the existing LaserVision standard and is playable on the large population of players now in service, a brief discussion of standard disc parameters is given.

The disc contains a spiral track of information that starts at the inner radius and continues to the outer radius. With a track pitch of about 1.6 μ and the disc spinning at a constant angular velocity of 1800 rpm, a 12-in. diameter disc contains about 30 min of material or approximately 54,000 video frames. Although there is a means for encoding at a constant linear velocity that increases playing time to 60 min, it does not exploit the capabilities of stop motion and frame accuracy and will not be discussed here.

Pivotal to the player's ability to properly handle the disc is the coding inserted in the vertical interval of the recorded video. This encoding contains information that defines the beginning of the disc (Lead In), the end of the disc (Lead Out), subsections of the program area (Chapter Numbers), and individual frame numbers. Since both film and video editing require frame accuracy, it is imperative that the vertical interval encoding process be equally as accurate. In addition, it must be flexible enough to fulfill the variety of requirements of individual post-production environments.

The ODC encoder/generator was designed to fully encode the video signal from a telecine, VTR, or any other video source. The unit can be operated from the front panel, remotely, or from a terminal. When controlled by the terminal, a list of SMPTE time-code action points can be created which will carry out designated actions at the corresponding time code. Pulldown (or first field of picture) information can be driven from an external input or derived from SMPTE time code and inserted as a SMPTE action point. Once an action point table exists, the SMPTE code may be initiated at any point and the encoding will be in sync with the video within one second.

Besides controlling all the LaserVision vertical interval states and pulldown types, SMPTE action points can be utilized to control test signal generation, external input data, and eight independent parallel output signals. In an effort to enhance the interface with a user's system, two serial ports exist to communicate with the encoder software. One is intended for the stand alone terminal and the other is for a remote computer.

The ODC encoder/generator is intended to be flexible enough to fit a variety of post-production environments: front panel control for the simplest of systems, remote control for the already computer controlled facility, and terminal control for the SMPTE time-code based system. When the recordable laser video disc is used as a tool in a larger process, the disc should enhance rather than impede the process. The ODC encoder/generator makes efficient and accurate encoding possible so that the disc user can get on to the task at hand: the creative process of editing.

Television Systems and Broadcast Technology

96. A New Concept for the Multiple Events Record and Playback System. *By Koichi Sadashige*, Matsushita Electric Corp. of America, Secaucus, N.J.

The advent of broadcast quality VTRs using a compact video deck system and $\frac{1}{2}$-in. cassette tape offers a totally new approach to the design of multiple events program transmission system, or the "Cart Machine."

The concept, operational philosophy, and design principles of the new-generation automatic program transmission system MVP-100 will be discussed.

This system has an unparalled operation reliability based on a time-proven VHS transport system. Its dependability is further enhanced by the low operational duty cycle of each deck, and the redundancy of tape decks, an important feature of a multi-deck concept.

A unique feature of the system is that it can be operated in a most rudimentary manual mode despite its most advanced automatic operation capability including multiple events random access per cassette.

The MVP-100 can be configured in 8/12/16/24 deck systems, with the most advanced system capable of 12 h of continuous automatic operation with 480 program events. It is a television station programming and business automation system.

97. A New Master Control System for NHK's Local Stations. *By Yutaka Morii, Shingo Miura, and Ryo Yoshida*, NHK, *and Masahiro Ohta, Koichi Koide, and Kazuo Takeuchi*, NEC Corp., Tokyo, Japan

A new automatic TV/radio master control system has been developed jointly by NHK (Japan Broadcasting Corp.) and NEC Corp. while introducing the distributed processing technique using microcomputers and the hybrid IC technique wherever applicable. This system has been developed to be installed at NHK's local stations for the automatic program transmission of two TV channels, two medium-wave radio channels, and one FM radio channel. This paper refers to two types of the automatic transmission systems designated E-81 and G-81 master control equipment from technical standpoints.

NHK has over 40 TV and radio networks including several local broadcasting stations throughout Japan, with the Tokyo Broadcasting Center being the nucleus of the net-

works. The national networks were automated for the first time by the introduction of the NHK-TOPICS (Total On-line Program and Information Control System) in 1968. The automatic transmission systems of all local stations were then composed of hardware logic circuits. Accordingly, these automatic transmission systems were not necessarily satisfactory from the standpoint of operationality. In the more than ten years after the introduction of the first automatic transmission systems at NKH's local stations, equipment deterioration is now pronounced, and the development of new transmission facilities is required for coping with the variety of programming demanded and for providing new broadcasting services (such as sound multiplexing, teletext, and emergency alarm broadcasting).

The major design objectives of this new automatic TV/radio master control system were as follows. The first design objective was system flexibility and readiness for various types of programs and new broadcasting services. The second objective was equipment compactness and ease of installation in a short period of time to allow replacement with the existing equipment in limited floor space while the broadcasting service was continued. The equipment is required to employ natural air cooling without the use of fans so as to eliminate noise. The third objective was ease of operation and maintenance and system adaptability with the human system. In addition to these objectives, functional expandability for allowing use over more than ten years and development in performance and reliability were also aims.

In order to realize these objectives, the new system has been designed to provide the following features by introducing many new techniques.

1. For the control system, the distributed processing method is introduced and the individual functional blocks are processed separately by using a number of micro-CPUs. (The E-81 employs about 30 micro-CPUs.) The system has been designed to be compact by using software logic circuitry. Data transmission between different equipment is performed by serial transmission with a coaxial cable. Entry, check, and change of program data are achievable as desired through a CRT terminal in conversational method. Important sections in the system provide redundancy and are furnished with data logging and self-diagnosis functions.

2. The video and audio systems use ten types of newly developed hybrid ICs to achieve compactness and low power consumption. Switching and processing circuits are accommodated in the form of functional blocks in a large-scale multilayer printed circuit board, greatly reducing the number of component cards and simplifying the entire video and audio systems. One redundant output bus is provided in combination with an automatic monitor, allowing failure of other output buses to be backed up. In addition, new contact connectors have been developed and various new techniques have been introduced in the field of cable connection by adopting mother boards and flat cables.

The first master control system furnished with these features was completed in 1979, and more than 20 local stations have introduced the new system. Although furnished with many new functions not employed in the conventional equipment, the new system is accommodated in only seven racks in the E-81 (whereas the conventional equipment was accommodated in 17 racks). Both the amount of installation work and the period of installation can be shortened while greatly facilitating the work for replacing the existing system with the new system. On the other hand, the system operationality has been greatly improved when compared with the conventional hardware logic, allowing operation with fewer operators. The electrical performance and reliability also have shown excellent results.

98. A Fourth Generation Master Control Switcher. *By Don Edvalson*, Robert Bosch Corp., Salt Lake City, Ut.

When the design of this master control switcher was started, it was decided to abandon traditional switcher design and look only at the needs of the market. As a result, both the control panel and the internal architecture are quite different from previous switchers.

In this paper, the overall operational and electrical design of the switcher is discussed. Primary emphasis is placed on two aspects: the operational features that make the switcher easy to use for the operator; and the new design concepts that make the device stable, reliable, and easy to maintain.

This switcher is intended to be an integrated part of a station's routing switcher, machine control, automation, and master clock systems, rather than a stand-alone unit. This allows great versatility both in the operational concepts and in the electrical design.

Many of the controls which are present on traditional switchers are present here in a radically different form — for instance, the audio controls and the keyer. Many of the other controls and features are new to the industry, such as an automatic bypass button. These features, and the extensive use of dynamically labeled switches, are discussed. The extensive audio metering and monitoring facilities, and the ability to control four levels of audio, are also discussed.

The internal structure is as different from the traditional as the control panel. Extensive use of digital technology has been made throughout the switcher, whose hardware is controlled by twin microprocessors. The use of EEPROM and battery-backed-up RAM in the processors is discussed. The wipes and keys are also performed by digital circuitry, and the techniques discussed. The use of single stage mixing in both the audio and video sections, and a patented VCA design, provide the highest performance specifications ever offered in the master control industry.

The design of the fourth-generation master control switcher has applications beyond master control. Its implications for other types of equipment, and for the entire TV station operational mode, are discussed in the remainder of the paper.

99. Benefits of Hybrid Circuits in Routing Switchers. *By Frank Zimmerman*, Broadcast and Related Products Div., 3M, St. Paul, Minn.

The concept of hybrid electronic circuit manufacturing is hardly new. It has been used for years in a variety of military, industrial and commercial products, including defense equipment, consumer electronics, microwave ovens, automotive electronics, and implantable medical devices. However, until recently hybrid circuitry has not been widely used for routing switchers or other broadcast equipment.

Until the 3M Series H was introduced in 1983, there had been no widespread change in routing switcher

Donna Foster-Roizen delivering her paper.

design for at least 10 or 15 years. Some attempts have been made at partial hybridization but they have not taken advantage of many of the significant potential benefits of this construction technique. In this paper we will examine those benefits in detail.

What Are Hybrid Circuits?

Hybrid thick-film circuits are made by a method which falls midway between conventional printed circuit construction (printed circuit boards with soldered DIP packages and discrete components) and monolithic circuit integration (such as specialized VSLI packages). Hybird circuits offer some of the compactness and performance efficiencies of integration without need for high volume production or complex micro-design work.

Hybrid Advantages

There are a number of theoretical advantages for hybrid circuitry depending on the application. Most of these benefits are directly applicable to hybrid audio/video switcher construction because of the unique and specialized needs of this task. (This paper will examine the general characteristics of hybrid circuitry, and discuss their unique applicability to the hybrid switcher task.)

Implementing the Theories — An Effective Hybrid Design

The new 3M Series H audio and video routing switchers have been designed on the basis of a careful understanding of hybrid possibilities. A modular design has evolved which uses seven basic hybrid dual in-line packages to handle all of the necessary switcher functions. This paper will identify each, and explain how they are integrated for system dependability and special ease of maintenance.

3M uses three integrated circuits in these hybrid modules. The design of these integrated circuits has made it possible to reduce the transistor/diode parts count by a factor of 10 to one, and the IC part count by two-to-one compared to conventional routing switcher circuit design.

Each of the seven hybrid modules plugs into a dual in-line socket, and is easily replaceable in the field. As a result, this sophisticated electronic system can be put back in service by a technician with a minimum of test equipment and engineering know-how. Once the nature of a malfunction has been identified, it can be repaired by merely replacing plug-in hybrid circuits from a local inventory of parts on a trial-and-error basis.

Users in this and other industries find it more practical to replace a $100 part in 10 minutes than to spend several hours locating a malfunctioning 10-cent component. The high cost of equipment down-time in the broadcast industry makes this logic even more apparent.

Series H hybrid audio and video switchers also incorporate a distributed power supply regulation design concept which is a natural extension of the hybrid packaging method, and contributes to system simplicity and performance.

With final regulation at the circuit level, any cross-talk generated after the main power supply is eliminated. Circuit level regulation also eliminates the varying effects of resistance losses in cables between the supply and each circuit. Modularity and circuit redundancy minimizes the extra cost of distributed regulation, and prevents a short circuit on one hybrid from loading the main power bus.

Summary — The Logic of Hybrid Switching

The ultimate test of the hybrid switcher is its workability in day-to-day operations. Considerations such as rack space required, expandability, maintenance and adjustment costs, signal quality and dependability are best assessed on the job.

A Series H switcher is about one-eighth the physical size of previous 3M switchers of equivalent capacity, one-fourth the size of current 10 × 10 style units, and half the size of partial hybrid designs currently on the market.

This marked size advantage is of particular value in large metropolitan installations where space is at a premium; but the size-related benefits of reduced cross-talk, shortened signal paths, and reduced power requirements per function are of value in any location.

The Series H switcher has proven the practicality and workability of hybrid electronic construction, and it is clear that this design approach will find greatly expanded use in the future for all kinds of audio and video equipment.

100. Flexible Video Tape Recorder Diagnostics. *By John C. Stearns*, Ampex Corp., Redwood City, Calif.

In looking at diagnostics for a videotape recorder, we must look at the main purpose of diagnostics. The main function of diagnostics should be to tell an operator why his VTR isn't performing correctly. There are several possible causes for the device's failure to work properly. These conditions are:

- A system setup switch is in a non-standard position.
- A fault condition exists.
- The tape has been improperly recorded.

When one of these conditions occurs, the operator needs to be informed so he can decide what to do. The VPR-3 continuously monitors these conditions and displays any that become active. Since there is a possibility that several fault conditions could be-

come active at the same time, they are assigned a priority for display. The more important conditions have a higher priority and are displayed ahead of those with lower priority.

Some fault conditions cause others to occur, so these fault conditions have a higher priority than the faults they cause. An example is that the "control track absent" fault condition causes the "control track unlocked" fault to become true. The "control track absent" fault has a higher priority than the "control track unlocked" fault, and will be the fault displayed.

The priority of faults has been arranged so that faults that can cause tape damage have the highest priority. The rest of fault/non-standard conditions are arranged in the following descending order:

1. Power supply and line voltage faults.
2. Transport and tape faults.
3. Non-standard setup.

The flexible part of the VPR-3's continuous diagnostics comes about in the way faults are handled. The handling of a fault condition is done differently depending on the way the VTR is being used. If you were playing to air and the control track servo momentarily unlocked and locked up again, you wouldn't want the "control track unlocked" message left on the display after the fault has gone away. But if you were making a copy of a tape and the play machine had a servo fault while you were away from the machine, you would want to know about it.

The VPR-3 continuous diagnostics have four different modes for each condition monitored. The modes are set up in the diagnostic MORE menu. By using the scroll keys in the diagnostic MORE menu, you can scroll through all 40 conditions monitored by continuous diagnostics. As you scroll through the 40 conditions, the mode selected for each condition is printed on the top line of the control panel display, the priority of the condition is printed to the right of the condition, and the PASS/FAIL or STANDARD/NONSTANDARD status of the condition is printed to the left of the condition.

An example of a monitored condition would be the "capstan tach failure" fault. It would appear on the diagnostic MORE menu with a "3" to the right of the message and a "PASS" to the left of the message if there were no capstan tach failure. The "3" on the right of the message means it is the third highest priority fault of the 40 faults monitored. Only a priority 1 or 2-level fault would be displayed ahead of it.

The four modes of continuous diagnostics are:

- Normal Mode — Fault is displayed as soon as it becomes active, display is cleared when fault goes away.
- Inhibit Mode — Fault is inhibited from being displayed on the HOME menu, PASS/FAIL status will still be active on diagnostic MORE menu.
- Latch Mode — If fault becomes active, FAIL status is latched in next to the fault on the diagnostic MORE menu.
- Count Mode — Each occurrence of a fault is counted, and the total is displayed on the diagnostic MORE menu.

Once a machine failure condition, such as power supply or servo failure, is detected, the problem can be isolated more by use of system/board diagnostics which are accessible from the diagnostic menu. The probe diagnostics are used to prove the system control bus is being properly received and decoded by the various boards on the bus.

101. Hitachi's HR-230 Type-C 1-in. VTR; New Generation Production Tool. *By T. Kawamura, A. Sato, and F. Scott*, Hitachi Denshi America, Ltd., Woodbury, N.Y.

In the last few years, VTRs have been designed to impress engineers. However, planning for the HR-230 was focused around operator needs, while still incorporating the required features. The most obvious indication of this is the control panel, which provides all basic functions, while eliminating controls that might distract or hinder routine VTR operation. Conveniently located below the main control panel is a concealed fold-out Edit Panel that provides all the advanced operator controls.

This presentation will include an overview of the VTR, as well as an examination of the microprocessor-based system and servo control system. The extensive real-time diagnostics that assist the operator and maintenance engineer will also be reviewed.

102. Portable 1-in.-VTRs — Still a Topic? *By H. Zahn*, Robert Bosch GmbH, Darmstadt, W. Germany

After a short history of portable VTRs, a comparison of existing 1-in. VTRs for EFP will be given. A view of performance parameters and user requirements will be pointed out, with special attention to the present trend towards analog component videotape recording.

The resulting conclusion is realized in the BCN 21. The advanced technology employed mechanically as well as electronically to fulfill all requirements of the most flexible application, will be described in detail. Special attention will be given to the video and audio editing capabilities. It will be shown that portable 1-in. VTRs have and will have a remarkable place in the market.

Future Trends in Image Technology — Photographic and Electronic II

103. Transition from Analog to Digital Television Plants — A Broadcaster's View. *By Bernard L. Dickens*, CBS, New York, N.Y.

In this paper the author discusses the transition of television plants from composite NTSC to the higher quality digital component system. The alternative methods of achieving this goal and the CBS preference for the direct transition to digital are discussed.

104. Second-Generation Videocassette Machine. *By M. Takano, I. Tamaki, and P. Dare*, Sony Corp., Teaneck, N.Y.

Fifteen years after the introduction of the first videocassette machines for broadcast use, a second-generation machine has been designed with engineering concepts and features that address current industry requirements. Using a software-based control system, flexibility of interface to automation systems has been greatly expanded. In addition, facilities such as still frame, start, and multiple video/audio outputs create a number of software programming options, which are user-addressable. The use of more than two replay transports increases operational flexibility, while the availability and use of 30-min cassettes introduces further uses which could not previously be handled.

The expanded application of multiple-cassette machines to news as well as commercial uses requires separate software. This paper will describe the considerations and complexities that have been experienced during the product development.

105. Motion Picture, Still Image, and TV Audio Recording Systems: Technology Trends Versus User Needs. *By C. Robert Paulson*, AVP Communication, Westborough, Mass.

Rampaging technology, imaginative recording equipment designers, and harassed film, television, and audio industry engineering managers are the forces behind a proliferation of motion-picture, still-image and TV audio recording formats that passed the fifty mark at the 1984 NAB equipment exhibit. In the immediate future the number may well pass 100, because old formats, unlike old soldiers, just don't fade away.

Nine variables, each moving independently, are the reason that format proliferation is today so much out of the control of the buyers, equipment designers, or industry standards-setting groups. To define any recording format completely and unambiguously, it is necessary to specify:

1. The (recording) material whose state is changed to create the recording.
2. The physical dimensions and substance of the (backing) material on which the recording material is carried.
3. The physical dimensions and design of the (reel/cassette) package in/on which the recording medium defined by Specifications 1 and 2 is placed.
4. The transducer(s) which change the input signal to a state which effects a recording, and recovers the recorded signal to initiate reproduction.
5. The relative geometry and velocity of motion between the transducer and the recording medium.
6. The electrical waveform(s), dynamic range and bandwidth of the signal(s) at the input to the recording system.
7. The manner in which the signal(s) are translated or conditioned before passing to the recording transducer.
8. The numbers of these signals to be recorded on the medium installed in the recording system being defined.
9. The individual physical placement of these recordings on the medium, and/or their electrical time or frequency division multiplexing with selected signals before recording.

In the absence of industry efforts to standardize on a select number of the combinations of these variables, it is obvious that the total number could climb toward the infinite. Even if the current slow but steady movement toward world-wide standardization of emerging video and audio formats continues, the total number of official and de facto standard formats seems certain to remain between 50 and 100.

All of the recording media now in use in the professional and consumer film, television, radio, audio, computer, and communications industries are contributors to the proliferation: optical and magnetic film, magnetic tape, magnetic disks with both rigid and floppy substrates, semiconductor memories, punched tape and cards, and now optical and capacitance disks. Analog recording and reproduction of motion pictures and sound in real time is the departure point for their post-production digital processing into enhanced video, still images and compresssed audio on the same or other media. Graphics creation software has transformed every customer into a still-image maker, and some into animation sequence producers. Broadband videotape and videodisk recording systems have become random-access, on-line repositories for virtually unlimited mixtures of motion pictures, still images, wild and synchronous sound, human-readable data and graphics, and machine-readable data.

To add to the harassment of broadcasters and producers trying to use this melange of recording formats creatively and economically, each new format is introduced with little or no provision for integrating it into existing systems. What the user wants and is beginning to demand, however, is automated integration of these systems, not their splintering into increasing numbers of automation islands. Complete versatility is needed in dealing with all the picture and sound elements of production as demanded by creative considerations, not as proscribed by recording system characteristics.

It has also become apparent that the ultimate economies offered by facilities automation can be achieved only by its total integration with and control by the facility's mainframe computer. This fact foreordains a drastic change in the capabilities and activities of the generally unrelated and unintegrated hardware and software companies now selling "automation" to broadcasters and producers. The history of the suddenly rapidly maturing computer industry of ten to twenty years ago may be looked back to as a model of what will transpire in the industries represented in the SMPTE membership in the next five to ten years.

The paper's observations and conclusions will be supported by appropriate pictures, graphs, and block diagrams. These will visualize industry trends in recording system proliferation and the automation systems architecture and capabilities needed to balance improvements in creativity with controls on costs.

106. Multichannel Sound for Television Broadcasting in the United States. *By Edmund A. Williams*, National Association of Broadcasters, Washington, D.C.

After five years of committee meetings, laboratory work, and field tests, the broadcast and consumer electronics industries together proposed a single multichannel television sound system to the Federal Communications Commission (FCC) for adoption as a single standard. The FCC responded by protecting the recommended system while at the same time permitting other TV aural subcarrier schemes to be utilized. This paper reviews the development of the multichannel sound system, describes the system protected by the FCC, and outlines those technical requirements that are essential to the implementation of stereophonic sound and second audio program channel transmission by broadcasters.

The new U.S. TV multichannel sound (MTS) system is called the BTSC system (after the Broadcast Television Systems Committee which performed the work) and consists of a compatible monophonic channel, a stereo subchannel with noise reduction, and a separate audio program (SAP) channel, also with noise reduction. Overall deviation of the TV FM aural carrier is raised to 73 KHz to permit the addition of the stereo and SAP subcarriers along with pilot and professional use subcarriers.

Implementation of MTS calls for

improved performance television transmitters (visual as well as aural), refurbishment of television studio facilities to handle the additional sound channels, a recognition of the nature of technical characteristics of the transmission path between transmitter and receiver, and the development of new stereo production techniques specifically tailored to television studio production procedures.

107. Effects of Transmission Impairments on the Quality and Coverage of Multichannel Sound for Television. *By James J. Gibson*, RCA Laboratories, Princeton, N.J.

Measurements and calculations of the effects of transmission impairments on the quality of the received audio signals in the BTSC multichannel sound system for television are summarized. Coverage is predicted on the basis of signal-to-noise ratio calculations. Levels of buzz and buzzbeat are related to transmitter incidental phase modulation and multipath. The effects of random noise and buzz are background audio noise and noise pumping. Distortion and crosstalk are related to imperfections in the transfer characteristic of the aural carrier caused by notch diplexers, imperfect matching of transmission lines, and multipath. The analyses and measurements summarized in this paper have been published in detail in a report entitled "Multichannel Television Sound" published by the National Association of Broadcasters and the Electronic Industries Association.

108. HDVS — A New Generation Production System for High Definition Television. *By L. Thorpe, G. Smith, H. Tanimura, T. Nakamura, and K. Tsujikawa*, Sony Broadcast Products Co., Teaneck, N.J.

Following the extensive showings of High Definition Television prototype equipments throughout 1982–84, both in the U.S. and Europe, the industry interest in HDTV has sharply increased. In the U.S. the Advanced Television Systems Committee (ATSC) and the SMPTE are actively studying all aspects of television enhancement, including HDTV. The areas of study have been separated into three: Production, Transmission, and Display. Worldwide, there is a strong interest in achieving a single HDTV standard for Production.

Production in 525/60 television has seen dramatic growth with the advent of today's high-performing portable cameras and VTRs. Electronic Field Production (EFP) is now a major business. EFP has diversified in the methodology employed in its implementation. There is EFP, TV-style, using a video operator to make real-time corrections on perhaps a number of TV cameras prior to recording; and there is EFP, film-style, where the camera and VTR shoot and record in a manner analogous to a film camera.

The subject of Electronic Cinematography (EC) has been central to considerable debate in recent years. The extensive amount of TV programming that is currently shot on 35mm film and subsequently transformed to videotape poses a natural challenge to seek an all-electronic system. EC cameras have been developed which offer attractive capabilities and yet their commercial success has been quite limited. The issues of the "film look" and all that constitutes a true EC system are central to this debate.

High Definition Television's image quality has been demonstrated to indisputably rival the best of projected 35mm motion picture images. A giant step has been taken in fulfilling many of the requirements of the film look. The next important evolution is the development of a fully functional High Definition Video System (HDVS) capable of offering a viable alternative to film as a high-quality master for standard TV production, motion pictures for cinema release, or future HD electronic distribution. Sony has taken the position that the optimum system will evolve only by developing a close working relationship with both the film and TV communities. We have, therefore, developed the foundation of a new HDVS system to allow initial experiments to be conducted toward this goal. The elements of this system were developed following extensive consultation with the production world and based also on valuable field experience gained with our first prototype HDTV experiments within both the U.S. and Europe.

The new HDVS system is now commercially available and is comprised of the following: the Electronic cinematography camera chain; 1-in.-based VTR; digital image enhancer; and projector system and monitors.

The technical aspects of each type of equipment are described in the paper. This equipment will be made available to R&D labs and production companies (film or TV) which are engaged in HDVS experiments and need to purchase such basic building blocks to support their developments. A prototype HDVS video switcher and noise reduction system are also described in the paper.

Sony believes that by our active participation within the industry in this fashion, highly refined HDVS production tools and systems will more rapidly evolve in the coming years. It is also envisaged that active and practical experimentation in HDVS will do much to offer positive support to the activities of SMPTE and ATSC in their seeking of a universal production standard for HDTV.

Most technical sessions enjoyed an excellent turnout.