

Report on the 122nd SMPTE Technical Conference and Equipment Exhibit

New York Hilton Hotel, New York,
9-14 November 1980

Surpassing all previous records for SMPTE Conferences in New York, the 122nd Conference was memorable not only in terms of the unprecedented numbers of registrants and exhibitors and the quality of the technical papers, but in the enthusiasm shown by all those attending — engineers, technicians, managers, and other interested persons convening from all over the world for this prestigious event. It was upbeat all the way.

Here are a few statistics: Total number of registrants about 1,400. Exhibits from 149 companies occupied 311 booths covering 25,000 square feet of floor space, with more than 8,000 persons viewing the exhibits. Seventy-five papers were presented on the Technical Program.

The papers — 14 of them from countries other than the U.S. — covered a wide range of topics, the unifying theme being "Past, Present and Future," with at least eleven historical papers providing continuity between the past and the present. Obviously, without the past there could be no present; and without the past and the present there could be no future. For a specific example, without the invention of the iconoscope, where would television be today?

Registration began at noon Sunday with the official opening of the Conference taking place Monday morning. The opening address by SMPTE Executive Vice-President Charles E. Anderson stressed the vitality of the motion picture and television industries. Excerpts from his speech appear on p. 2 of this issue.

The Monday afternoon session was devoted to the history of television. An outstanding event was a taped interview with Vladimir Zworykin, the 92-year-old "Father of Television" who is still working out his ideas in a special office assigned to him when he "retired" from RCA at the age of 80. His invention of the iconoscope (patented in 1923) and the kinescope made possible modern television as we know it.

Following the taped interview, P. Sidey, B. Longman, A. Pilgrim, and D. Glencross presented "The History of British Television" covering the years from 1923 to the present. This very scholarly paper approached television history in terms of the evolution of the technology beginning with Baird's early work, and tracing the interdependence of television technology and the art and craft of program-making and the culture. The paper had previously been read before the Royal Television Society.

Among other historical papers, Wesley T. Hanson, Jr., Eastman Kodak (retired), traced the evolution of Eastman color motion picture films, pointing out that there was a continuing research program going on at Eastman Kodak in the areas of emulsion technology, coating technology, couplers, sensitizers, gelatine hardeners, and processing chemistry leading to additional improvements in color motion picture film.

Among other papers presented at other sessions, Greg Murphy in "A Primer on Television Pickup Tubes" traced the development of pickup tubes from the 1930s to the present, followed by Blair Benson, who reported on "Current Developments in Television Camera Tubes."

Karl Malkames described the "Evolution of the 35-mm Film." His presentation included a 33-min film providing a fascinating and informative look at cameras used during the era of silent films.

S. F. Spiro, in "A Collection of Persistence of Vision and Other motion Producing Devices," took the audience back to the pre-history of motion pictures, citing the many 19th-century inventors whose imaginative devices led, even though indirectly, to the 20th-century development of motion pictures.

In the Session on Television Production and Post Production (Wednesday morning), Frank Back traced the history of zoom lenses, noting that the concept of the zoom lens is as old as cinematography.

Two historical papers were given in the Thursday morning session on Lighting and Sound. Ted Uzzle's presentation on "The Historical Development of Cinema Architecture and Its Acoustical Effect on Filmsound Recording" was an in-depth and well researched examination of cinema architecture and its relation to and effect on film sound; and Evan William Cameron in "The Divergence of Cinematographic From Still Photography Lighting Techniques 1930-1945" discussed the development of motion picture lighting as it stemmed from still photographic lighting. He described the new lighting procedures that were gradually developed to meet new motion picture situations.

The history of mechanical television began in 1901, according to George Shiers, who, in his very informative paper, discussed the hybrid nature of television, its mixed parentage, and the events that led to worldwide interest in television which reached a peak in 1928 when more than 30 companies engaged in television ventures.

The development of the Ampex videotape recorder was described by Charles Ginsburg, who was leader of the videotape recorder project at Ampex from 1952 to 1956. In this very interesting paper he explained this exciting project in detail from the beginning, including the approaches which failed, the unexpected solutions which turned up, the experiments that succeeded, and the contributions of the original project team.

While giving due credit to the past in these carefully researched historical papers, the program's main emphasis was on the current developments that have significance in terms of the future. There is no question that digital television will continue to be a "live" topic. Three especially interesting reports were given at the Friday morning session on Digital Television. Frank Davidoff gave a status report on the SMPTE Task Force on Component Digital Coding, and William Connolly reported on the SMPTE Study Group on Digital Tape Recording. Graeme Little gave a progress report on Standardization of the Digital Control Code. A paper by Frederick Remley entitled "What Do We Expect From Digital Video Equipment?" provided an overview of advances in technology that are urging designers of broadcast equipment toward digital systems. The reports given at this session provided the audiences with an excellent survey of digital television as it is at present.

The five papers presented at the session on Computer Graphics (Tuesday afternoon) were also involved with digital technology. This session was concurrent with the session on Motion Picture New Film and Equipment.

Two very interesting sessions, Motion Picture Laboratory Technology, and Problems of Maintenance, ran concurrently Wednesday afternoon. The eight papers given at the Laboratory session offered practical information for the benefit of all those involved with film printing and processing, silver recovery, and disposal of effluents. Two papers, one from Switzerland and one from the People's Republic of China, dealt with this latter problem. "Regenomat, An Electronic Replenishment System" was presented by the author, Yngvar Cramer of Switzerland. An especially interesting paper, "The Present Status of Disposal of Film Processing Effluents and Solutions in China," was prepared by Qian Xiaozhang, Deputy Director of the Film Bureau, The Ministry of Culture, PRC; Jing Jia-dong, Chemical Engineer of the China Film Science and Technology Research Institute; and Lin Jing-yun, Electrical Engineer of the CCTV, all of whom were members of the delegation for the People's Republic of China attending the SMPTE Conference.

The entire program, with its mixture of history, practical information helpful to present day scientists and technicians, scientific theory and fact, and reports on motion picture and television technology, was an exciting smorgasbord of up-to-date information, well researched history, and indications of future trends in technology.

MONDAY MORNING
Opening Address

The opening address of the 122nd Conference was given by Executive Vice-President Charles E. Anderson. Following are excerpts from his welcoming speech:

"In my opening remarks at the 1979 SMPTE Conference in Los Angeles, I commented on the vitality shown by both television and film. The same is true today, although it is obvious that the roles of both media are changing; the changes being very similar to those that occurred in the late 40s and early 50s when television came into our lives. At that time everyone thought that radio was dead, but radio went into a long period of readjustment and then emerged as a powerful but entirely different medium from the one it was before television.

"Today there are hundreds of thousands of videotape recorders in use in homes. Videodisks are almost a reality and cable has finally sailed out of the doldrums. We are all going to be obliged to re-think our plans for supplying new equipment and using existing equipment in new ways, and for producing programming to meet these new challenges.

"I, personally, am a little tired of the film vs. tape and television discussion. We are here this week as engineers who have developed much of the film and television technology we use today. We are the experts in our fields. Our time and our talents are too valuable to waste in bickering and in pointless controversy. Instead let us embrace the new technology and lend our experience to the young engineers while they contribute new approaches to our fields of work. Speaking as an "old timer," I am

awed by the skills and energy of my very young colleagues, and it is an exhilarating and rewarding experience to work with them.

"Technology refuses to stand still, and if we wish to survive and prosper, we must understand it and learn how to use it. It can be done, probably not without effort, but those who do not make that effort will find themselves in a backwater.

"In order to plan for the future, it helps to see how we arrived at the point where we are now. This year's program recognizes the past as well as the present and the future, and you will find in certain of the sessions a number of historical papers presented by outstanding men who participated in the historical events they relate. New technology in both film and television is well covered this year. Digital television and audio are in our present and our future and are covered by several papers. Although I am not an expert in film, I recognize several significant papers. I note also the burgeoning use of computers in the fields of both film and television for control and for creative purposes. An entire session is devoted to the subject of computer graphics, and there are several papers on the program covering the use of computers for the control of film and television equipment.

"To my way of thinking, this is one of the most exciting programs we have had at any conference, and I hope you will enjoy it as much as I plan to. This is your Society, your Conference, and we can now go on to the Papers Program with an assured anticipation of a stimulating and rewarding experience.

1. New Television Technology — Once Over Lightly (Joe Roizen, Telegen, Palo

Alto, Calif.) In this age of high specialization in every field of human endeavor, television technology is no exception. A television engineer must become competent in or at least comprehend numerous and diverse areas, such as digital signal formats, computer controlled processing, fiber optic and SHF satellite links, data transfer via teletext or viewdata, scrambled STV, and home VCRs and videodisks. This paper explored in a relatively basic manner the areas that represent the leading edge of each specific branch of technology, with emphasis on current terminology (buzz words) and projected applications in the decade ahead. Among the topics included were high resolution TV, direct satellite broadcasting, computer generated video graphics, teletext and viewdata, digital effects, digital VTRs, flat screen TV, multiple image receivers, VCRs, longitudinal videotape recorders (LVRs), and videodisks. This primer on new television technology also included an overview of the impact of these new technologies in the domestic and international fields.

A Taped Interview with Vladimir Zworykin (Produced and directed by Stephen C. Chamberlain, Chairma SMPTE Historical Committee, Du Art Film Labs, Inc., New York, N.Y., and Richard Marcus, Rombex Productions Corp., New York, N.Y.) After the Awards Luncheon the Technical Program resumed with a videotaped interview with Vladimir K. Zworykin, often referred to as the Father of Television. As a fitting introduction the tape began with a montage of some of Zworykin's many professional awards and publications. In a series of segments, Dr. Zworykin then reminisced about some aspects of his life: his early education in St. Petersburg (now Leningrad); the strong influence of Boris Rosing, under whom he did his early research in Russia; his enlistment in the Russian army; and his work with Paul Langevin in Paris, across the street from the laboratory of the Curies. A childhood incident made perhaps the greatest impression on Zworykin. At the age of eight, while on his father's ship, he saw how by depressing a push-button, one could bring a response from someone in another part of the ship. He credits this memory with directing his interest and career toward electronics and then television.

Appearance of Dr. Zworykin

At the conclusion of the taped interview, a most delightful surprise awaited those present. Dr. Zworykin was with the audience not only on tape but also in person. Introduced by Mr. Chamberlain, he came to the podium with Robert Smith, President of SMPTE, and received further well-deserved recognition. Mr. Smith referred to Dr. Zworykin's earlier elevation to Honorary Membership in SMPTE, and concluded by saying "You are the Father of Television, and we are very proud to have you here today as our guest." Dr.



Pre-Conference conference. Where shall we put the signs?

Zworykin graciously thanked Mr. Smith and the audience. He charmed the audience with an anecdote concerning David Sarnoff. Zworykin admitted to being a dreamer at times, but Sarnoff, who was "the big boss" (at RCA), was also a dreamer. Sarnoff used to tell people: "Do you think Zworykin is a dreamer? He is the best salesman I know. I asked him to tell me how much it will cost for television. He looked on the ceiling, and he said 'A hundred thousand dollars.' It cost forty million dollars!" Mr. Phil Sidey, of the Royal Television Society, also presented an additional honor to Dr. Zworykin. He indicated that some time earlier the RTS had been delighted and pleased to make Dr. Zworykin a Fellow of the Society. Since an earlier meeting had not been possible, Mr. Sidey took the present opportunity to ask Dr. Zworykin to formally accept the Fellowship of the Royal Television Society. The award was presented to Dr. Zworykin, with Mr. Sidey concluding: "By doing so (accepting the award), it is not we who are honoring you, but it is you who are honoring us." The audience was deeply moved by the series of events and all felt that they had just participated in a warm and significant experience.

MONDAY AFTERNOON

The History of Television

2. The History of British Television (Presented for The Royal Television Society by *Phil Sidey, Bob Longman, and Tony Pilgrim, British Broadcasting Corp., and David Glencross, Independent Broadcasting Authority, London, England*) The Royal Television Society was founded following John Logie Baird's demonstration to the British Association in 1927. The presentation dealt with the history of British television from its earliest stages in terms of the evolution of the technology, the art and craft of program making, and the institutional framework. Baird's early work on 30-line pictures led to short-lived experimental broadcast transmissions by the BBC as early as 1932. A high-definition service began in 1936 by the BBC using Baird's mechanical and Marconi/EMI's electronic system in parallel. The Baird system was dropped early in 1937. Lacking the support of the film industry, having only lukewarm support of the radio service, and finding no previous experience to draw upon, the whole concept of television programs, program planning, and presentation had to be invented. Nevertheless, the nature of the BBC as the sole broadcasting organization in the United Kingdom and its established successes in radio were major influences in the birth of the new art of television. The production facilities were primitive and seriously inhibited producers; in addition, all programs had to be live because there was no recording system. By September 1939 when the service



Joseph Roizen delivering the first paper of the first technical session Monday morning. His paper was entitled "New Television Technology: Once Over Lightly."

closed down due to the war, there were some 20,000 viewers, and a surprisingly wide range of programs had been built up and firmly established. When the sleeping beauty, television, woke again after seven years, she was unchanged, but the prewar experience meant that the BBC had established reserves in staff and technology to draw upon. New and more sensitive cameras, improved telecine machines, and film recording came in rapid succession. The BBC launched its own film department to make documentary films which incidentally helped in the development of realistic live studio drama programs with location film inserts. In 1949 the first transmitter outside London began broadcasting from Birmingham, and gradually the network was extended to cover the whole country. The 1950s were a period of development with new studios, new operational techniques, recording and new program formats to exploit these advances. A competitive television network breaking the BBC's monopoly was launched in 1955 with the opening of commercial television financed by advertising. By the end of the decade, two television networks were competing for the attention of an audience of 50 million people. Many think this was the great spur to the range and quality of British television. The opening of the new purpose-built BBC Television Centre in London in 1960 started a decade of innovation in technology and program making. A new UHF transmitter network designed to carry four channels on the new 625-line standard using the PAL system was opened in 1964 with the introduction of a second complementary BBC network. By 1970 all three networks were being transmitted on UHF in color and the technology had reached the stage where program makers were increasingly demanding more sophisticated facilities. Rising costs led to greater emphasis on economical resource management in the making of programs. New



Vladimir Zworykin holding the plaque presented to him by the British Royal Television Society.

major studio centers by the BBC and ITV were opened in all parts of the U.K. and various refinements were steadily introduced into service. The paper also outlined the structure of the two broadcasting organizations in the U.K. and the ways in which they are financed. The U.S. and British television systems have developed technically in parallel, but the structure of broadcasting and the nature of the programs in the two countries show some significant variations. An explanation is offered for these differences.

TUESDAY MORNING

Motion Picture Film Production

3. The Evolution of Eastman Color Motion Picture Films (*Wesley T. Hanson, Jr. (retired), Eastman Kodak Co., Rochester, N.Y.*) The development of Eastman color films is traced back to the introduction of Kodachrome, the first integral monopack film to become commercially available. A variant of this type of process was developed for use as a 35-mm motion picture camera film and first used by Technicolor in 1942. Couplers for incorporation in the emulsion layers of color films were invented in 1912 but did not become feasible until the late 1930s. They were first used in amateur films and commercial sheet films where the larger film formats led to a relaxation in the requirements regarding graininess and resolving power of motion picture film. Copies or prints made from such films suffered in color quality because of the absorption characteristics of the dyes that were available for use in color films. This problem was solved by the invention of "colored couplers" in the early 1940s. As developments in emulsion and coating technology made it possible to improve the sharpness and graininess of incorporated coupler films, work on a motion picture negative and print film was initiated in the late 1940s and came to fruition in 1950 with

the introduction of Eastman color negative and Eastman color print film. The intermediate films required in motion picture production involved different problems which were not solved until 1953 when an entire integrated process was made available. A continuing research program in the areas of emulsion technology, coating technology, couplers, sensitizers, gelatine hardeners, and processing chemistry has made it possible to make many improvements in the characteristics of Eastman color motion picture films. It is to be expected that continuing research will make possible additional improvements in the future.

4. Higher Speed Fujicolor Negative Film and Improved Fujicolor Positive Film (*Hisao Kishimoto, Sadayuki Yamaryo, and Makoto Hara, Fuji Photo Film Co., Ltd., Tokyo, Japan*) Fujicolor negative film A 250, 35-mm, Type 8518, and 16-mm, Type 8528, is a high speed tungsten type motion picture material with an exposure index of 250. The film has fine grain, high definition, natural color reproduction, and wide exposure latitude. It is designed for both indoor and outdoor motion picture production and is especially useful in photographic situations where the lighting levels are low. Since an effective exposure index of 500 can be derived by forced development, the photographic possibilities are greatly enlarged and a considerable savings can be made in energy costs. Processing for this film is the same as with the current Fujicolor negative film. Furthermore, this film can be processed without modification in Eastman Kodak Process ECN-2. Fujicolor positive film HP, 35-mm, Type 8814, and 16-mm, Type 8824, is an improved color positive material. Improvements have been made in flesh-to-neutral rendering tone and color reproduction in the highlight and deep shadow areas and also in film speed. Eastman Kodak Process ECP-2 may be used without modification to process this film.

5. How Would a Feature Shot in Super 16 Compare with one Shot in 35mm on a Theater Screen? (*Irwin W. Young, Du Art Film Laboratories, Inc., New York, N.Y.*) The Super 16 format was designed to provide the greatest possible picture area on a single perforated 16mm original for enlargement onto 35mm for widescreen theatrical presentation. It achieves a 1.66:1 format by extending the picture into the unperforated area of the camera original. A blowup from this can be cropped in projection to the 1.85:1 aspect ratio. The first Super 16 feature was photographed by its inventor, Rune Ericson, in 1970. He used a converted Eclair NPR camera, photographed on Eastman color negative film 7254, and used a blowup to 35mm Eastman color reversal intermediate film (CRI) 5249. The 1970s brought many improvements in cameras, lenses, and original camera films, and it was felt that Super 16 should be reevaluated. To explore this mat-

ter, the author's laboratory produced a comparison film which was shown during this presentation. A feature film crew was used to photograph several scenes simultaneously in both Super 16 and 35mm color negative. From this footage, 35mm printing negatives were obtained. The original Super 16 negative was blown up to 35mm CRI. From the original 35mm negative, a master positive and 35mm color dupe negative as well as a 35mm CRI were made. The demonstration film consisted of two parts. Part 1 contained: (a) scenes originally shot in the Super 16 format and shown as a 35mm print made from the blowup on 35mm CRI; (b) scenes from the original 35mm negative, shown as a 35mm print made from the 35mm color dupe negative; and (c) the scenes shot on the 35mm negative, shown as print made from the 35mm CRI. Part 2 was a direct quality comparison 35mm release type print alternating original Super 16 and 35mm scenes. In the first half, even numbered scenes were blowups from Super 16 and the odd ones were printed from the 35mm CRI made from the 35mm original. In the second half, the odd scenes were blowups and the even scenes were prints from the 35mm color dupe negative of the 35mm original. The author concluded by describing the various procedures by which white titles can be superimposed on live background material shot in Super 16 or as original 35mm negatives.

6. ImageVision™ — Film or Tape? (*Ken Holland and Gary Matz, Compact Video Systems, Burbank, Calif.*) The object of this paper was to discuss and demonstrate the advances made in the past year on a high definition system called ImageVision. Tape to film transfer systems have always shown several deficiencies. Most notable of these have been the lack of definition. The transfer device has not always been to blame; instead the limiting bandwidth of the lenses, cameras, line scan rates, color systems, and video recording machines have all contributed to a comparatively low definition signal. The same limitations are apparent when the image is viewed on a large television display system. An increase of the bandwidth to 8.5 MHz and moving the subcarrier frequency to 7.16 MHz have solved most of the before-mentioned problems. The advantage of the system allows the use of existing cameras and videotape machines, although they must be substantially modified. These modifications were discussed and demonstrated. Both video displays and 35-mm films were shown.

7. Relation Between the Effective Exposure Latitude Color Negative Film and the Lighting Parameters (*K. Staes, Agfa-Gevaert, Mortsel, Belgium*) Traditionally, color negative film is used for shooting film productions under carefully controlled conditions. This means that, for instance, the lighting contrast, the luminance level, and

the spectral light distribution (color temperature) are checked, and appropriate corrections are made whenever necessary. Frequently, however, color negative film is used under conditions where it is not always possible to control the lighting parameters, and often appropriate corrections cannot be applied. As an example, the author mentioned the use of color negative film for shooting television serials and documentaries. Color negative is often preferred for these, instead of color reversal film, because of its larger exposure latitude and its lower contrast. Thus, larger exposure tolerances are provided and a more elaborate control of the overall system's contrast is obtained. The paper discussed the relation between the effective exposure latitude of color negative film and the various lighting parameters.

8. A New Filmmaking Concept: Bidirectional Memory in Cameras (*Jean-Pierre Beauviala, Aäton Cameras, Grenoble, France*) A system has been devised whereby filmmaking equipment (i.e. film and video cameras and sound recorders) can be fitted with relatively simple microprocessor-based time generators and memories, so that the collation, synchronizing, and cross-referencing of the various resulting films and tapes can be easily accomplished. This is of special interest for multi-camera shoots; but even when there is only one camera and one sound recorder, the system greatly facilitates and reduces the cost of post production. The microprocessor circuits must be added to existing cameras and recorders with a minimum of modifications. Once it has been done, however, this addition will allow the equipment, after being set once daily by a single master clock, to record a complete set of information including time address to the second. Once each second this complete set of information is recorded — by exposure on the film edge, or with pilotone compatible signals on the central track of the audio tape. A RAM or EEROM memory in each of the machines will retain the precise times and parameters of each take: start point, stop, etc. At the end of each filming day, a data collector will retrieve from each camera and sound recorder all the time information concerning the day's shoot. The machine language at every point in this system is ASCII, so that the data collector can then be connected to a standard computer printer, which will provide for editing purposes a printout indicating when the various cameras and sound recorders ran.

8A. Cleartime Recording System—Time Code on Film (*Thora Van Male, Aäton Cameras, Grenoble, France*) This paper described a complete clear time recording system, already in use in Europe by the French TV, the BBC in England, and at the Swedish TV stations. It is called a time recording system, as different from a time code system, because no actual code is



At the Press Conference, Sunday, Charles Anderson, George Laughead, William Rhodes, Robert Smith, and Roland Zavada.



Frederick Remley, Mr. and Mrs. William Hedden, Charles Anderson, and Alex Alden at the Eastman Kodak party.

used. Clear and directly readable information, printed on the edge of the film between the perforations, is obtained, spelling out once per second a complete time address in figures and letters, giving such data as production number, equipment number, year, month, day, hour, minute, second, and sync reference sign. The system functions on film and magnetic tape, and it is compatible with the SMPTE time code. A simple CCD imager can read out the clear figures and convert them, if desired, into the SMPTE time code. A masterclock, set to any convenient starting time (zero time or local time for example), injects the corresponding signal into cameras or sound recorders. It will run with one-frame accuracy for up to 6 or 8 hours. Intercommunication between several pieces of equipment uses the ASCII computer language. An LED display on the outside of the camera permits checking, at any time, the progress and functioning of the time recorder inside the camera. To record the time on the magnetic sound tape, a circuit board of about 2×5 in is fitted into the sound recorder. This converts the time signal to the standard SMPTE 80-bit time code. A transcoder permits continuous read-out of the time record on the tape during playback. It also assures synchronism of image and sound. A printing table that can read the recorded time code off the audio tape and feed it to a daisy-wheel printer, permits fast-speed ink printing of the time information on the base side of the full-coat film during a rewinding operation. Operational features and general advantages of the system were discussed.

Television Signal Generation and Processing

10. The Forces at Work Behind the NTSC Standards (Donald G. Fink, Director Emeritus, Institute of Electrical & Electronics Engineers, Somers, N.Y.) This paper reviewed the forces at work prior to

and during the action of the two National Television System Committees (NTSCs) that selected and recommended the U.S. standards for monochrome television (1941) and compatible color television (1953). The first NTSC had the active encouragement of the FCC and completed its task in less than nine months. The standards it recommended for monochrome transmission remain as the basis of the television service now broadcast in North America and many other countries. The second NTSC had a rougher road to follow. The FCC, having approved a non-compatible color system, did not welcome the second NTSC. That NTSC also had a very difficult technical task — one thought by many as flatly impossible: to impose high quality color values on the black-and-white system without injuring reception on the monochrome receivers then in the hands of the public. The second NTSC reviewed alternative proposals and field tested them from early 1950 to mid 1953. In July 1953 the NTSC approved and recommended to the FCC the standards for the color system we now enjoy — accepted in principle throughout the world. The author's aim was to reveal the constructive and destructive forces that had to be dealt with by the two NTSCs before the industrywide agreement, demanded by the FCC, could be reached. He then reviewed the similarities and dissimilarities among the NTSC, PAL, and SECAM systems, and reported on modern standard conversion methods that were not visualized by the original NTSCs, but which make international program exchange much simpler in many cases. The author, who served as a panel member of the first NTSC and as Vice Chairman of the second, proffered his personal views of what features of the NTSC standards might be changed, if we had to do it over again. He concluded by reviewing the probable avenues of future improvement without change in the NTSC standards. The prospect of a third NTSC being convened, if frame stores become inexpensive enough to be a part of the receiver, was offered.

11. Predictive Coding of Composite NTSC Color Television Signals (R. C. Brainard, A. N. Netravali, and D. E. Pearson, Bell Laboratories, Holmdel, N.J.) This paper reported on a study of intrafield predictive coding of composite NTSC television signals, sampled at four times the color subcarrier frequency (14.3 MHz). The choice of predictor was found to be governed by three constraints. The first was the need to provide correct subcarrier phase combination among pels (or pixels) used in the prediction; a mathematical formula was developed to express this constraint. The second arose because some same-line pels could not be formed into valid phase-combining groups in the short time period resulting from the 14.3-MHz sampling frequency. The third constraint was in the avoidance of certain unweighted pel groups which gave rise to limit-cycle oscillations, the cure for which required additional quantizer levels. Of several predictors which satisfied these constraints, one which used an element from the present line and two elements from the previous line all having the same phase, together with a phase-combining group of elements from the previous line performed the best. A procedure for designing quantizers for composite signals was developed based on three-parameter piecewise linear approximation to the quantizer error threshold function. This procedure guarantees that the quantization error would be below the error threshold function for any prediction error. Although the threshold function was not obtained directly from subjective measurements, it was extrapolated from the existing data on luminance and chrominance component threshold functions. Observations of picture quality were made using real-time processing on a mixed hardware/software experimental facility, from which it was concluded that between 5 and 6 bits/pel were required for broadcast quality. Preliminary results were obtained on the effect of composite predictive coding on the Vertical Interval Test Signals (VITS). Our observations indicate that the waveform distortion criteria applied to VITS



The Eastman Kodak Cocktail Party at the Copacabana was attended by a delegation from the People's Republic of China. Shown here are members of the delegation accompanied by Leonard Coleman, Eastman Kodak host, and President and Mrs. Robert Smith. Conversation soon turned to the visit to China made in the Spring of 1979 by Robert Smith (accompanied by Mrs. Smith) together with William Hedden and Frederick Remley, Jr., where many lasting friendships were made. (A report on the trip appears in the September 1979 issue of the *SMPTE Journal*.)

give some indication of granular noise visibility (in the SNR measurements), are too severe in their requirements for slope overload distortion, and give no indication of edge busyness, an important temporal impairment in predictive coding.

12. PIL Tubes: The Modern Approach to Color Monitor Design (*Richard N. Lawrence, Lenco, Inc., Jackson, Miss.*) This paper discussed the modern color monitor design using a Precision In-Line (PIL) tube system that offers reduced circuitry for reliability, reduced power consumption, and meets or exceeds industry standards and specifications. For 25 years now, the standard delta gun color-receiving tube has been used, and although its quality and construction have been greatly improved over the years, it still has high power consumption and — most important — up to 36 amplifier circuits are required for total control of convergence. Lately, the single gun Sony Trinitron™ color tube has increased in popularity because of its simplified convergence controls, but it falls short of the industry requirements for resolution and accurate color convergence. In 1972, a new color tube was introduced to the industry with a slotted shadow mask and in-line gun. It requires no dynamic convergence amplifiers and shows resolution equal to the delta gun tube, low power consumption, and higher brightness and contrast capabilities not found in color monitors today. The system employs a deflection yoke of semitoroidal construction consisting of a multilayer toroid type vertical winding and a saddle type horizontal winding. This facilitates advantageous field design and offers preeminent deflection sensitivity. Coma type errors not controlled by the field design are compensated with a field controller, a ring of high mag-

netic permeable material located at the outlet of the electron gun. Its design ensures dynamic coupling with the magnetic flux of the deflection yoke. Also discussed were the slotted mask aperture designed for a horizontal pitch of 0.65 mm which provides a 600-line video resolution, and the PIL gun with delta dot shadow mask and phosphor providing ultra high resolution as required in engineering monitors or graphic displays. The self-converging deflection yoke in combination with the PIL gun achieves the precision arrangement required within industry limits without any dynamic convergence correction or circuitry. Its convergence performance is independent of scan size, pincushion correction, line voltage fluctuations, or circuit changes through aging. Thus a system with smaller raster distortion, lower power consumption, sharper focus, and a brighter and higher contrast picture is realized in a modern approach to color monitor design.

13. A Primer on Television Pickup Tubes (*Gregory J. Murphy, Amperex Electronic Corp., Slatersville, R.I.*) When television service began in the 1930s, the early cameras used available camera tubes such as the iconoscope. The size of these tubes severely restricted the portability of television, and their performance was far from the ideal. Considerable development work led to the image orthicon and the vidicon. Although smaller and simpler than the iconoscope, the performance of these devices still fell short of the ideal. The need for a better pickup device became even more apparent with the introduction of color television. In 1964 N. V. Philips introduced a new pickup tube much closer to the ideal. This tube was the original 55875 Plumbicon camera tube. The uniqueness of the Plumbicon was that it employed a semiconductor lead oxide PIN diode structure com-

bined with an electron gun to generate a signal current proportional to the light in a television scene. Any device that is designed to produce an electrical image of an optical scene has some limitations. These limitations include resolving power, sensitivity, and lag. The development of diode gun and low capacity versions of the Plumbicon has significantly improved the performance of this device and brings the Plumbicon performance very close to that of the ideal pickup service.

14. Current Developments in Television Camera Tubes (*K. Blair Benson, Video Corp. of America, New York, N.Y.*) For many years since the inception of commercial television broadcasting in the 1940s, the choice of pickup tube was limited to the image orthicon for studio and field applications, and the vidicon for transmission of films. Some variations in the design of these two basic transducer systems were introduced to satisfy the demands for improved gray scale, greater resolution, and lower noise. Examples were the 4½-in (11.4-cm) image orthicon for monochrome cameras, and the 3-in (7.6-cm) close-spaced target image orthicon for first generation color cameras. This latter application was rapidly supplanted in 1965 by the Plumbicon, the first vidicon-type tube using a semiconductor target rather than a deposited photosensitive surface. The outgrowth of this initial revolutionary approach to target construction has been the development of a variety of pickup tubes and companion camera designs suitable for a wide range of operating requirements and, equally important, cost considerations. In addition, the vidicon has been made available with different photocathode materials in several sizes, each to meet a different broadcast or closed-circuit need. The myriad of camera tubes currently manufactured in the U.S. and overseas is exemplified by the list of tube types from one major distributor. Over forty different types are offered for broadcast service. Furthermore, no longer can many of the various types be identified by generic names, since some are unique to a specific manufacturer and have been assigned a product name. Some of these new types and nomenclature are: Leddicon, Vistacon, Chalnicon, Saticon, Newvicon, and Trinitron. In order to provide the user, as well as the equipment designer, with some clarification of the present chaotic situation, a classification and description of currently-available camera tubes by generic or traditional nomenclature was given. The characteristics, advantages and limitations, and recommended applications were discussed. Lastly, the relative initial and operating costs were compared.

15. Test Materials for the Alignment of Telecine Colorimetry (*Richard F. D. Corley, D and S Corley Limited, Rexdale,*

Ontario, Canada) A number of factors determine the characteristics of a series of test objects to be used for the operational testing and alignment of telecine colorimetry. These factors were examined, and the characteristics of film, telecine, and display kinescopes were considered in defining desirable attributes of test materials. The overall system aim of reproducing film through the television system to match its projected image led to the development of a mathematical model of an ideal telecine chain. Design, analysis, and calibration of test colors using this model have made it possible to produce a series of test objects that enable telecine operators to match the characteristics of their telecines as closely as possible with those of the ideal. These test objects are a series of slides and films of specified spectral characteristics and chromaticities. The patterns are produced on dye image film stock, each pattern incorporating a series of gray and/or colored patches. The patches have been designed to produce easily identifiable displays on the waveform and vectorscope monitors of an accurately aligned telecine chain, while providing a comprehensive test of the parameter being measured. In production, spectrophotometric data are fed to a computer that uses the ideal telecine chain model to produce the individually calibrated waveform and/or vectorscope simulations that accompany each test object. Tolerances of test materials are measured in the $L^*u^*v^*$ color space and represent the smallest color error that an observer can identify when viewing similar colors on two adjacent television receivers under standard viewing conditions. The ideal telecine chain model was also used in the evaluation of color differences resulting from alignment of television cameras for various phosphor systems. Differences were calculated in terms of $L^*u^*v^*$ color space and vectorscope output for a set of six test colors reproduced through three phosphor systems (NTSC and two modern phosphors). The results showed that, although differences exist between the mod-

ern phosphor sets, alignment to either one will produce only imperceptible color errors on most kinescopes, whereas the differences between these phosphors and the NTSC system were such that serious color errors would result from the display of pictures (which had been generated for the NTSC phosphors) on a typical modern kinescope.

16. Character Generators and Allied Species (*Eugene Leonard, DaVinci Research Group, Port Washington, N.Y.*)

This paper discussed the past and present development and predicted future development of the equipment that is generally referred to as character generators. Three classifications were discussed: character generators, titling generators, and graphics generators. The technical characteristics and circuitry were presented for each of these categories, and the impact on operating and display capabilities was covered. The discussion included methods of constructing characters and other shapes, as well as the assembling of shapes in the composition mode for the various categories of equipment. In addition, various types of peripheral equipment and their applications were noted. The role of the character generator used in conjunction with other "effects" equipment was also discussed. Finally the next level of digital graphics technology was anticipated, and the practical and economic effects that this would have on various aspects of television production were indicated.

17. Video Disk Replication with Photopolymerizable Resins (*R. J. Anderson, D. J. Kerfeld, and T. W. Lewis, 3M Co., St. Paul, Minn.*)

This paper outlined the requirements placed on recording and replication materials by the storage of information at high, television-compatible, densities. Also described was a replication system for the production of videodisks and the performance of such disks. The stored information usually corresponds to a color television picture, its luminance sig-



Toni Roth, first woman Governor of the SMPTE.

nal, with the addition of a color subcarrier modulated by chroma. This signal is used to frequency-modulate a high frequency carrier. Temporal frequencies are converted to spatial frequencies and recorded on a disk. In recording, the modulated carrier is used to turn the laser on and off. The modulated laser exposes a positive acting photoresist which when developed becomes an array of pits and lands. The speaker next discussed the precision required in recording pit dimensions. Other disk properties are essential. One is disk flatness, necessary to maintain focus. Another is track circularity to maintain the focused laser spot centered on a particular track. To make a replica, one technique used by 3M involves liquid photopolymers in a cast and cure process. The stamper is covered with a liquid photopolymer and a backing sheet. The polymer is cured by UV radiation, and as a unit, polymer and backing are stripped from the stamper, forming the replica. This process can be carried out at room temperature with low pressures,



Nancy Littlefield of Mayor Koch's office, Leonard Coleman, and Mrs. Robert (Edna) Smith at the Board of Governors reception.



In friendly discussion at the Board of Governors Reception, Edward Blasko of Eastman Kodak Co.; Donald Breidt, Executive Director, SMPTE; Findlay Quinn, Medallion Film Laboratories, Toronto; and K. Blair Benson, SMPTE Editorial Vice-President.



In the SMPTE membership booth Josephine LaVecchia is filling out an application for a prospective member.

and thus exerts very little stress on the replication stamper. Replicas made by this process are checked for performance by measuring the signal-to-noise ratio, flatness, and roundness of the information track. In addition, the replicas are environmentally aged and then checked for dimensional stability and scratch resistance. The photopolymers used in making replicas have been formulated to provide an abrasion resistant replica. Scanning electron micrographs documenting the resistance to abrasion were shown.

TUESDAY AFTERNOON

Motion Picture New Film and Equipment

18. A Television Equipment Primer for Filmmakers, Technicians, and Producers (C. Robert Paulson, AVP Communication, Westborough, Mass.) In the television industry, production and post production have finally become two distinct and highly specialized functions. Equipment for electronic field production (EFP) has reached capabilities analogous to the film format in its various widths, from the super-8 format to 70-mm film. Electronic post production (EPP) equipment can now duplicate and even surpass pictorial and sound effects obtainable with film. New capabilities are being introduced by the month. Much of the use of the new electronic video equipment has been known as "film style use." Paulson discussed in film production language the capabilities and control interfaces of the electronic apparatus. The best of film and video techniques should be merged to obtain a maximum of creativity at a minimum of cost. Given the fast pace of television's technological development, the filmmaker who enters this field should make the move

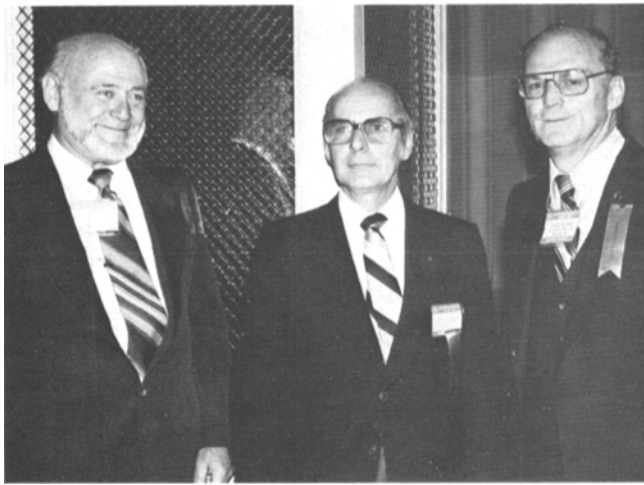
with a well planned sequence of equipment acquisitions. Before purchasing equipment, an analysis should be carried out, comparing renting and purchasing costs, in view of future savings from the investment.

19. A Collection of Persistence of Vision and Other Motion-Producing Devices, 1830 to the Present (S. F. Spira, Spiratone, Flushing, N.Y.) The history of the development of the inventions and concepts that led to the introduction of modern cinematography has been ably covered by many and is also the subject of numerous museum exhibits. The three major figures in the years immediately preceding the actual invention of motion picture apparatus, the American, Muybridge; the Frenchman, Marey; and the Polish-German, Anschütz, have been given ample credit, with perhaps more literature available on Muybridge and his work than on any other individual connected with the history of photography. The author's collection relates, he stated, to the many "minor" inventions that led to the development of the Cinematograph, as well as to other moving picture producing devices which have no direct bearing on the production of motion pictures. However, his collection does not stop with the 1890s. It continues to the present day, because many of the devices developed in the 19th century proved to be popular optical toys, and many are even now reintroduced in different versions for entertainment and advertising purposes. Slides were shown on the many devices — some showing both the early and the modern versions — based on the 19th century concepts of persistence of vision. These devices were complemented by show books and magazines. "Because these devices are so closely related to the very field in which we all work," the speaker stated, "I hope that my talk will stimulate others to seek out exam-

ples of interesting motion producing devices so that more of these will be preserved for future generations, and greater appreciation will be gained of the efforts of the early inventors in a field which has since acquired such tremendous importance."

20. Design Challenges in Developing a New 16-mm Film Editor (Vernon B. Bushway, Jr. and Robert Olodort, Cinema Products Corp., Los Angeles, Calif.) An experimental prototype of a 16-mm film editor was invented by one of the authors (Robert Olodort). Using this as a starting point, the authors and an engineering team from Cinema Products set out to design and develop a fully professional editing console that would serve all phases of the 16-mm editing field yet be comfortable to work with, easy to maintain, and also economical and compact enough for an editor to own and store in his own home. The development of this piece of equipment required the use of diverse engineering disciplines: electrical, mechanical, and optical engineering. Out of this challenge there evolved an entirely new concept in editing tables utilizing simpler mechanics, plastic and glass optics, and unique electronic systems. The result of this program is the U/F-16 editing console, which features a unique patented design combining advantages of upright editing machines and those of modern sophisticated flatbed editing machines in a single lightweight and compact unit; this unit has a unique hollow polygon system for continuous flickerless projection, good sound quality, and an electronic time/frame/footage counter that is designed to accept a future time-base coding option. Of special interest is the unique terraced arrangement of all feed and take-up plates, which permits all sprocket wheel assemblies to be arranged in a vertical synchronizer-type configuration for easy marking, syncing, and cutting of film. This arrangement also places all plates within easy reach of the editor without requiring him to stretch, while yet providing him with ample tabletop work area. The simplified design and rugged, modular construction of the U/F-16 make it extremely reliable and easy to maintain, permitting the editor to concentrate on the creative editing task without worrying about the editing machine.

21. SOLVIT: New Innovations in Film Splicing Technology (C. F. Mossman, R. C. Barnett, and R. Sharpless, Rank Film Laboratories, London, England) When running positive processing machines at 300 ft/min, Rank Film Laboratories found it necessary to support cement film splices with a small piece of polyester tape on the base side of the film. These splices had been made with a foot splicer in use for many years. The quality of splices made with this equipment was critically dependent on the precise setting of the scraping blades on the diligence of the operator. A



Chester Beachell, Arnold Schleman, and Robert Smith at the reception preceding the Awards Luncheon.



Charles Ahto, Nancy Littlefield, and Leonard Coleman at the pre-Luncheon reception.

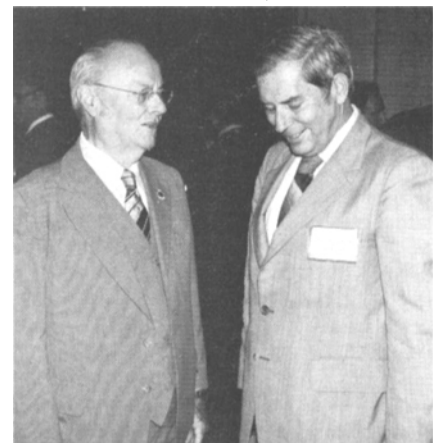
need was recognized for a splicer to (1) remove both cell surface and emulsion, (2) produce a splice which can be run through the processing machine at 300 ft/min (91 m/min) without needing a protective support, and (3) form the splice precisely on the frame line. The splicer developed at Rank Film Laboratories utilizes the linear bearing principle and comprises two carriages. The left-hand carriage moves laterally, and the right-hand one moves vertically. The transverse lateral movement of the left-hand carriage enables both ends of the film to be trimmed and scraped clean of cell surface and emulsion and a liquid joining agent to be applied. The right-hand carriage allows a vertical movement which precisely overlaps the two scraped ends. The joining agent is a solvent with special additives rather than a film cement. It produces a stronger, cleaner join even though the overlap is only 0.050 in (1.27 mm). The precision-made splicer allows for consistent machining of cell and emulsion, using diamond blades. Several units are now under field tests and their performance has been encouraging. They are currently undergoing trials for splicing cut negatives.

22. Evolution of the 35mm Motion Picture Camera (*Karl Malkames, Karl Malkames, Inc., Scarsdale, N.Y.*) Twenty-four years ago SMPTE Life Fellow Don Malkames produced a three-reel documentary film, tracing the history of professional theater projection as seen through the Malkames collection of cinemachinery. Over many years since then, the Malkames family has been encouraged to complete another film displaying its camera collection in the same fashion. The result is a 33-min film, *The Motion Picture Camera*, that was shown during this presentation. The film provided a fascinating and intimate look at the camera equipment used during the so-called silent era. Don Malkames himself operated many of these machines during his career, starting at the Fox studios in Hollywood, back in the early twenties. His

son, Karl, and grandson, Rick Malkames, as second and third generation cameramen, continue the tradition. They have added to the collection, devoting tender loving care to these historic instruments of their profession. The Malkames presentation was derived from the research required to prepare the narrative for their documentary film. It draws attention to the origin of the 35mm standard filmwidth and to the most prominent 35mm cameras in use from the very beginning up to the advent of sound.

23. A Balanced Tension Servocontrolled Film Transport System (*John P. Seabourne, Sigma Film Equipment Ltd., West Sussex, England*) A balanced tension servocontrolled film rewinding system that minimizes the risk of damage in negative handling was presented. Most film damage results during winding operations. Thus, the first design priority was to create a safe *hands-off* negative winder using balanced controlled tension. Today, a negative is often manipulated on winders basically like the ones of 40 years ago. They are not the best devices for handling valuable negatives, but there is no way of avoiding the many negative handling operations. Until recently, the technology necessary to create a safe hands-off winder did not exist. Today, reels of greater diameter and fast winding cycles are essential for modern laboratory operation. Sigma Film Equipment decided to produce a winder using technology not previously applied to winding motion picture film. Three years ago, a preproduction model was created that was considered absolutely safe for hands-off winding of negatives. The basic problem was to persuade a major laboratory to test the winder for a reasonable period. Finally, Rank Laboratories agreed to undertake tests. The results were conclusive, and subsequently Rank placed orders for some 15 winders. The Mark IV Auto-wind is now widely used in Europe, and the author stated his belief that it has made a significant contribution to eliminating the

risks of negative damage. It is based on the principle of maintaining controlled tension throughout the winding cycle irrespective of the size of the reels on the feed and takeup spindles. Tension also remains controlled during acceleration and deceleration and also when stopping and starting at any point during the wind. Stop and start are electronically controlled and are very gentle and progressive. Change from the 35- to 16-mm format is by simple switching which automatically applies the correct tension for the film gauge selected. The speaker then gave further technical performance data in detail. A further development was the design of a negative inspection table incorporating the new winder principle, and finally, a two-way transport system without hold-down rollers for 2000-ft A & B assemblies, which can be used for frame count, cueing, and timing operations. One important use of this negative winding system in the form of left hand and right hand "towers" is to transport the A & B rolls across the color analyzer head to avoid the high risk to the negatives during timing operations.



Loren Ryder chatting with Richard O'Brien at the cocktail party preceding the Fellows Luncheon.



Eric V. Knutsen, Chairman of the Tuesday morning session on Motion Picture Film Production, and Frank Giovanelli, Vice-Chairman.

The paper that follows was originally scheduled as No. 9 on the Conference Program.

24. Motion Picture Image Stability (*C. Bard and P. T. Kurtz, Eastman Kodak Co., Rochester, N.Y.*) After a brief and illustrated discussion of the methods used and operations carried out by the Eastman Kodak dye stability testing laboratory, a wealth of data on color film dye stability was provided by this paper. Reliable predictions can now be made for the density loss in the various layers of a color film over a period of dark storage time as a function of temperature, humidity, and atmospheric constituents. Exposure to light is not normally of much concern. The actual amount of light received by a print, projected 300 times, is equivalent to only an exposure of 10 fc for 10 h a day during six months. But if, during dark storage, temperature is increased from 75° to 86°F, dark-keeping stability will be cut in half; if, on the other hand, temperature is reduced to 45°F, dark-keeping stability is predicted to improve ten times. At 14°F predicted improvement will be 110 times, and it will be 1000 times at -15°F. Recommendations for storing and preserving processed films were made. They included selection of an appropriate print production method; processing in strict accordance with the manufacturer's specifications; storage of processed materials under carefully controlled temperature and humidity conditions; and other measures of vault storage, moisture-proof sealing, and periodic inspection. In addition, Kodak provides Eastman color LFSP print film 7379, which exhibits improved dark-keeping stability when compared to the existing SP print film 5383. Four methods for the production of release prints were described and their bearing on dye stability of the resulting print, as well as on the keeping properties of the original record. Many other details were given, too numerous to list in this summary. "As film professionals," the author stated in conclusion, "one needs to be mindful of the mutual responsibility [of the user and the manufacturer] in one's decisions about both print production and the storage of



Audience at the Tuesday morning session on Motion Picture Film Production.

valuable originals. We must all share this responsibility."

Computer Graphics

25. An Introduction to Digital Computer Graphics for Video (*Rodney Stock, Ampex Corp., Redwood City, Calif.*) This paper was intended to serve as an introduction to the field of digital computer graphics for an audience in video broadcast engineering. It included a brief description of computer graphics as presently used in the television industry. Then some relevant display technologies were described. Various image representation and generation techniques were also discussed. For the various technologies, attention was given to the terminology and its advantages and disadvantages. Frame store systems were emphasized in the discussion and future trends in video image generation were suggested.

26. Interactive Graphics and Real-Time Animation for Television (*Richard G. Shoup, Aurora Imaging Systems, San Francisco, Calif.*) The value of computer graphics in television production is greatly enhanced if graphics and animation can be produced interactively, in real time, and directly in the video medium. Real-time "videographics" in a raster-scan system have generally been prohibitively expensive due to the large bandwidths and computing power necessary to change an image rapidly. Mr. Shoup's presentation described a simple method for providing a limited — but very useful — real-time interactive animation capability in a frame buffer based display system. This method, called "color table animation," relies on continual modification of a single frame buffer image by table look-up techniques. The additional hardware required is sim-

ple, but a well designed human interface is essential to allow the artist to easily and flexibly create and control the animation.

27. Assessing Computer Graphics Software (*Peter Black, Xiphias, Santa Monica, Calif.*) The video engineer can no longer hope that if he closes his eyes the computer will go away. The world of digits and bugs and software acquisition must be faced. In facilities such as the computerized newsroom and where computer graphics are generated, software — programs that direct computers to perform specific functions — will be a particular problem. Most organizations will place a high value on proven packaged software, which is more than just a stack of IBM cards or a couple of floppy disks. A good software package includes the software product, accompanied by good thorough documentation, installation, training, and continuing support; it is finally more service than product. Under the heading of computer graphics there are many subheadings, but two in particular are: "paint" or "sketch" systems optimized for the production of freehand artwork, and information display systems optimized for the creation of charts, graphs, maps, etc. Various sources of software packages were considered in this presentation, along with their respective advantages and disadvantages. Sources include: in-house, hardware vendors, software houses, software brokers, and turnkey systems suppliers. A number of key questions were spelled out that ought to be asked by anyone acquiring software.

28. Digital Animation Techniques (*Lance Williams, New York Institute of Technology, Old Westbury, N.Y.*) Digital computer technology has begun to make substantial inroads in commercial and special effects animation. The spectacular results made



An intent audience at the Motion Picture Film Production session Tuesday morning.

possible by digital computers may have a new and different look which distinguishes them from the more familiar optical, mechanical, and hand-drawn methods. As yet, however, the new technology is little known; it may be difficult to select the digital animation technique appropriate to a given project from the various commercial computer-animation shops, whose approaches vary greatly. It is instructive to characterize what kind of animation a digital computer can produce by the kinds of information that it is programmed to manipulate. The kinds of information can be usefully organized by their basic geometry. Animation can be performed with points, lines, areas, surfaces, and volumes. In this hierarchy, the complexity and the expense of the animation increase with the dimensionality of the data. The expressive power of animation is still very much the responsibility of the artist, but an overview of the various digital techniques can be very helpful in composing a particular sequence or effect. For many applications, conventional methods may prove quicker and more economical. To realize the unique power of the digital approach, it is necessary to choose the application carefully.

29. Computer Graphics in Motion Picture Special Effects (*Alvy Ray Smith, Lucas Films, San Anselmo, Calif.*) The term computer graphics means different things to different people. The speaker clarified what the term means to him by posing a number of questions that led to a more precise classification of the term. Is there digital control or a digital signal? Is there any memory in the system? (If there is, we have true computer graphics.) The related term computer animation may be defined as "the giving of life to line drawings." Additional important questions include the kinds of programs available and the resolution of the system. It was next indicated

that a computer can help in the filmmaking process. It can do the "bookkeeping" — keeping track of individual pieces of film and handling of "movie status" record-keeping. In conclusion the speaker showed some behind-the-scenes shots involving motion picture special effects, including blue screen techniques and matte painting.

WEDNESDAY MORNING

Television Production and Post Production

30. Design Considerations for an Electronic Cinematography Camera (*R. Streeter, CBS, New York, N.Y.*) The application of television to cinematography imposes camera requirements which in some respects are similar to those of an ENG camera. The camera and its companion VTR should be essentially a very high quality, reliable, and rugged ENG system. However, in addition to the much more stringent performance requirements, there are a number of other departures which are required to optimize this camera for use in single camera cinematographic productions. The camera should be physically and functionally similar to the traditional 35-mm film camera. Special attention must be given to the choice of the camera sensors, optics, and circuitry, taking into account what has sometimes been referred to as the "film look." Resolution, image enhancement, lag, noise, and transfer characteristics were some of the areas considered by the author. In keeping with the techniques of 35-mm film work, a similar inventory of equivalent focal length lenses, filters, and special effects devices should be available.

31. Zoomlens: History and Present (*Frank G. Back, Consultant (retired), La Jolla, Calif.*) The concept of the variable



Irwin Young of Du Art Film Laboratories presenting a paper entitled "How Would a Feature Shot in Super 16 Compare with One Shot in 35mm on a Theater Screen?" at the Tuesday morning session.

focal length lens or zoom lens is as old as cinematography. Several early zoom lenses were constructed with variable iris adjustments, but they had very limited uses because cams with the necessary accuracy could not be produced and this led to poor picture quality. These shortcomings led the author and two assistants (Herbert Lowen and Leonard Bergstein) to examine the mathematical principles of an optically compensated zoom lens which had no cam requirement. Solving this problem allowed such a lens to be manufactured. The only practical way to keep the f value constant is to locate the iris behind the last movable lens element. Furthermore, every optically compensated zoom lens has to have a separate group of lenses to change the focal length and another one to compensate for focal plane shift. Between those groups there must be a group that remains stationary. Five lens groups with specific functions were therefore necessary: the focuser, the variator, the erector, the compensator, and the relay. This history on the evolution of the zoom lens was recounted, along with efforts to bring down aberrations to the same level as standard photographic lenses. Initially the only practical zoom lenses for cinematography were optically compensated lenses, but later on, mechanically compensated zoom lenses became possible when cam technology was improved. The latest zoom lenses, from various manufacturers, use combined optical and mechanical compensation to achieve picture quality as good as standard non-zoom lenses.

32. A Lightweight Portable Broadcast Camera with Optional Digital Control (*Y. Miyaji, Naotake Morita, and Tamotsu Nishizawa, Toshiba America Inc., Sunnyvale, Calif.*) This presentation described Toshiba's new, compact, lightweight, broadcast quality, portable color camera (model PK-60) with optional digital control. It has been designed for ENG, EFP, and studio applications. To facilitate the



The record-breaking exhibit was visited by thousands of interested persons.

use of this camera in ENG applications and to make it as lightweight, compact, and portable as possible a building block design was chosen. In this design, the overall size of the camera head, the complexity of camera control, and the type of accessories used all depend on the intended use — ENG, EFP, or studio use. The basic functions required for a broadcast quality camera have been packaged as one unit together with a 1.5-in viewfinder. It weighs 9.4 lb (4.26 kg), and its dimensions are: length 11 in (28 cm), width 3¾ in (9½ cm), and height 9 in (23 cm). The camera head is of ruggedized construction, made of cast magnesium alloys and aluminum. For specific purposes, a combination of optional accessories will provide the required functions. The speaker then enumerated available accessories in the areas of sound, remote control, digital memory adapter, automation of setup by means of a microprocessor unit, and a setup box for setting up the digital memories in one or more cameras sequentially. The microprocessor can operate as a stand-alone unit, or it may be incorporated into the base station. In its simplest form, field operational controls are limited to lens control, automatic white balance, gain, and iris control. In its full functional form the engineer may set up all camera parameters either manually or automatically by means of microprocessor units. The camera can be operated with analog transmission or with a digital triaxial transmission system. The speaker then elaborated on the options that can be used in either the analog or the digital configuration. This equipment is to be available in North America starting in November 1980.

33. The Cost of Camera Mobility: Part I-Conventional Cameras; Part II-Lightweight Cameras (*W. P. Vinten, W. Vinten Ltd., Suffolk, England*) The first half of this paper made an analysis of the camera mobility means in use today. The author stated that, until now, mobility means had been designed for camera plus lens combinations in the 200-lb weight range. The cost of television camera mobility can be evaluated in terms of dollars per inch of height deviation above and below a normal lens height of 4½ ft (137 cm) above floor level (the average normal eye level of man). The available range of tripods, pedestals, dollies, and cranes was analyzed under application of this criterion. It was found that when the mobile height range is increased beyond the normal accepted eye level range of man, the cost per inch factor changes significantly. To this was added the increase in cost linked to the degree of achievable lateral mobility that can be obtained with the various available camera mounts. The second half of the paper was dedicated to the future and the potential effect of the use of lightweight camera plus lens combinations in the studio. Increased camera mobility and attendant cost were considered. This cost must include the re-



Past President Kenneth M. Mason addressing the newly elected SMPTE Fellows at the Fellows Luncheon.



Officers and newly elected SMPTE Fellows at the Fellows Luncheon.

training of personnel if radically new equipment is to be adopted. The question is whether the television industry will accept the retraining of cameramen resulting from the introduction of radically new equipment. The use of lightweight camera and lens combinations will give little gain in camera mobility if the conventional means of camera operation — camera mobility handling — are to remain in use. If mounting systems for lightweight cameras are used to obtain greater mobility, the benefits are balanced by the demands of greater skill from the operating personnel. Skill is directly related to camera mobility. The speaker then tried to answer an important question: "If we increase camera mobility and thereby make the cameraman's job more difficult, will there be any overall gain or loss in production efficiency?"

34. Automated Enhancement for Portable ENG Recorders (*Yves Faroudja, Faroudja, Inc., Los Altos, Calif., and Joseph Roizen, Telegen, Palo Alto, Calif.*) A new patented system for use with ENG and EFP video recorders was described. The major problem often encountered with enhancement equipment for "color under" recorders is that the multiple adjustments made by operators to optimize such factors

as signal-to-noise ratio, contour correction, chrominance-luminance delay, and others, often leads to degraded results. The principles and circuitry of the new system were designated to eliminate operator adjustments. Means were provided whereby the system becomes self-correcting through the use of a "training" signal at the input and automatic sensing with commensurate correction at the output. A special pilot signal, inserted in the vertical interval (and subsequently eliminated), is added to the record path where additional small signal processing is performed. This is accomplished by a very compact circuit that can be attached to the portable recorder with a single cable connection. The playback unit then uses the pilot signal variations of the "color under" VTR to automatically correct the video signal and restore it to its best subjective potential. The combined action of pre- and post-recording correction produces a result which includes 6-dB signal-to-noise improvement in both luminance and chrominance, horizontal crispening of image edges to 160 ns, for up to 300 ns, transition, enhancement of vertical transitions, and chrominance-luminance delay correction of ± 300 ns. The speaker stated that substantial subjective image results were achieved, because the combined effect of

processing the various signal parameters produces cleaner, sharper pictures without the cartooning effects of overenhancement and with the retention of small signal detail, often lost in low-cost ENG videotape recorders.

35. A New Approach to Space Ships and Aerial Scenes in Television Productions (*Reginald King, Evershed Power Optics Ltd., Chertsey, Surrey, England*) Since stories were first told through the medium of motion picture and television production, one of the continuously popular subjects has been flight. More often than not the flying sequences become the best remembered part of some of these productions. But such effects are very expensive. Space subjects are of necessity made with miniatures, leaving the flying of conventional aircraft to the expert stunt pilots. Almost invariably the video side of the industry cannot afford to produce flying subjects. This paper described how the video industry can now consider stories that contain space or conventional flying sequences. This newly possible consideration is based on experiments carried out after the development of the so-called "Scene Sync" system that enables cameras to pan through an arc of up to 90° while



At the Fellows Luncheon, President Smith addresses the group.



At the Fellows Luncheon, Harold Eady, Maurice French, and Charles Ahto.



Kenneth Mason, Gerald Graham, Robert Smith, and Jean Pierre Houguenade at a meeting of the International Relations Committee.



A meeting of the Committee on Video Recording and Reproduction Technology (Chairman David Fibush).



A meeting of the Committee on Theatrical Projection Technology (Chairman, Jack Baer).



Alex Alden, Jack Baer, and Roland Zavada at a meeting of the Committee on Theatrical Projection Technology.

using chromakey. In its basic form, the system is in regular use in the U.K. At the time of its development stage, BBC produced a series about a pilot in the Royal Flying Corps. The flying sequences were limited by budget. True air to air shots were not possible, because a 1915 flying replica plane was out of the question and would have presented many filming problems. Therefore, the old method was used of mounting a nonflying replica biplane on a tubular structure. Thus, a great deal of the realism and excitement was lost. For the author, this was a disappointment, because the shots were not what they should have been. Consequently, experiments were carried out to see how the Scene Sync system could help. Two categories of shots were contemplated: air to air and flybys. The author described first how the Scene Sync system works and how it can be used for a basic chromakey situation. This was illustrated by a short videotape. An interesting series of slides showed how the system can be applied to space and aerial subjects. During the experiments carried out for this presentation, great care was taken to ensure that all effects tested can be carried out under normal studio conditions. The presentation concluded with a tape that showed how the illustrated effects will actually appear on the screen.

36. Recent Advances in the Fast Charging of Sealed Nickel Cadmium Batteries (D. C. Hamill and E. K. G. James, *PAG Power Limited, London, England*) The

scaled nicad battery is commonly used as a portable power source for film and video cameras and for lighting units. To reduce the down time for such batteries the quickest possible recharge time is desirable. This could lead to problems of short battery life due to overcharging. A charge termination system has been developed that provides reliable fast charging of fully or partially discharged nicad batteries. The speaker stated that the system is so safe that it can be applied to batteries that are already fully charged without impairing them. He then discussed the theory and chemical reactions proper to the charging process. When overcharging of a nicad cell occurs, oxygen gas is evolved at the positive electrode and recombined at the negative electrode. These reactions will generate not only heat, but also internal pressure and a somewhat higher cell terminal voltage. The pressure may eventually blow out the cell's safety vent, reducing the cell's life. The speaker then enumerated the various methods that have been used to terminate at the proper time the fast charging cycle. All these methods have disadvantages. A recently developed method of cell temperature sensing overcomes these difficulties and gives an accurate and repeatable indication of the onset of overcharge. The thermal characteristics of a D-size nicad cell have been determined, and an equivalent electrical circuit has been subjected to numerical analysis by digital computer. The results were confirmed by actual measurement of nicad cells. It was shown that good rejection

of ambient temperature variations was obtainable while maintaining high sensitivity to overcharging. A fast charging system based on temperature controlled termination of the charging process has been designed. Many hundred units have been successfully in use over the last three years.

37. Flying Spot Scanning on 525-Line NTSC Standards (John D. Millward, *Rank Cintel, Hertfordshire, England*) For the past three decades Europe has enjoyed the advantages of continuous motion, flying spot film scanning, these advantages being high resolution, high contrast, no image retention, and no requirement for color registration. Film scanners of this kind simply consist of a single flying spot, cathode ray tube with a broad spectrum of light output, a film transport, image forming optics to scan the film, and color splitting optics to excite three photomultipliers. Since these photomultipliers are only light collectors and are not present in the imaging section, as previously mentioned, there is no color registration requirement. Because the cathode ray tube cannot produce a stored image, the film must be transported in field blanking or must be moved continuously with some form of image immobilization. In Europe the most common television standard is 625/50; therefore, films are driven at 25 frames per second, and two field scans of each film frame are required; a very convenient ratio. It was therefore possible to design a twin lens telecine



Meeting of the Committee on Theatrical Projection Technology.



where each objective lens provided one field scan as the film moved continuously through the vision gate. Therefore half the vertical scan was provided by the film motion, and a half-height stationary raster was required on the CRT, with a shutter selecting the required objective lens for each field scan. Unfortunately the twin lens system cannot be applied to the 525/60 standard because the requirement for alternate two and three field scans would require five instead of two objectives, and thus be quite impractical. An alternative system is to move the scanning raster to follow the film and to use only one objective. Until 1973 the problem here was the variation in afterglow characteristic of the CRT with temperature and beam current, which caused afterglow flicker. In 1973, however, a new phosphor that overcame these problems was developed. At the same time, integrated circuits were becoming available to correct for the geometry and brightness errors produced by the moving raster. Therefore, in 1975 a multistandard multiformat flying spot machine was introduced to the market. This telecine was mainly confined to production houses where there is a demand for high quality and operational flexibility and where the necessary alignment time is available. The only limitation was the alignment time, and further development proceeded to eliminate this requirement. Rather than develop automatic-alignment systems provided with color cameras, it was envisaged to develop a means to eliminate critical alignment affecting flicker. This was achieved by using

a 525/24 sequential scan of each film frame. The scan is stationary on the tube, and since odd and even field scan lines are adjacent, as in a flying spot slide scanner, there is no possibility of field-to-field registration and brightness errors. The nonstandard 525/24 sequential picture is converted to 525/60 interlaced by using a digital store. Therefore, it is now possible to provide a flying spot film scanner with geometry and flicker errors eliminated and the operational flexibility required for production use.

WEDNESDAY AFTERNOON

Motion Picture Laboratory Technology

38. An Interchangeable Format Total Immersion Wet Printer with "Damage-Proof" Transport System (*W. D. Carter, Carter Equipment Co., Inc., Lawndale, Calif.*) The ninth year of research and development in the technology of total immersion wet-printing equipment has resulted in the development of a line of laboratory proven, practical, and economical total-immersion continuous-contact sprocket-registered wet printers with interchangeable formats. These machines have the printing tank and drive components mounted on a single plate which can be removed as a unit and replaced in less than five minutes. To achieve this, a modification of the conventional transport system was necessary. The result, a damage proof

film transport system, removes all inertial loads transmitted to the film, except those of the driving sprockets themselves. Perforation damage is virtually eliminated. Electromechanical clutches isolate the film driving sprockets from the drive components, such as motors, gears, flywheels, etc. By application of the concepts utilized in the Carter Equipment interchangeable format wet printers, and of the magnetic clutch couplings utilized in these printers, existing printing machines can be upgraded to a higher level of operational performance. Details of construction and design, as well as the dynamics of film transport mechanisms in general, were discussed during the presentation. Also, applications to other types of printing machines were discussed, including tension sensing devices which disconnect the driving system before film damage occurs or permit slip-



Frederick Kolb, Norman Ritter, and Carlos Kennedy at a meeting of the Working Group on Video Test Materials. Kennedy is Chairman of the Group.

page during dissipation of rotational inertia forces. Engineering details such as electronic control circuitry, fluid circulation systems, etc., were also described. Interchange operations are performed quickly and reliably by the operator from the front of the printer without adjustment or removal of drive components. The resulting operational advantages were emphasized. The discussion was complemented with film tension data at various transport speeds and the description of parameters indicating the flexibility of the new transport system and its possible application to new or existing printing equipment. Demonstration films of display modules in operation were shown.

39. Persulfate Bleach and Motion Picture Film Processes (*R. C. Sehlin, Eastman Kodak Co., Rochester, N.Y.*) Mr. Sehlin's paper summarized two years of successful experience with sodium persulfate bleach in reversal and negative/positive motion picture processes. First, the important parameters governing persulfate bleach performance were reviewed. Then, the major advantages of using persulfate bleach were discussed. Kodak's successful experience with persulfate bleach has led to several changes in process specifications, and these were discussed in detail. These changes include a new sound developer formula that facilitates repairs of sound developer misapplication errors, a persulfate bleach accelerator additive that increases the accelerator tank solution life, and a simplification of the bleach tank formula.

40. REGENOMAT — An Electronic Replenishment System Brings Remote Control to the Operator's Fingertips (*Yngvar Cramer, Schwarz Filmtechnik, Ostermundigen, Switzerland*) Today's laboratory customer asks for faster film processing and official regulations ask for less polluting effluents. While the first demand is met by high-temperature processes, the latter is complied with by using more concentrated processing formulas and recycling techniques wherever possible. Film processing machine solutions are subject to continuous change due to chemical reac-

tions, and to carryover from bath to bath. Baths are replenished with appropriate solutions to keep their composition at the same activity level all the time and to maintain constant processing conditions. Deviations from standard replenishing conditions can cause irremediable effects in the processed film. To determine whether the replenishment rate is correct, processing solutions are regularly checked for their chemical constitution, and sensitometric strips are developed at regular intervals. The most commonly used replenishment devices are flowmeters. Their performance depends on many factors such as temperature, viscosity, and pressure drop of the solution. They must be checked and adjusted several times per day to maintain constant and exact replenishment. Thus, proper control can be quite tedious. An alternative way to process-control is offered by a dosing system consisting of a reciprocating pump and an electronic control unit. In this system — called Regenomat — the pumps are normally incorporated in the recirculation system and the electronic control devices are mounted in the main machine control board. The pumps are able to work even against high back pressure, allowing the solution to be injected directly in the return line of the recirculation system and leading to a good mixing of replenisher and tank solution. This is especially important if concentrated replenishment formulas are used. With this dosing equipment, the amount of replenishment required can be set to any desired value directly at the central machine control board, and the numeric display makes supervision of the process easier, as the operator has available at a glance the replenishment rates together with all the other main functions. In an enhanced version of the Regenomat system, three different pump types (depending on the required volumes of replenisher for, say, 35-mm, 16-mm, or leader film) can be connected to the same type of controller to simplify systems design and machine control.

41. Silver Management in a Motion Picture Laboratory (*Paul L. Deer, Calvin Communications, Inc., Kansas City, Mo.*)

The management of silver is a twofold laboratory requirement in today's economy. Present silver prices make the highest degree of silver recovery an economic opportunity. Also, environmental regulations of remnant silver in discharged solutions require mandated laboratory operating restrictions. An engineering approach was described for a motion picture laboratory that makes it possible to obtain the highest possible degree of silver recovery from all sources within a laboratory. This includes the proper design of processing equipment, recovery from solutions, wash water treatment, recovery of silver from waste raw stock, reclamation from rejected processed film, and other practices. Also discussed were methods of accountability to determine the effectiveness of the total recovery system. They included proper marketing of the recovered silver. An effective recovery system will yield not only profitability, but also accepted levels in discharged effluents.

42. Challenges to the Concept of Cancellation (*Roland J. Zavada, Eastman Kodak Co., Rochester, N.Y.*) If motion picture film were perforated to ideal dimensions with no tolerance, and film equipment could position and reposition film without variability, the concept of cancellation of film dimensional variables would be academic. Neither of these conditions existed in the early history of motion picture technology, nor do they exist today. However, we can and do achieve sophisticated titling and special effects and steady images. Early motion picture films had significant dimensional variability, and the concepts of cancellation of these variables were well understood though little documented. Shifts to narrower-gauge formats mandated cancellation concepts and, through their use, acceptable steadiness was and is achieved with 8-mm and 16-mm films. Improvements in film structure and perforating quality allowed some departures from fundamental rules, but recent advances in printing technology to solve some quality problems and to improve productivity challenge the fundamental concepts of image-positioning. The potential



Harry Teitelbaum and William Hedden.



K. Blair Benson and Roland Zavada.

expanded use of commercial "blow-up" of 16-mm originals for entertainment programming again mandates a thorough understanding of basic image-positioning and repositioning concepts. It was the aim of this paper to review the fundamentals of film-perforating and image-positioning and the demands that film dimensional characteristics place on motion picture hardware. In doing so, the objective was to stress the fundamental characteristics of cancellation and how they apply to modern image-capture, printing, and presentation technology, especially stressing the need for the fundamental concepts to be applied to 16-mm blow-ups to 35-mm.

43. Silver Recovery from ECP-2 Wash Waters by Ion Exchange Methods (*Rami Mina, Eastman Kodak Co., Rochester, N.Y.*) Conservation of a very valuable resource, such as silver, is of the greatest importance. About 90 to 95% going into the process is recovered directly from the fixing solution, 2% is found in the tailings, and about 8% ends up in the fix wash. Ion exchange recovery methods are primarily intended for the recovery of silver from the fix wash. This type of recovery consists primarily of two operations: exhaustion and regeneration. In the exhaustion cycle, the resin is loaded up with silver thiosulfate ion from the wash water until the adsorption capacity of the resin is exhausted. An exhaustion curve can be traced by monitoring the amount of silver thiosulfate ion present at the outflow of the resin column. This will indicate the break-through point and concurrent completion of exhaustion. In the regeneration cycle, silver thiosulfate ion is stripped by an appropriate regenerant from the loaded resin column. By monitoring the silver content of the outflowing regenerant solution, a regeneration curve can be plotted. It will indicate the proper end of the regeneration cycle, and the area under this curve will be proportional to the amount of silver recovered. From these curves the efficiency of the ion exchange process can be evaluated. The characteristics of two typical resins were discussed. Tests with both resins were described. Their functioning depends on such factors

as pH, flow rates, concentration of other anions in solution, and column configuration. Adding a second resin column increases the efficiency by 50% over a single-column process. Concrete data for operational parameters were given. They included both cycles: exhaustion and regeneration. The usefulness and application of such regenerants as sodium chloride and ammonium thiosulfate were elucidated. Precipitation characteristics of silver compounds in the regenerant solution were described. Practical ion exchange systems and their operational methods were outlined for two types of resins. Three resin columns give sufficient efficiency. Investment for the complete system would be less than \$50,000, and the amount of silver recovered in a year (at .20¢ per troy ounce) could amount to about \$60,000.

44. The Super Colormaster Processor for Interchangeable 35/16-mm Films (*I. Ryman and D. Macho, Houston Fearless 76, Inc., Carson, Calif.*) A review of the HF line of processors revealed the need for new equipment with an operational range of from 60 to 250 ft/min. This need provided an opportunity to review construction materials, methods of controlling operational functions, and the processor shape itself. The major items in the specifications for the new design included the following: complete modularity, both in the wet section and the supporting components; maximum component access for ease of servicing; maximum operational reliability; and control of the basic functions of the processor by means of a micro-processor. In the wet section, traditional stainless steel tank construction was abandoned to avoid heat loss, chemical corrosion by many new chemicals, and high cost. A new manufacturing method makes it possible to use linear polyethylene or other suitable plastics and produces a seamless tank of dimensional stability and free of corrosion. Threaded plumbing fittings are spin welded to the tank. This construction makes possible the use of the modular concept. A light-gauge support structure secures the tank and also houses the drive system components, the heat exchanger, pump, filter,

and associated plumbing. Each module is manufactured as a separate unit, and additional units can be used to modify or increase processor performance and capacity in the field. A split-rack system is used for the film transport. A top mini-rack incorporates the drive components and has two interchangeable driven shafts, one above solution level and the other for submerged operation. The bottom rack is similar to the upper rack in construction and uses identical parts. It is vertically adjustable in any desired position without a lifter rod protruding. A spring-loaded demand drive system allows film transport at high speed with low film tension. At this point, the paper reviewed briefly the theory of the top shaft demand drive system. The load end accommodates a 2000-ft daylight magazine or dual 2000- or 3000-ft capacity flanges in the darkroom version. A three-shaft accumulator is available in darkroom or daylight versions as required for load or take-up applications. The dryer module is a self-contained unit and one or more can be used to ensure complete drying. The take-up module accommodates single or dual torque motor-driven take-up spindles for flanges with a 2000-ft capacity. It also contains the main control panel, computer rack, and other electrical controls. The control system utilizes a microprocessor and functions as a programmable controller. Its output modules directly control the circuits required for the processor operation. The control system is based on operational mode sequencing to reduce operator error. The operating status of the processor is shown on the control panel by means of indicator lights. A detailed description of the functioning of the controller unit concluded the presentation of this paper.

44A. The Present Status of Disposal of Film Processing Effluents and Solutions in China (*J. D. Jin, China Film Science & Technology Institute, Beijing, People's Republic of China*) Many substances poisonous to living beings and detrimental to the environment are contained in film processing solutions. According to China's environmental protection regulations, existing laboratories, as well as new installa-



Donald Breidt and Charles Ahto.



Leonard Coleman and Joseph Flaherty.



Peggy Caggiano, International Standards Coordinator, SMPTE Staff, at the Banquet chatting with Charles Ginsburg and Charles E. Anderson.



SMPTE Staff Members at the Banquet: Esther Adler, Accountant (accompanied by her husband, Fred); Judy Greenburg, Bookkeeper; Julia Ashley, Secretary; and Donald Breidt, Executive Director.

tions, are responsible for clean-up and treatment of wastes. To this effect scientific studies and experiments have been carried out. They include the following: synthesis, selection, and improvement of ion exchange resins; biological treatment of effluents and wash waters; electrolytic methods for ferricyanide regeneration and recovery of black-and-white developers; ozone oxidizing methods; adsorption by active carbon; ultra filtration techniques for gelatin elimination; silver recovery; and water conservation. In 1958, the Central News and Documentary Film Studio and the Shanghai Film Technical Supply Laboratory started using ion exchange resins for color developer reclamation. Starting in the 70s, Nan Kai University and the army film studio 8.1 Film began synthesizing and experimenting with diverse types of ion exchange resins. The domestically manufactured color print is of the AGFA type, using TSS as the developing agent. The D261 resin is used for removing oxidation products and retaining the TSS. With this resin 40,000 L of developer can be reclaimed annually, equivalent to approximately 1.2 tons of TSS recovered from the overflow. Ultra filtration techniques are used to avoid accumulation of gelatin in the solutions. The Environmental Chemistry Institute of the CAS, in cooperation with 8.1 Film studio, succeeded in applying these techniques using porous tubes covered on the outside with a polysulfone membrane. Eighty-five of such tubes grouped inside a plastic containing tube form a filtering module with an effective filtering surface of about 2 m². Silver is recovered by electrolysis from the fixing baths and by ion exchange methods from the wash waters. Effluent treatment is carried out by means of a biodegradation tower of about 20 m height. Effluents are pumped to the top of the tower and flow from there down through 6 layers of honeycomb filters. Air for bio-oxidation is introduced from the bottom. Flow-through time from top to sewer is about 3 min. The

Science Academy, through its Research Institute of Bacteriology, and the Shanghai Film Studio worked together in cultivating a strain of bacteria to be used in the biodegradation tower. It was originally extracted from the sewer of the Shanghai Film Technique Laboratory. This strain, known as the S-9 bacterium, is most effective. A 48-h goldfish survival test gave a 100% survival rate in treated effluent versus a 20% survival rate in untreated effluent. The Army Academy of Medical Science has performed systematic studies of the toxicity of developing agents, such as CD-2, CD-3, TSS, and metol. It has suggested maximum permissible concentrations in surface waters. The speaker concluded by saying: "You have just heard a brief account of the present status of our initial attempts at treatment of film processing effluents in our country. Film plays an important role in the promotion of modernization. To avoid the damages of effluent pollution, so closely associated with the production of films, we are striving hard in our search for advanced control techniques. This is why I am here, looking for your friendly advice. I hope that this occasion may become one of the many links to further Sino-American friendship."

Problems of Maintenance

45. Maintenance and Repair Considerations in Equipment Design (*Robert A. Williams, Ampex, Redwood City, Calif.*) Maintenance and repair considerations in equipment design cannot be ignored for today's products that are growing in complexity. Ignorance of this will affect the product already in use where the visibility of product quality and the cost of maintenance is high. Economic effects alone point to the necessity of considering, during the design phase, the maintainability of equipment. While consideration of maintenance in design is very beneficial, the skill level of field technicians may also necessi-

tate special documented explanations or circuit additions. The documentation itself must be well organized and specialized. Product design constraints such as weight, power consumption, appearance, estimated costs, and time schedules determine design considerations for maintenance. The goal is to improve reliability and repairability in the field while recognizing the constraints in each particular situation. Product design should include some of the following: (1) warning indicators for detection of subtle faults or degrading performance; (2) fault diagnostics; and (3) arranging or modifying circuits for ease of adjustment and troubleshooting. These goals can be achieved — it was explained — by including in the design, circuits that monitor system inputs, outputs, and important internal signals. This philosophy can be applied to digital as well as analog circuitry. Without equipment "testability" there are many dangers. The ensuing need for more highly skilled field technicians, better test equipment, and extensive documentation may prove excessively costly. Equipment testability is not in conflict with innovative design. It is a supplement to design which helps reduce the costs of maintenance and repair. Designing maintainability into products reduces costs in the field, and increased design costs should be more than offset by reduced maintenance costs.

46. Maintenance and Repair Considerations in Systems and Facility Design (*Steven A. Smith, Broadcast Technology Consultants, Mission, Kansas*) This paper dealt with the design of systems and facilities, including the analysis of factors that determine their maintenance and repair characteristics during their useful life. The electrical power distribution within the facility; grounding and bonding; and design of the heating, ventilation, and air conditioning systems determine the operational environment of the technical systems, and these factors have a direct relationship to the reliability and performance of the sys-

tems and equipment. The technical systems design considerations including performance monitoring, fault detection, fault isolation, centralized-vs.-decentralized installation, series-vs.-parallel distribution, and system reconfiguration modes are vital considerations, which determine the system performance and reliability; improvements in these areas, therefore, reduce and simplify maintenance and repair activities.

47. Diagnostic Techniques: Maintenance and Repair Considerations in the Use of Diagnostic Techniques (Jeff Peterson, *System Concepts Inc., Salt Lake City, Utah*) The shift in emphasis in design from analog to digital in today's television equipment makes it advisable to take a "new look" at diagnostic techniques and associated equipment. This paper offered a direction for maintenance departments to take in order for them to have continued efficient performance in the 1980s. There is no doubt that the digital revolution is here to stay. With it comes an endless list of new components and subsystem strategies. It is also true that much of the emphasis in maintenance is now, and must continue, to remain with existing analog equipment. To combine these seemingly conflicting needs is the challenge. The speaker indicated some of the approaches, equipment, and resources that a technician needs to do an effective job.

48. Selection, Training, Upgrading, and Cherishing of Maintenance Personnel (Norman Rosenshein, *Unitel Production Services, New York, N.Y.*) This paper stressed some essential points in the making of a studio production equipment maintenance engineer. The proper background of a maintenance engineer should include a solid technical knowledge of basic electronics, specialization in television electronics, and as complete an operational knowledge as can be acquired of the equipment he has to repair. Some of the major problems of the maintenance engineer are not only the personalities of people around him and his own personality, but also the "show biz" aspects of the job. Technical training should be continuous and should be acquired through technical training schools that are available from most equipment companies or colleges. Also the always available technical manuals are an important training source. Psychologically, the maintenance engineer must have a good understanding of his employer's aims as well as of the client's points of view when an actual breakdown occurs. He must be able to competently handle the often pressing situations he may be confronted with. The employer's support and continued upgrading and training of the maintenance engineer must be kept up throughout his career if the engineer is expected to perform skillfully and successfully.

49. Documentation and Vendor Support (Walter C. Nichol, *KPIX, Westinghouse Broadcasting Co., Inc., San Francisco,*

Calif.) This paper discussed the subject of the documentation to be provided with both digital and analog equipment, including desirable support for hardware as well as software maintenance efforts. The format of documentation should show awareness of the working conditions in the television station or production house. Standards in symbology and even in the format of the documentation would be highly desirable when it becomes necessary to troubleshoot in the plant environment and perhaps be involved with more than one piece of equipment. The need for clear identification and accessibility of test points was related to the prior discussion of maintenance considerations and equipment design. A proposal was given for an ideal "semiautomatic" means for rapidly accessing various maintenance documents. In connection with software, various policies were described regarding the availability of software and the absolute minimum requirement of software documentation including such things as memory maps, location of key instructions, and description of ways of forcing test loops or break points. The availability of devices with control over microprocessor-based systems is practically equivalent to the control one has with mini-computer-based systems. In connection with vendor support, the area of field change orders to maintenance by the vendor of a data bank of symptoms, the possibility of diagnosis by means of phone data connections, and the up-to-date maintenance of information systems were covered.

50. Panel Discussion for the Session: Problems of Maintenance (Moderated by Eugene Leonard, *Session Chairman, Davinci Research Group, Port Washington, N.Y.*) The discussion for this session — rather than being concentrated within the allotted time period — was actually spread throughout the entire session. Various questions were posed by Mr. Leonard and members of the panel. Answers and other comments were provided by members of the audience and by other panel members. A personal summation was solicited from and given by Session Vice-Chairman C. Robert Paulson, *AVP Communication, Westborough, Mass.* Points of view of both users and vendors were given. Subjects touched upon included the need for adequate documentation, the shortcomings of some documentation supplied with equipment, the rapid advance of technology and resulting increased complexity of equipment, and the difficulty of replacing defective software if the manufacturer has gone out of business. A vendor made the point that the development of software can be quite expensive and so a vendor is reluctant to divulge too much information, because he wishes to guard against his software being "pirated." (Note. Consideration is being given to the possible publication of the complete session discussion in a future issue of the *Journal*.)



Roland Zavada, *SMPTE Engineering Vice-President*, and Lynne Robinson, *Programming and Scheduling Manager*.



Mrs. Herbert Pilzer (Pucki), *Ladies Program Chairman*, with Herbert Pilzer.

THURSDAY MORNING

Lighting and Sound for Television and Motion Pictures

51. The Development of Stereo Magnetic Recording for Film (Hazard E. Reeves, *Reeves Teletape Corp., New York, N.Y.*) Cinerama, a motion picture technique closely linked to stereo magnetic sound recording, was introduced 28 years ago. It attempted to duplicate the arc of peripheral vision and the directional and surround qualities of stereo sound. Three simultaneously shot images were interlocked on a huge curved screen as one single image. The sound system was the first magnetic multiple track stereo recording and reproducing system in history. It was a revolutionary combination of optical projection and magnetic sound technology. An overview of the history of magnetic sound recording was given by the speaker, starting with Oberlin Smith, who in 1888 proposed the idea of recording sound by the use of a cotton cord impregnated with magnetic metallic dust, until the time when A. M. Poniatoff, head of the Ampex Corp., designed the first professional audio magnetic tape recorder in the U.S. in 1948. Around that time, the Rangertone system

appeared, a specifically adapted system which allowed 1/4-in tape to be run in sync with sprocketed film. Magnetic film was the wave of the future. Reeves Soundcraft was one of the early manufacturers of magnetic tape in 1947. They first made 1/4-in tape, rapidly followed by 16-mm and 35-mm magnetic sprocketed film. Shortly thereafter they developed the first process for magnetic striping of motion picture film. When the author first started plans for Cinerama sound, he was convinced that it should have a multiple soundtrack stereo system. Optical recorders were adapted by removal of the optical head and substitution of magnetic recording heads. Some changes were made in the amplifiers. Two individual head assemblies were set up: one had three heads in line and the other, four. Five channels were the minimum required to obtain good stereo effects; the other two (of the total of seven) were used as roving or control tracks for surround sound. *This is Cinerama* opened in a converted theater on Broadway in 1952. The stereo sound could travel left and right across the screen or jump behind the audience. Recognition came to the creators of Cinerama in the form of several Academy Awards: to Fred Waller for the development of Cinerama; to Reeves Soundcraft for development of magnetic striping; and to Walter Hicks for developing the Cinerama stereo sound system. The author ended his presentation by stating that sound technology today is at a very high level. However, real stereo sound, as it could be, hardly exists in the motion picture industry. And at this late date, stereo sound has not yet reached the home television set, except for a limited amount of simulcasting. Stereo sound and the Cinerama process stand ready to be tapped, to be improved, and to be fully realized by the talented, creative, and resourceful people working in the motion picture industry today.

52. The Historical Development of Cinema Architecture and Its Acoustical Effect on Filmsound Recording (*Ted Uzzle, Altec Lansing, Anaheim, Calif.*) Unique among recording formats, motion picture sound has been recorded and mixed with a precise understanding of the acoustic and electroacoustic conditions under which it would be played back. Even though these may change profoundly over the space of decades, at any given moment there is a very limited number of type of theater and type of loudspeaker in use. This permits a more powerful dramatic illusion than high fidelity recordings or television sound, because the recordist and mixer can tailor his every decision knowing how the track will sound in playback in the theater.

This paper showed that the development of theater architecture in the face of economic imperatives and aesthetic pretensions has led to enormous changes in the acoustic environment in which we listen to the movies, and that these have stimulated change in the film soundtracks themselves.

Before the movies were first projected, one popular form of public amusement was the showing of slides by an explorer. This individual would narrate with anecdotes of his travels. After Edison executed an agreement to exploit the projecting machine which had been developed by Armat and Jenkins, the most natural places to show the exotic travelogues and reenacted new events were B. F. Keith's Museum in Boston or Egyptian Hall in London, which had been showing the same material on slides.

As the nickelodeons made torrents of money, they grew in size, but they were permitted to remain very reverberant because this enhanced the piano and made the audience response sound greater — laughter or applause would sound like thunder.

The great flowering of the movie palace, starting around 1919 with the work of architect Thomas Lamb, continued this tradition. These houses were designed for the instrumental accompaniment of silent films, and some quite successfully, it would seem, considering the number of them renovated and used today as concert halls. Suddenly, in October 1927, acoustical disaster struck: the talkies. Electroacoustics, then in its infancy, had to produce devices capable of filling a large movie theater with thunderous effects; rich, full music; and also crisp, clear dialogue. It would take fifteen years of research, and an additional interregnum of five years for the Second World War, for a loudspeaker meeting these criteria to be introduced.

At about the same time, the Academy of Motion Picture Arts and Sciences began specifying desired theater size and shape, reverberation characteristics, and electrical response characteristics. Soon after, the introduction of stereophonic sound in the theater resulted in even lower reverberation times.

This paper concluded with a derivation from standard modern theater design criteria of acoustic characteristics that are to be expected in theaters built today.

53. CBC Experience in Stereo Broadcasting (*James Kitchen, Canadian Broadcasting Corp., Toronto, Ont., Canada*) Stereo sound by means of the simulcast technique has been in use by CBC on an experimental basis since about 1970. While this approach satisfies the compatibility with the essentially monaural NTSC television system, the integration of high quality stereo sound into the television plant is not easily accomplished. Providing the production team with the flexibility of extensive post production capability for both audio and video, while maintaining high sound quality, proved to be somewhat difficult. The process was further complicated by pickups that could occur in a controlled studio environment or at any remote location, or by program sound varying from a simple left and right recording up to full 16-

channel reproduction. The lack of sufficient audio tracks, and tracks capable of the required response, dictated the use of multitrack audio machines with time code based synchronizers. With such a double system operation, careful documentation is required at all steps: from the initial record, through post production, to air. The ability to synchronize a telecast for editing is based on the use of the SMPTE time code, a standard code which in many facilities deviated from the standard version. The final obstacle for the simulcast is the network release. Pictures and mono sound are distributed by a communication satellite, while the radio FM network uses land based systems for program distribution. The difference in transit delay requires compensation so that the program will arrive at the user's receiver in correct sync. This is further complicated by the requirement for multirelease to provide the program at the correct local time in each of the time zones.

54. A Procedure for Optimizing Photographic Sound Recording Systems (*Charles Nairn, Communications Technology, Inc., Detroit, Mich.*) The recent introduction of radically improved sound recording stocks has required significant changes in user operating procedures. This paper described a logical, comprehensive, and realistic procedure for obtaining optimum performance from a photographic sound recording system. The techniques can also be used when changes are made in light modulators, electronics, negative processing, or in release stocks, their printing, or their processing. Eight steps, which should be carried out in the following order, comprise the complete optimization procedure: (1) determine the general exposure/processing range; (2) optimize focus; (3) select the probable operating density; (4) adjust film loss equalization; (5) find optimum operating density; (6) select proper high frequency cutoff; (7) determine noise reduction bias setting; and (8) measure cross modulation control point. Only a limited amount of test equipment is required for this procedure, because heavy emphasis is placed on listening tests. Steps 1, 2, 4, and 8 require the following test equipment: a densitometer, a 50X microscope, an audio signal generator, an ac voltage measuring instrument, and a cross modulation test set. Steps 3, 5, 6, and 7 require the following for comprehensive listening tests: a small group of careful listeners, a variety of listening environments, and a representative sample of photographic sound reproducers. A simple scoring technique, particularly suited for subjective listening tests, has been developed. A listener is asked to determine only whether the current sound sample is better than, the same as, or worse than the previous sample. Using this technique, the very important subjective evaluations can be made using essentially untrained listeners.



Edmund Williams and friend making sure the slide projector works.



Arthur Hansen, Lynne Robinson, and Richard Marcus in the Authors Lounge.

Careful implementation of this procedure will assist in locating the optimum operating point for a system as well as determining acceptable control limits for routine operation.

55. The Divergence of Cinematographic from Still Photographic Lighting Techniques, 1930-1945 (*Evan William Cameron, Washington State University, Pullman, Wash.*) Mr. Cameron started his lecture by remarking that, when cinematographic production started in the first decade of this century, still photographers had already been at work for over 50 years. He then discussed the formidable obstacles the still photographer had to overcome to obtain workable procedures. Correct exposure was determined, initially, by trial and error and accurate records were kept for future reference and repeatability. The scene luminance range was reduced, compressed, to fit it into the limited exposure latitude of the film, and lighting effects such as the so-called "kicker" lights were used to separate foreground objects from the background. Cinematographers set out using still photography procedures, but they were faced by three additional problems: (1) the film grain (visible in repeated images); (2) contrast loss (due to projection flare, lack of control in development and printing, etc.); and (3) a need for continuity of lighting from one shot to the next. They therefore evolved two additional procedures: breaking up large areas of middle gray by "decorating" them with patterned light, and achieving lighting continuity from shot to shot by using a predominant monodirectional light source. In the 1930s two movements helped to free cinematography from still photography lighting traditions. Continental documentarists began to photograph subjects over which they had no lighting control, but audiences readily accepted the results. In Hollywood, on the other hand, Sternberg and others discovered that a new style could be created by eliminating the fill-in lighting system. An audience perceives the cinematic image differently than a still photograph in

that the latter can be studied by the observer in minute detail whereas the motion picture image is observed by concentrating on one point at a time. There is no need for avoiding blocked shadows in unattended areas of the image. Thus the cinematographer was freed from the vestigial restrictions of still photography, and the scene was set for the post-war cinema verité, and for location shooting in feature production, using adequate production equipment.

56. High Power Single Ended Discharge Lamps for Film Lighting (*R. Hall and B. Preston, Thorn Lighting Ltd., Leicester, England*) For application to film lighting with a color temperature of 5500 K, a new range of compact source tin halide discharge lamps has been developed which differ from other available lamps by using a unique compact single ended construction. Two ratings, a 1- and a 2½-kW lamp, have been developed so far. The arc tubes are fabricated from vitreous silica and use a single pinch onto molybdenum foil seals to position the tungsten electrodes 15 and 18 mm apart respectively. Both lamps are constructed with a ceramic cap and are mounted on a G38 pinpin (Mogul Bipost) base. The physical dimensions of the lamps are similar to tungsten halogen studio lamps of similar wattage (i.e. the light center length is 63.5 and 127 mm respectively). The 1-kW lamp is also available in a sealed beam construction where the arc tube is mounted in a PAR 64 housing with a clear front lens and the envelope is filled with an inert gas. This produces a source with high axial intensity and also increases the rated life of the arc tube by a factor of two. Both lamps can be operated from commercially available chokes for line voltages of 200 V or greater. For 110-V operation, a series capacitor or high reactance transformer ballast is required to ensure satisfactory commutation. The lamps are started by a high voltage (about 30 kV) pulse ignitor without problems of creepage or flashover and with hot restrike capability. Earlier developments on lamps with a tin halide dose have suffered serious

drawbacks due to electrode erosion and arc snaking. Improved processing techniques and the geometrical construction of the new arc tubes have virtually eliminated these problems. The tin halide dose is totally evaporated in the operating lamp and gives an efficacy of up to 80 lm/W. The emission spectra of these lamps show a high degree of continuum which is attributed to the tin halide molecular radiation. Because of the rapid absorption of short wavelength radiation by the tin iodide atoms, the UV radiation is exceptionally low. One of the properties of the totally evaporated dose used in these lamps is the stability of emission with variations in lamp power. On conventional power lines this eliminates color changes associated with line voltage variations. If the lamp is operated from an electronic ballast with a dimming facility, the light output can be dimmed to less than half with only a minimal change in color temperature. Other advantages of the electronic ballast such as flicker free operation and low weight also were discussed.

57. An Innovative Approach to HMI Fixture Design (*Edwin S. Clare, Cinema Products Corp., Los Angeles, Calif., and Joseph N. Tawil, Great American Market, Woodland Hills, Calif.*) The RDS Company of Tokyo, Japan, has developed a new series of HMI lighting fixtures. Initially, HMI fixtures were manufactured by modifying an existing tungsten luminaire design so that it would accept an HMI lamp socket and the lamp control electronics. Acting on recommendations from Dr. W. Block and Dr. B. Kuhl of Osram (the inventors of the HMI lamp), RDS designed a lamp socket assembly that permits extremely rapid heat dissipation. This provides longer lamp life and optimal lumen output. The new ignitor circuitry allows for a reduction in the overall width of the fixture. The external focus knob is mounted in the base of the unit, allowing either manual or pole operation. The entire HMI system can be removed as a unit from the lighting fixture. A tungsten assembly may then be installed; thus the designation of the RDS

fixture as HMI/Tungsten Universal. Accidental ignition of the HMI lamp is prevented by an interlock switch in the front of the HMI assembly. The assembly is installed from the rear of the fixture, rather than swinging open the fresnel lens to install the lamp unit from the front. The cooler operating temperature of the HMI lamp permits bringing the lamp closer to the fresnel lens for flood operation. However, existing fresnel lenses, designed for tungsten lighting, do not realize maximum flood output capability. RDS thus developed a new stepping pattern on the front of the fresnel and a new stippling design on its rear surface to maximize light output in the flood position. The new luminaires are box shaped rather than round. The control panel and electronics are located on the bottom of the unit, the coolest area during operation. A special bell cup locking device engages the yoke pole and prevents accidental tipping. RDS has introduced four fresnel fixtures ranging from 575 to 4000 W for the HMI lamps, and from 1000 to 10,000 W for tungsten lamps. The speaker added that four further models are in the design stage and will soon be manufactured: a 200-W open face with ac operated reactor ballast, a 575-W open face, a flicker free ballast for the 575-W HMI unit, and a flicker free ballast for the 1200-W HMI unit.

58. This paper was not presented.

THURSDAY AFTERNOON

Videotape Recording

59. The Rise of Mechanical Television, 1901-1930 (*George Shiers, Santa Barbara, Calif.*) This paper described the methods available in 1901, their origins, and the advances that were made during the next thirty years. The hybrid nature of television, its mixed parentage, and the consequent variety and complexity of ideas are pointed out. Developments in electronic technology and the inception of broadcast radio after 1920 led to commercial phototelegraphy and a rising interest in television. Shadowgraphs and silhouettes had been demonstrated by 1925. Over 100 patents were filed during these five years, chiefly in Britain, France, Germany, the U.S.S.R., and the U.S. Images in light and shade were publicly demonstrated in London early in 1926. In 1927 patent activity and the quantity of published materials increased nearly threefold. Color, stereo, film transmission, and intermediate film storage are some of the special features that appeared in more than 80 specifications. Long-distance transmissions were demonstrated in the U.S. and Britain, and the Television Society was founded in Britain. Public interest reached a peak in 1928; over 30 companies were engaged in television ventures; experimental broadcasts were begun in the U.S.; amateur construction became a new hobby; apparatus was featured

at radio shows in the U.S., Britain, and Germany; receivers and kits began to appear on the market; and the British monthly publication *Television* appeared. More than 130 patent applications revealed spreading interest in many countries, and increases in corporate involvement and in contributions by independent inventors. Images were transmitted across the Atlantic and from London to a ship at sea. Daylight pickup, full-color pictures, and stereoscopic images were demonstrated in Britain. A political event and a play were broadcast in the U.S. Technical activity increased in 1929, with 158 patents being filed. Fourteen companies entered the field, but public interest and the quantity of published materials declined. The introduction of sound films directed attention toward the use of film transmission and increased the prospects of radio movies in the home, particularly in the U.S. Fernseh A.-G. was founded in Germany, and the Post Office exhibited two-way telephone-television apparatus at the radio show in Berlin. Official broadcasts were begun in Berlin and London. Television was a highlight at the radio show in New York; technical standards were introduced in the U.S. and Germany; and plans for domestic receivers were announced by the Baird Co., Fernseh, and the Jenkins Corp. The technology expanded during 1930 with 205 patent applications, 60 of them by independents. Interest in television rose in Britain and Germany, but declined further in the U.S. The German Television Society was founded in January, when the monthly journal *Fernsehen* appeared. Regular short programs with simultaneous sight and sound were inaugurated in London, and a play was broadcast by the British Broadcasting Corp. Large screens were shown in theaters in the U.S. and Britain, and numerous other demonstrations were given in both countries. Studio techniques were introduced; and technical aspects, including picture tubes, received greater attention, particularly in Germany. By the end of 1930 an industry had been established through the efforts of more than 350 patentees and many others, representing contributions from 23 countries. Materials not hitherto published that were presented include tables with numerical examples that illustrate the progress of scanning methods, the growth of special systems and of corporate patents, and a bar chart showing the rise in activities from 1878 to 1930. There was also an inventory of resources from 1829 to 1920 showing their origins, and a list of notable events from 1926. The survey was based on the study and analysis of more than 2500 printed items, including 800 patents and abridgments. Brief details of selected patents and equipment were given, and the components employed were reviewed to show the scope of developments and changes in the technology. A bibliography containing 49 articles and books from 1911 to 1979 has been compiled.

60. The Development of the Ampex Videotape Recorder (*Charles P. Ginsburg, Ampex Corp., Redwood City, Calif.*) This account, by the leader of the videotape recorder project at Ampex from 1952 to 1956, described many aspects of the development program: how the approach was chosen, how it evolved, who the members of the original project team were, and — in considerable detail — just who did what. From the initial concept of a rotating three-headed drum describing arcuate sweeps across a 2-inch tape, the author related the reasons for the change to a four-headed drum, and to the final transverse configuration. He also described the origin of the vestigial sideband FM system. He described the first demonstration for Ampex's Board of Directors, a significant showing for a large Ampex management group, and finally the dramatic unveiling at the 1956 Annual Convention of the National Association of Radio and Television Broadcasters (now the NAB) which came as a considerable surprise to the TV industry. The author's presentation was closely based on a similar paper he read before the 82nd SMPTE Conference in Philadelphia in October 1957. This unpublished story, described the approaches which failed, the unexpected solutions which turned up while searching for others, the experiments that succeeded, and the interplay of technical contributions by the staff's creative personalities. Some material has been added to provide more perspective.

61. Videotape Post Production: Operating Procedures 1980 (*Lawrence J. Kreeger, EUE Video Services, New York, N.Y.*) As recently as four years ago, videotape post production and film post production for TV were far apart, especially as regards special effects. Image repositioning, zooms, image flip, reverse imagery, and others were not possible then on videotape, but these were precisely the special effects required by agency producers for most of their commercials. Today, these problems are being solved by the flick of a switch. The introduction of the 1-in Type C videotape format and the associated VTRs have made tape editing faster and more versatile. It has become comparable to 35-mm film post production. The use of $\frac{3}{4}$ -in ENG shooting and editing with sophisticated time base correction and noise reduction has made electronic newsgathering, documentary and industrial shooting, and post production equivalent to 16-mm production and post production. On-line editing is done today on 1-in Type C helical machines as well as on 2-in quadruplex VTRs. As more 1-in VTRs are delivered to the major networks and videotape post production centers, 2-in quad on-line editing will eventually be phased out, 2-in VTRs will continue to be used for tape dubbing and 2-in quad tape distribution to stations throughout the U.S. and the rest of the world for quite some time. Sound editing on tape has also come a long way over the



Joseph Flaherty, Carlos Kennedy, and Frederick Remley.



Mrs. Herbert (Puckl) Pilzer, Chairman of the Ladies Program (R), discussing program activities with Mrs. Dominick Capano.

past four years. Sophisticated sound recording companies have installed videotape equipment that enables them to carry out sound mixing without having to go to black-and-white 16-mm kinescope film transfers. Of course, if the sound mix is very complicated and intricate, it is still highly recommended to do a sound mix using film techniques by means of 16-mm black-and-white kinescope transfers. Over the last few years, tape to film transfers and kinescope records also have made great advances in picture definition, depth of focus, reduction of video noise and grain, increased color saturation, and so on. Because of this, the use of film made from a tape has increased dramatically, especially in nontheatrical productions, industrials, super 8, and others. Stock material which originally came from film is now coming from tape; therefore, documentaries and industrials produced and finished on film must get their stock material from tape via kinescope transfer to either A-wind 16-mm film or on B-wind to be intercut with the finished film product. The marriage between film and tape post production is a more complete reality today than what it was just a few years ago. By making use of film terms and tape terms, film producers, directors, and editors will be able to use their film background in deciding whether they want to work either exclusively with tape techniques or with a combination of film and tape techniques.

62. (The paper originally scheduled was not presented and was replaced by the following paper) **Introduction to the Digital Time Base Corrector** (David Acker, Datra (an independent consulting company), North Granby, Conn.) This paper traced the development of the time base corrector (TBC) from its earliest form (in 1956) to the present. Time base errors are introduced in the video signal during both recording and playback with a videotape recorder. The various types of VTRs were enumerated and briefly described. The different types of time base errors that arise

were also described. The mechanical imperfections in the system are the basic cause of time base errors, but there are other causes as well. With this background it becomes possible to discuss the techniques that are actually used to achieve the correction. Digital storage is an important characteristic of a TBC. Once the signal has been converted, it must be stored in the digital memory. The cost of digital memory has been falling steadily and rapidly and has reached the point where it is quite attractive compared with analog techniques. The presentation was supplemented with a number of slides.

63. **The New RCA One-Inch Type C Helical VTR** (Lee V. Hedlund, RCA Corp., Camden, N.J.) In the 1980s, the microprocessor will have a significant impact on the manufacturers and users of broadcast quality equipment. This paper described how the VTR, the mainstay of image reproduction, can be designed to take maximum advantage of this highly innovative and flexible technology. A distributed processor system was described, wherein the main functions of the VTR are handled by a "central processor," and individual processors manage such things as variable-speed broadcastable picture control, time code generation and reading, and sophisticated editing systems.

64. **HBU and Portable HBU Videotape Recorders** (Sidney B. McCollum, Recortec, Mountain View, Calif.) In this paper the speaker presented a short history of the High Band U-format recorders. HBU recorders have the same video specifications as the 2-in quad and the 1-in C-format recorders, but they utilize 3/4-in videotape as the recording medium. Problems that had to be solved were explained, and decisions that eventually led to the new format were described. Related equipment that has been developed was also described. At present there is an HBU family of devices based on the HBU-2860 recorder.

65. This paper was not presented.

FRIDAY MORNING

Digital Television

66. **Status Report: SMPTE Task Force on Component Digital Coding** (Frank Davidoff, Consultant, Lynbrook, N.Y.) Digital video is an important technology that affects television program production and broadcasting throughout the world. The SMPTE has established three technical study and working groups on this subject since 1972. Although the initial emphasis was on the composite coding of a video signal, during 1979 the interest in component coding grew very rapidly. About this time, the European Broadcasting Union (EBU) group on digital coding prepared a recommendation for a "12:4:4" component digital code for approval by the EBU Technical Committee. The SMPTE, believing that an early decision on such a digital code might preclude a worldwide compatible specification, set up a new Task Force on Component Digital Coding under the chairmanship of the author. The membership of the Task Force is drawn from the other SMPTE digital television groups. The scope of activities of the Task Force is: "To examine the objectives and constraints involved in a worldwide component video digital code for program production and television studio operation, with the primary objective of developing an SMPTE position . . . The principal areas to be examined shall include, but are not restricted to, the following: (1) Quality objectives; (2) Worldwide compatibility; (3) Influence of the digital videotape recorder and other studio equipment; (4) Luminance chrominance sampling ratios; and (5) Interface with common carrier (PTT) digital hierarchies . . . As appropriate, the Task Force shall establish liaison with other organizations involved with digital coding. The Task Force shall prepare and submit to

the SMPTE Committee on New Technology a final report containing the recommendations of the Task Force for further action by the SMPTE and for publication of an SMPTE position paper on worldwide component digital code."

The Task Force has had frequent meetings and has prepared two documents on Quality Objectives and on Worldwide Compatibility for digital television. These documents have now been submitted for approval of publication in the *SMPTE Journal*. Other documents on digital videotape recorders and other studio equipment are under discussion. The Task Force has also prepared a document on a worldwide compatible code for television studios which suggests component coding, line-locked co-sited samples, and a simple hierarchy of digital codes. In April 1980, the EBU group on digital coding prepared a series of demonstrations of the "12:4:4" digital code for the EBU Technical Committee in London. The Task Force was invited to observe these demonstrations and to submit their impressions and comments. Almost the entire Task Force was present at the demonstrations and subsequently drafted a report that was given to the Technical Committee which expressed its appreciation for the interest and effort made by the Task Force. Perhaps the most important aspect of its report was the consensus that it was unlikely that the "12:4:4" digital system would be adopted in North America. The SMPTE invited the Bureau of the EBU Technical Committee to hold a meeting at the SMPTE Television Conference in San Francisco in February 1981. The Task Force sponsored and organized a series of demonstrations at the Television Conference showing the characteristics of various digital systems. It was hoped that these demonstrations would help the EBU and the SMPTE to adopt digital specifications that could result in a worldwide compatible digital code. The Task Force called upon the three other SMPTE digital groups to execute these demonstrations. After much discussion and planning, three categories of demonstrations are firmly underway: (1) Picture qualities in a hierarchical system; (2) Picture processing; and (3) Interfacing the digital component system to the analog composite environment. These demonstrations are being implemented by the SMPTE Working Group on Digital Video Standards under the chairmanship of Ken Davies. These demonstrations represent a massive effort by the SMPTE digital groups and the organizations who are contributing their personnel, time, and equipment. It is expected that the demonstrations will provide a solid technical basis for the selection of digital specifications which will undoubtedly affect television program production and broadcast operations for the next few decades. The Task Force is also cooperating with the EBU and the groups will be maintaining close liaison by frequently meeting together both in Europe and North America. It is hoped that this

close cooperation will contribute to a truly worldwide compatible digital code that will be beneficial to all.

67. What Do We Expect From Digital Video Equipment? (*Frederick M. Remley, University of Michigan, Ann Arbor, Mich.*)

Digital video and digital audio are headline topics in nearly all journals serving the broadcasting industry. It is also true that virtually every standardizing group in the world has one or more committees assigned to consider specifications for digital video and audio systems. In spite of this, both manufacturers and broadcasters are quick to admit that the course of progress toward digital studio systems is far from being clearly charted. This paper provided an overview of the advances in technology that are urging designers of broadcast equipment toward digital systems. It also defined the general problems that face both the equipment design engineer and the broadcast user in considering the future of digital video and digital audio systems in the studio environment.

68. The SMPTE Study Group on Digital Television Tape Recording: Progress Report (*William G. Connolly, CBS, New York, N.Y.*)

The formation of the SMPTE Study Group on Digital Television Tape Recording was directed by the Steering Committee in March 1979. The formation of a digital VTR study group was in response to the broadcasters' desire that design of the digital recorder be influenced by realistic operational needs. Originally the study group was to be a user-only group but it was soon decided that the guidance of design experts would be beneficial. The first meeting was held on 26 October 1979. Eight additional full study group meetings have been held with two sub-group meetings. The charge for this SMPTE Study Group reads in part as follows: "Shall provide a forum for the exchange of information on user needs and on the technological capabilities of digital television tape recording." Discussions range throughout all aspects of digital design with the proviso that the setting of standards *not* be discussed by this group. A recommendation by this study group might signal when standards work should begin. The study group includes representatives from ABC, CBS, NBC, PBS, group ownership stations, independent stations, and design experts from every phase of VTR design. At the latest meeting, there were 23 active and 12 corresponding members in attendance. As a first priority of the study group a user survey document entitled "User Survey - 1980" was approved by the study group on 30 January 1980. Some 23% of the 1500 addressees from the production and broadcast community have responded so far. Results of this survey were reported during the presentation of the report. The study group has given considerable support to the SMPTE Digital Task Force. The group has reviewed the special considerations of the

digital videotape recorder in the selection of a worldwide compatible digital standard for 625- and 525-line standards. A hierarchy of digital codes in component coding form is seen as an appropriate choice. A hierarchy of digital codes with appropriate luminance sampling frequency and luminance to color difference signal ratios could give rise to a DVTR format structure which is upwardly and downwardly extensible. The progress report then discussed several possible simply related digital code hierarchy levels. Binarily related levels are suggested as representing a simple approach. If acceptable image plane sampling schemes for this kind of hierarchy can be devised, this approach offers the possibility for a videotape format which could record at any or all possible hierarchical levels. Tape consumption would be proportional to the level chosen for the original recording. Parallels with film format and tape speed hierarchies were drawn. The extensibility of this type of coding structure could permit DVTRs to be built at a level of hierarchy consistent with area packing densities achievable at the time of their introduction, and to reach the upper levels of the structure as packing densities improve with time, again with the proviso that a videotape format consistent with these concepts can be achieved in practice.

69. Digital Audio Technology, Today and Tomorrow (*Toshi T. Doi, Sony Corp., Tokyo, Japan*)

The author had earlier reported on proposed formats for digital audio recording. Further progress has been reported since then. In this paper, the author compared proposed formats of audio disks and discussed the problems of standardization and technical progress. Three proposed systems of digital audio disks were illustrated: the Audio High Density (AHD) disk, which is a digital audio version of the capacitive videodisk without grooves; the Digital Compact Disk (DCD); and the Mini Disk (MD). The last two also are based on videodisk technology, but all their parameters have been adapted to audio-only purposes with a smaller disk size. The DCD is remarkable, the speaker explained, for its modulation scheme and error correction system. A new modulation scheme, called EFM (Eight Fourteen Modulation) has a density ratio of 1.5. Its dc-free spectrum is essential for avoiding interference with tracking and focus servo signals. A special error code — called CIRC (Cross Interleave Reed-Solomon Code) — has been developed to improve the yield of disk production and disk life. The MD type is distinguished by its simple signal processing without error correction and its simple readout mechanisms. The AHD and the MD disks need some type of caddy for protection, while the DCD can be used directly because its signal surface is buried inside the transparent disk. A new technology always engenders problems. Until it is standardized, compatibility problems exist, but too early a standardization



Richard Corley and Edmund Williams in the Authors Lounge, checking slides to be shown at the session on Television Signal Generation and Processing.

will hamper further progress. Great progress has been made during recent years in the packing density of the stationary head digital audio recorders and digital audio disks, by a factor of about 20 for both. This is due mostly to improvement of modulation schemes and error correction codes, rather than head/tape or optical stylus technology, already perfected in the video field. The state of the art has now advanced to where it might not be a mistake to propose standards.

70. Videoscope: An Accurate Method for Certifying, Timing, and Analysis of RS-170A Systems (Bruce Blair, Lenco, Inc., Electronics Division, Jackson, Mo.) Recently it has been proposed, and generally accepted, that the "Picture Line Amplifier Output" specifications of EIA Standard RS-170 be altered to include a requirement for a sync-to-burst phase relationship, taking into account the increased use of videotape recorders in programming. Once video has been recorded, the sync-to-burst phase relationship can no longer be altered. This makes it very important that it be recorded with the same relationship it will need when played back. The only way that relationship can be predicted is to maintain a constant relationship during both recording and playback. This is the object of EIA Industrial Electronics Tentative Standard No. 1, part of RS-170A. Its specifications are deceptively simple. But, although the sync-to-burst phase relationship is easy to describe and relatively easy to achieve, it is not easy to measure or certify. It gives only a very dim trace on even a high quality oscilloscope. It further complicates things by requiring that only



SMPTE President Smith and Program Chairman Marcus — a pause in the day's occupation.

one cycle of subcarrier be resolved on the oscilloscope trace, which makes nearly every means of direct view impossible. The proposed RS-170A specification meets only two of the three requirements of a workable specification: establishment of a well defined standardization objective and the requirement of possible implementation. However, it falls short in the third requirement in that it is very difficult to maintain and certify. Three problems arise. First, just knowing when correct subcarrier-to-horizontal (SCH) phase is achieved is not enough. One must also know how incorrect the relationship may be. The second problem is related to how well or how badly any two video sources are correlated to each other. The third problem encountered in implementing an RS-170A system is caused by the physical layout of video systems. Normally, the point in the system where the phase relation is to be determined is far removed from that point in the system where the phase relationship is to be controlled. The Videoscope™ was designed to overcome these three problem areas. This device processes the phasing and timing information into a video format that can be viewed on a standard video monitor. The RS-170A specifies that a sine wave (subcarrier) is to be compared to the leading edge of sync line 10, field 1, where an upgoing zero cross is required. The Videoscope displays the literal description of this condition on a picture monitor screen, providing a very accurate means of indicating the SCH phase relationship. If another source is added to the display so that the second source can be compared to the first video source, a truly useful system timing and analysis tool is presented.

71. NTSC Color Field Identification (Charles E. Spicer, NBC, New York, N.Y.) There are four different color fields in an NTSC color signal. They are exactly defined by the EIA RS-170A Standard and



Maurice French, newly elected Editorial Vice-President.

can be summarized as follows. Field I ends in a *full* line with *positive* going subcarrier crossing at even numbered sync pulses. Field II ends in a *half* line with *negative* going subcarrier crossing at even numbered sync pulses. Field III ends in a *full* line with *negative* subcarrier crossing at even numbered sync pulses. Field IV ends in a *half* line with *positive* subcarrier crossing at even numbered sync pulses. Fields I and II are called Color Frame A (even). Fields III and IV are called Color Frame B (odd). For those cases where the relationship is critical for program integration, the 50% point of the leading edge of the sync signal must coincide with the zero crossing of subcarrier with a tolerance of $\pm 40^\circ$ to identify the field. This specification allows color field recognition by a comparison of vertical, horizontal, and subcarrier within one signal. If two signals are considered, which are driven from the same timebase, each may have *independently defined* color fields. However, there will be a 50% chance that Field I of the first signal will be time coincident with Field III of the second signal. This result stems from the fact that system subcarrier phase (burst and chroma) for each signal can be adjusted to two different settings 180° apart, yet both signals will satisfy the RS-170A specifications. If two such signals were delivered to a mixing junction, the following statements could be made: (1) relative subcarrier phase is not the same; or (2) color fields do not match. The author argued that field identification derived from a comparison of horizontal sync, vertical sync, and subcarrier will always have an ambiguity of field identification. Furthermore, the author argued, that if the video signal had an independent identification of color field, the system subcarrier phase could be adjusted correctly in relation to the horizontal sync at every source with the same accuracy as we now adjust burst, *I* and *Q* phase relationships. An appropriate independent field identification flag would also provide the means to measure accurately the sync-to-subcarrier phase relationship using only a standard waveform monitor. Broadcast manufacturers of videotape equipment and digital equipment presently claim color field recognition based on measurement of the sync to subcarrier horizontal (SCH) relationship. By the EIA RS-170A definition,

these systems can give no identification of color field to subcarrier phase lying beyond the $\pm 40^\circ$ tolerance specified. Thus, no definition is possible for 56% of the total signal possibilities. The author concluded that an independent identification of the proper color field, irrespective of SCH, is the ultimate solution to the problem.

72. The Advanced Automatic Videotape Editing/Dubbing System in NHK (*Ken-sho Sata, Takeshi Ogawa, and Iwao Obata, NHK - Japan Broadcasting Corp., Tokyo, Japan*) Since 1970, editing of videotaped programs has become ever more complicated. It has become necessary to improve the off-line editing and automatic dubbing systems. NHK developed a new automatic dubbing system in 1978. It is easily controlled by computer with a memory capacity of up to 1000 events. Now, NHK is also developing an off-line editing system with new functions, and the combination of both systems is expected to meet producers' editing requirements for some time to come. Videotape editing according to a production plan has been increasing sharply in volume. Until now, the preferred method was that of film editing as used in the production of documentary programs. In this method, the collected materials are gradually boiled down through a process of trial and error until the final edited version is achieved. The modern videotape editing system should be able to realize a psychological process similar to that of film editing. In NHK's Tokyo plant, nine automatic editing and dubbing systems have been installed. Five of these were developed in 1978, and the presenter of the paper enumerated their very interesting features. He pointed out, among other things, that even an unskilled operator can handle the manual editing sector of the system very easily. NHK has ten off-line editing rooms in their Tokyo plant, and four of these are equipped with magnetic drum memories for the storage of editing data. In the other six rooms, after completing the editing, the editor plays back the edited tape. He compiles an editing data list by viewing the monitor. Tape number code and frame address code of the edit are recorded and also displayed within the lower part of the image. Since 1975, approximately 500 dramatic and about 100 documentary programs have been edited per year on NHK's preexisting off-line editing and dubbing facilities. It is expected that the new off-line editing system — available to NHK by the end of 1980 — will make the editing chores more manageable and easier to control. The speaker then detailed the main technical specifications of the new videotape editing system.

73. The SqueezeZoom Digital Video Effects Unit (*Sidney J. Dodd, VTR Productions Ltd., Toronto, Ontario, Canada*) This paper dealt with a digital video effects unit called the SqueezeZoom. The unit has a

capability for either compressing (squeezing) or enlarging (zooming in on) a picture within a frame. It is unique in that it is the first such device to have multichannel capabilities, that is, it can manipulate several inputs simultaneously. At present, the unit can manipulate three inputs, and provision has been made for future expansion to four. The purpose of the SqueezeZoom is to create effects that previously could be obtained only through the use of film optical techniques. It has the advantage of immediacy, because the effects can be created "live" and may be used directly as part of the production process. The device has several other features in addition to its use as an effects unit: It can freeze a frame; it can accept any nonsynchronous source and therefore be used as a frame synchronizer; it can accept small-format signals with indirect color; it can be used as a rather expensive time base corrector; and, finally, because of its electronic zoom capability, it can be used to correct video signals that have nonstandard blanking.

74. Progress Report on Standardization of Digital Control Code (*Graeme Little, Ampex Corp., Redwood City, Calif.*) The Working Group on Standardization of Digital Control Code was established in June 1978 and held its first meeting in September 1978, under the chairmanship of Robert McCall. The members feel that the Working Group has progressed very well toward its objective of defining industry standards. The work has been broken down into three distinct areas, each of which will be covered in a separate document: (1) electrical and mechanical aspects of bus connect systems, (2) description of the protocol used on the bus in order to transfer data, and (3) the specific control codes to perform universal functions. The documents are to be introduced in numerical order, that is, first document 1, then 2, and finally 3. As of this date the Working Group has virtually completed document 1. Document 2 is also nearly complete, although it has been undergoing minor revisions during the past few months. The final document, no. 3, is still in the discussion stage.

75. User Bits for SMPTE Time Code (*DeWitt Smith, Amtel Systems, Inc., Doylestown, Penn.*) Many years ago, SMPTE set the standard for longitudinal time code. The structure of the code is one 80-bit digital word, which is used to identify each TV picture frame. The SMPTE Time Code Standard also provided 8 bits not assigned initially during the generating process; these are called user bits. During the presentation the speaker offered two new applications for SMPTE user bits, made possible through the development of a new microprocessor, software-based product. This product is the Amtel model 3700 Edit-Code Master Time-Code Reader/Generator.

Equipment Exhibit

The Equipment Exhibit at the 122nd SMPTE Conference was another record-shattering event. It was the largest Equipment Exhibit ever shown at an SMPTE Conference in New York. All available booths — 311 of them — were taken well in advance — in fact, several months before the final roundup. At the New York Conference in 1978, also a record-breaker, 211 booths were on display.

At the 122nd Conference, 149 companies representing most of the major manufacturers and suppliers of professional film and television equipment occupied 25,000 square feet of floor space.

More than 8,000 persons attended the Exhibit. Users of film and video equipment as well as interested viewers were impressed by the great variety of advanced technical equipment.

The booths were manned by officials of the exhibiting companies, all experts in their fields and eager to demonstrate and explain the advanced techniques incorporated in the equipment. Many items were newly developed, many of them never having been shown before.

It was a very upbeat experience for the viewers to be involved in the exciting demonstrations and to discuss the various features of the equipment with the experts.

The fact that each SMPTE Exhibit brings new equipment and new technologies to the attention of the viewers augurs well for the future of the industry.

A list of the exhibiting companies which made possible this exciting event is given below.

Exhibitors

AATON Cameras, Inc.
Acmade International
Adcom
Adda Corp.
The Allen Products Co.
American Data
Amperex Electronic Corp.
Ampex Corp.
Anton/Bauer, Inc.
Arriflex Corp.
ASACA/Shibasoku Co.
Audio Kinetics (UK) Ltd.
Belden Communications, Inc.
Bell & Howell/Prof. Equip. Div.
Berkey Colortran, Inc.
Bogen Photo Corp.
Bolex (U.S.A.), Inc.
Brumac Industries, Inc.
The Camera Mart, Inc.
Can-Am
Canon, U.S.A., Inc.
CECO Communications Co., Inc.
Central Dynamics Corp.
Century Precision Cine/Optics
Cetec Vega
Chyron Telesystems
Cinema Products
Cinemills Corp.
Cine 60, Inc.