

**AMPEX**

# READOUT

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EXPO 67

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U.S.S.R. Pavilion



## THE CANADIAN UNIVERSAL AND INTERNATIONAL EXHIBITION

Montreal, Canada, 1967

**1967** IS THE YEAR OF CANADA, the 100th anniversary of Canada's status as a self-governing country. The Canadian people pride themselves on their independent spirit, which they feel blends together the best in British, French, and North American cultures. If Expo 67 is any example, Canada has a great deal to be proud of. In fact, Expo 67 might just turn out to be one of the most exciting events of this generation. As with previous international expositions, it brings together several bold new architectural, technological and scientific ideas, just as the Eiffel Tower and the Monorail were first associated with earlier fairs. It also represents an important cultural endeavor, presenting much of the world's best dramatic and musical talent. During the six-month exposition, more than 25 to 35 million visitors are expected.

The Expo 67 setting is a group of islands, largely man-made, in the St. Lawrence River a few minutes from downtown Montreal. The site covers over a thousand acres (twice the size of the recent New York World's Fair). Beautifully landscaped with trees and shrubbery, the site presents a striking contrast to the hustle and urban beauty of Canada's largest city, and the second largest French speaking city in the world.

### Man and His World

Expo 67's basic theme is "Man and His World." This is divided into several sub-themes showing man as creator, explorer, producer, provider, and member of the community. Man and his spirit is treated in an unprecedented cooperative display of the eight major Christian churches in Canada in a unique Christian

pavilion. In the field of science, several striking demonstrations will be presented: a huge clear plastic model of a human cell magnified one million times through which visitors can walk and examine the parts and functions; the world of the microscope; simulated landscapes of the ocean floor and polar regions (the latter with midnight sun and the aurora borealis); and a series of lectures by an international group of scientific leaders.

### Seventy Nations on Display

More than 70 nations (45 was the previous record at Brussels in 1958) from all over the world are presenting exhibitions demonstrating value and usefulness to man within the general theme of Man and His World. In keeping with its centennial celebration, the Canadian displays are the largest, telling the story of man in the environment of Canada. The government pavilion, shaped like a massive inverted pyramid, is called Katimavik, which means meeting place in Eskimo. Twin spiraling staircases lead visitors up within the pyramid to a variety of displays. The United States pavilion is contained in a large geodesic bubble made of plastics and glass, 20 stories high, designed by Buckminster Fuller. With its glass and plastic exterior, it reflects the colors of nature by day and glows with man-made light at night. Its theme is to show the creative efforts of man based on life in a highly developed and automated society. Entitled "Creative America," its displays range from folk art to fine art to historic treasures to technology. One unusual feature is a lunar landscape showing space vehicles from the earth on the surface of the Moon, in a per-

view of the 1970 Apollo flight.

The British pavilion is contained in an exciting group of buildings on several levels. Its theme is to show the maturity, strength, and aspirations of the British nation and her contribution to history. The giant Soviet pavilion of striking cantilever design has as its theme "Everything in the name of man, for the good of man." Visitors will be taken on a simulated trip into space, complete with a sense of weightlessness, and a walk on the Moon. Many Russian art treasures, a scale model of a Ukrainian collective farm, and a continuous showing of Russian films round out the display. France, in its sculptured pavilion, will present the theme "Tradition and Invention," dedicated to modern France and its contribution to man and the world.

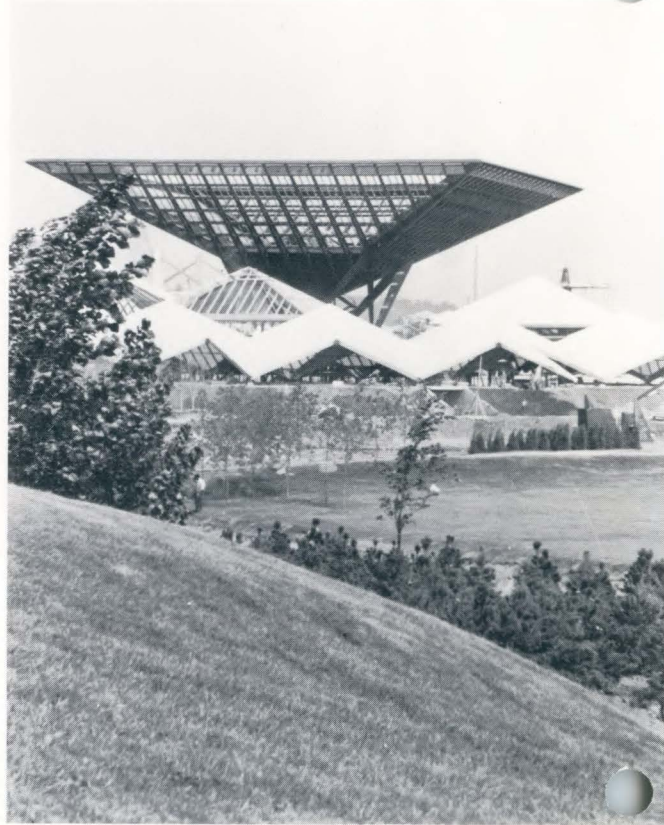
Many smaller nations are contributing impressive displays, too. The Czechs will show their glass, crystal, ceramics, and art to the world. Mexico's contribution is a presentation of a full size reproduction of a Mayan temple with the oldest frescos in America. Israel shows man's struggle against the desert. The Netherlands has built its story around man and the ocean. Italy, in a pavilion with a roof in the form of a sail, is presenting some of its most famous art treasures. Korea combines tradition and modern architecture in a building made entirely of wood. Its theme is "Man and His Hands." The Japanese present a combination of ultra-modern materials and ancient architecture, with prestressed concrete being used instead of wood and paper. Greece has chosen a modern theme of freedom of the human spirit in contrast to its ancient splendor.



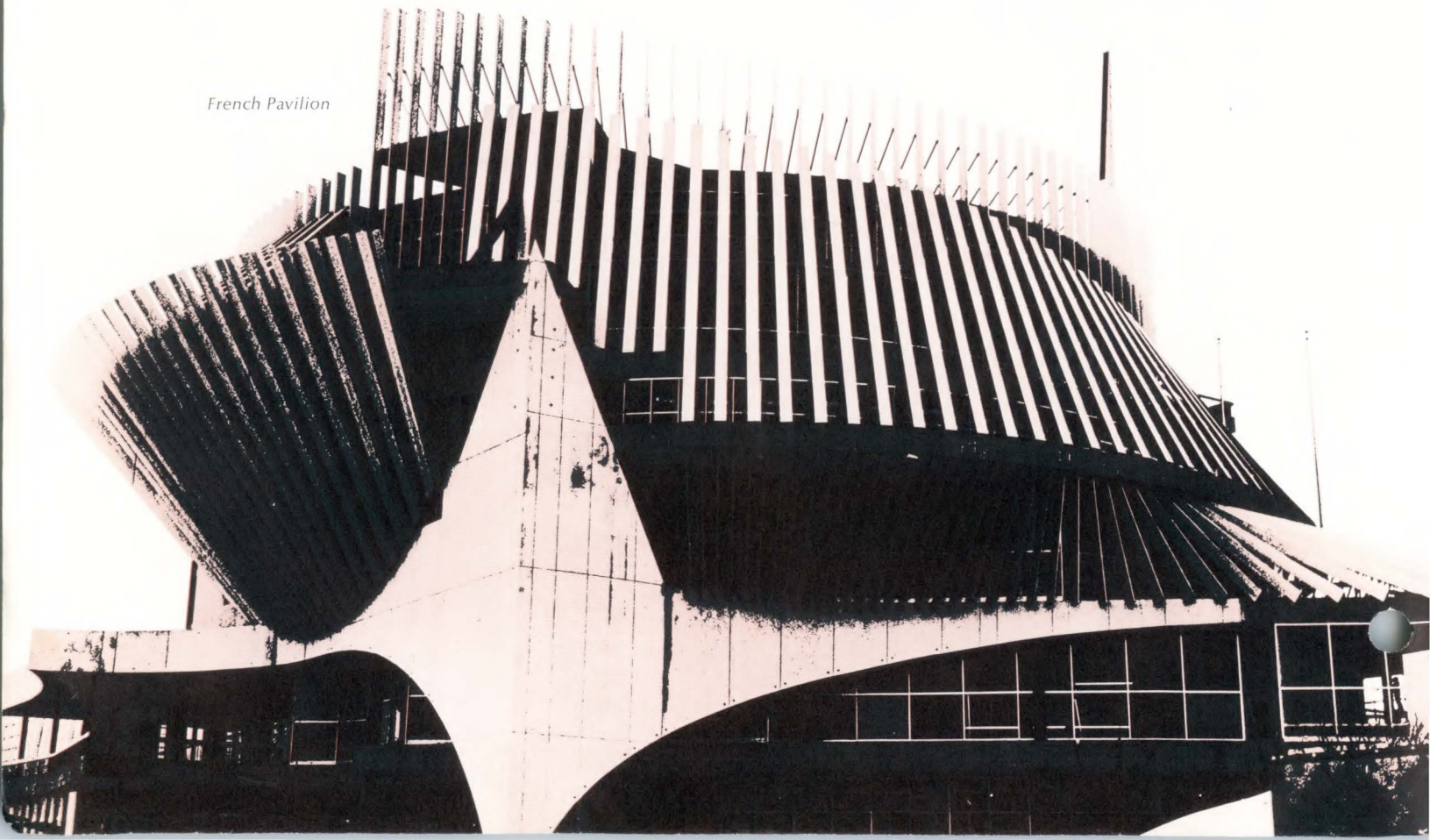


*Combined radio and television room can transmit any radio or television production either in the Centre or on any Expo site to any point in the world.*

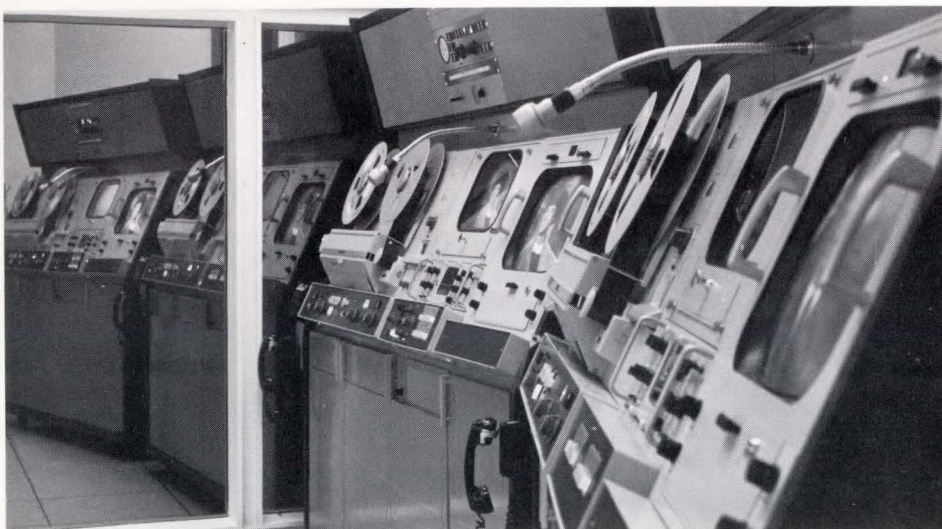
*Canadian Pavilion*



*French Pavilion*







Recorder room at the International Broadcasting Centre showing four of the five Ampex VR-2000 color equipped videotape recorders supplied by Ampex of Canada, Ltd. All recorders were modified with special overhead color monitoring facilities and high quality audio speaker/amplifiers. They can operate on either the American or the European line standards. A fifth recorder is in a color equipped mobile van for remote recording at any site on the Expo grounds.

### Habitat 67

Designed by architect Moshe Safdie, Habitat 67 is a concrete complex intended to revolutionize urban dwelling. Safdie, originally from Israel, took his training at Montreal's famed McGill University and now practices in Montreal. Habitat 67 will remain after the fair as a commercial housing development. Each living unit is complete unto itself, with the roof of each house forming a garden for the one above. The entire complex is roughly pyramidal in shape, and contains 158 houses with 15 different varieties of layout. Its purpose is to give people a suburban house in the city with its own outdoor space, and reduce commuting distances at the same time. Safdie's design represents a one-structure community with a complete village built with advanced mass production techniques.

### Culture and Entertainment

Part of the concept of Man and His World includes leisure, too. Expo 67 will present a world of entertainment with the best music, dance, drama, sports, and spectacles from many nations. Included in the program will be the Vienna Philharmonic, the Bolshoi Opera, the Australian Ballet, the Mormon Tabernacle Choir, the Cameri Theatre of Israel, Kabuki Theatre of Japan, National Theatre of Great Britain, the Canadian Armed Forces Tattoo, and many individual performing artists from around the world.

### International Broadcasting Centre

Man in the modern world includes the many advances in communications. Expo is presenting a first in this area, too, with its International Broadcasting Centre. Located adjacent to the Expo grounds, this new \$10 million Centre allows broadcasters from all participating nations to prepare radio and television programs covering the main events. So far, more than 117 of the 182 days (including 41 remote pick ups) have been scheduled for television production. In addition, 200 hours of radio broadcasting have been booked.

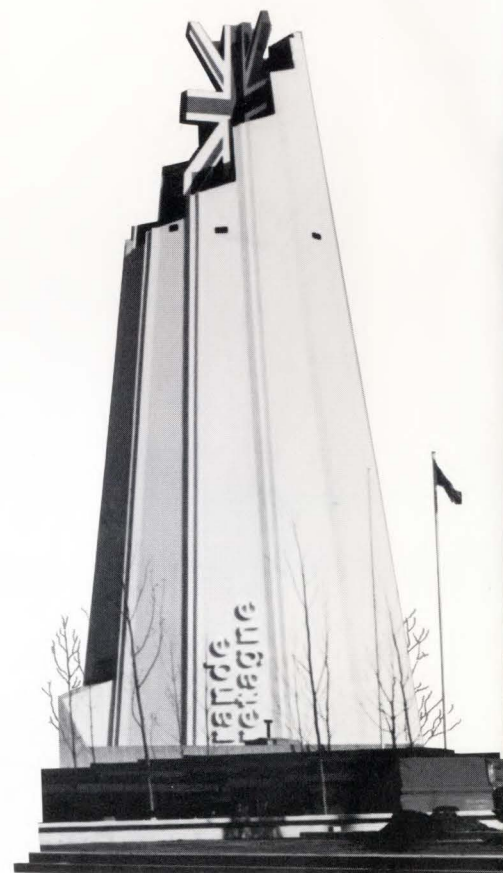
Even though the Centre is in a permanent building intended for continuing use, it is very much a communications showplace for Expo 67. It has been designed to allow visitors to go behind the scenes and watch actual television programs being produced and recorded on a regular tour route going through all operating areas. Visitors will actually see actors performing, people assembling sets, producers at work in the television control room, and technicians operating complex electronic equipment and videotape recorders.

The International Broadcasting Centre is operated and staffed by the Canadian Broadcasting Corporation during Expo 67. Radio and television programs will be produced at the Centre for distribution by microwave network, videotape recording, and in some instances by communications satellite. Television programming will be offered in color as well as monochrome. Of particular value

to broadcasters from other countries is the conversion equipment included in the Ampex VR-2000 videotape recorders to allow duplication of tapes in both the American and European television line standards.

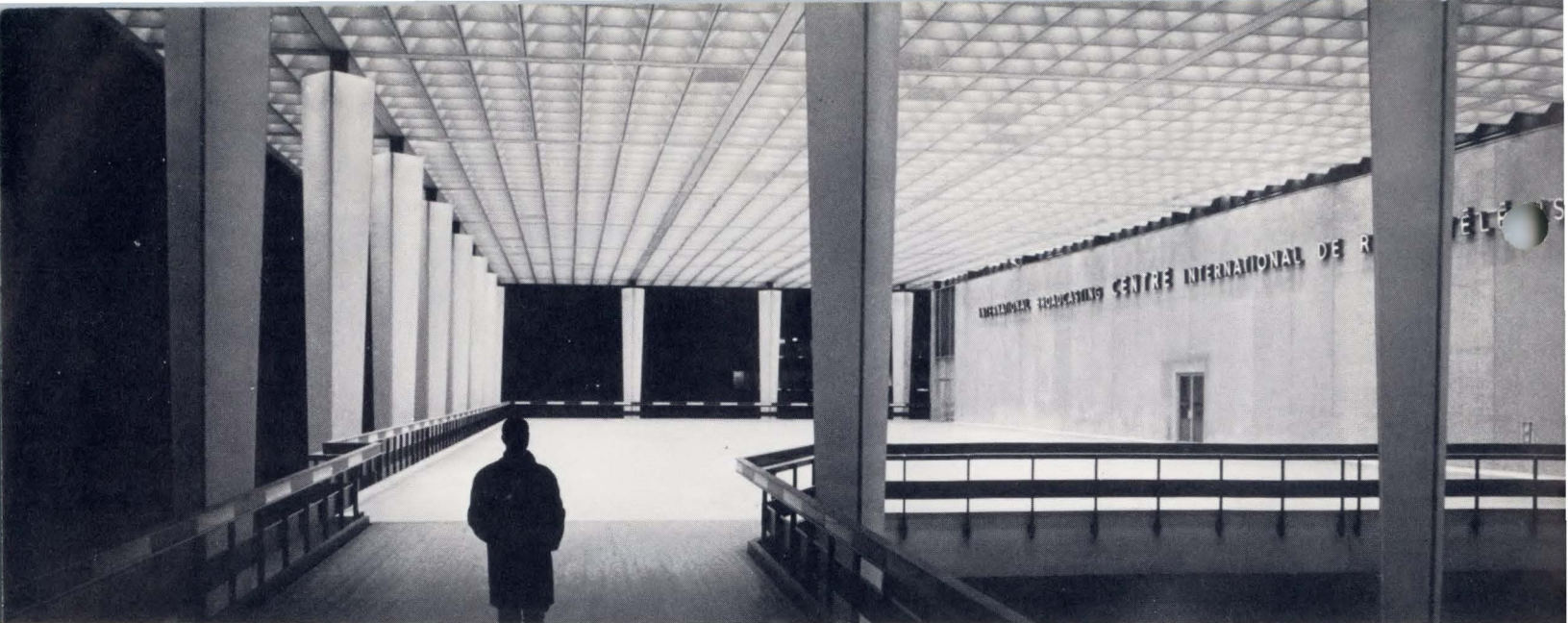
Two television studios, both equipped for color, will be used for teleproduction. The larger measures 110 x 70 feet, with seating for an audience of 250. This is the largest ever built by the Canadian Broadcasting Corporation. Both TV studios have all the necessary lighting, telecine chains, slide projectors and other associated equipment. Recording equipment is four high band VR-2000 videotape recorders, completely equipped for color and editing. For radio broadcasting, there are in addition six radio studios, the average size of which is 400 square feet. Recorders here include some 30 Ampex AG-350 Series, two banks of Model 3200 duplicators with 10 slaves each, and three of Ampex's new studio recorder, the AG-440.

In addition to the studio facilities, makeup and dressing rooms, a shop for set touchup, and all other facilities necessary for producing complete television and radio productions are included. The entire building is specially air-conditioned so that equipment noise and vibration will not be picked up by the microphones. A combined radio and television master control room can transmit any radio or television production either in the Centre or on the Expo site to any point in the world.



British Pavilion





*International Broadcasting Centre at night,  
as seen from the footbridge connecting it with Expo 67.  
(Photo by Malak, Ottawa)*

### Remote Broadcasting

For remote broadcasting from anywhere on the Expo site, the Centre has five television and three radio mobile units available. These will be called into extensive use particularly during the many national days which each country presents. Three of the five television vans contain complete color capability. Two of the vans, one color and one monochrome contain Ampex videotape recording equipment.

### Videotape Recording Facilities

As a major part of its contract to supply complete recording facilities for the Centre, Ampex of Canada, Ltd. engineered and installed all the equipment in the videotape recorder room. In total, five specially modified Ampex VR-2000 videotape recorders are used by the Centre. Two color VR-2000's offer a complete editing capability with Electronic Editor, and Editec. Two additional color VR-2000's are

also located in the videotape recorder room in the studio. All four recorders have special overhead monitoring facilities for color and high quality audio. A fifth color VR-2000 is installed in one of the mobile vans. Another van uses a monochrome VR-1100 recorder. All recorders are equipped with a dual standard capability to operate either on American (525) or European (625) television line standards.

For production of video tapes with the audio in different foreign languages, a Multilock system has been developed and installed at the Centre by Ampex of Canada. Using any of the four VR-2000 recorders located in the recorder room, several audio tracks in different foreign languages can be added to a video recording at the same time, or with a single recorder, several different languages can be played back simultaneously with the picture. Handling the audio and cue tracks are Ampex AG-300 Series audio recorders, equipped with Multilock equipment.

### FAIRS ... WORLD'S FAIRS ... EXPOSITIONS ...

Fairs are as old as mankind. In the dawn of pre-history, primitive men of different tribes first came together to barter food, clothing and tools. Over the centuries these periodic meetings grew into regular trading fairs and caravans in Egypt, Phoenicia, China, Arabia, Greece, and the Americas. They frequently were held at the same time as religious festivals to draw larger crowds of buyers. Later, athletes competed; magicians, clowns, acrobats and singers entertained. Ultimately, they came to be called fairs, from the Latin word for feasts, *feriae*. Then, as now, fairs primarily served as a marketplace to offer goods for sale.

Expositions grew out of these early fairs and their numerous contemporary counterparts. They differ in that expositions are meant to show value and usefulness of the products assembled.

In 1928, the International Exhibitions Bureau was set up to regulate and schedule all fairs and expositions. Expositions are general or special; general expositions are first or second category. At first category expositions, each nation must build its own building. At second category expositions, they are not so obligated.

So far (since 1928), the Bureau has only recognized three expositions in the first category: Brussels in 1935 and 1958, and Canada in 1967. Thus, Expo 67 is the first exposition to bring "first category" exhibits to the Americas.

*Habitat 67*





# The United States Army Band and Chorus





## ELECTRONICS ADDS TO THE POMP AND CEREMONY OF MILITARY MUSIC

By Specialist Alan Olson  
Music-Electronics Integration Supervisor,  
The United States Army Band and Chorus

IMPRESSED by the colorful excellence of the famous French and English military bands, and their tremendous effect on troop morale during World War I, General "Black Jack" Pershing resolved to establish an American counterpart. In his curt, concise style, America's only General of the Armies since George Washington, sent a memorandum to Captain Perry W. Lewis in 1922, stating simply: "You will organize and equip The Army Band."

Although American military music is as old as the nation itself (fifes and drums called us to arms in 1775), General Pershing wanted a permanent organization in the mold of Gilmore and Sousa, a band to bring back the fading glory of men marching to such songs as "Over There," "K-K-K-Katy," and "Stars & Stripes Forever." Perhaps he knew of the Confederate officer who said after the Civil War to a Union chorus: "I tell you gentlemen, if we had your songs, we would have whipped you out of your boots. Who couldn't have marched and fought with songs such as yours."

Then as now, the Department of the Army charges The United States Army Band and

Chorus with the formal mission of providing music at parades, ceremonies, concerts, and related military activities. But to the members of the 100-man band and 40-man chorus, the mission is more simple: "To set the standards of excellence for all military musical organizations." To accomplish this, The United States Army Band and Chorus must be heard, and where live performance ends or is impossible, recorded performance must fill in if these famous units are to touch the thousands of people who might not otherwise hear them.

### One Million Feet of Tape Each Year

From their superbly equipped studios overlooking the Arlington National Cemetery at historic Fort Myer, Virginia, The United States Army Band and Chorus meet this challenge by providing almost one-million feet of tape recorded music each year. Destined for release over all the major broadcast networks, local independent stations, and Armed Forces Radio and Television networks, this recorded music consists of every conceivable instrumental and vocal combination: concert band, male chorus, orchestra, dance bands and combos, instrumental ensembles, and vocal solos. Marches and minuets, Mancini and Mahler, any of 200 national anthems in response to an emergency call from the White House, a bugle call for a remote Army post in Alaska, or a complete symphony for a composer in St. Louis, these are the daily fare of the Band recording engineers.



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Interior of the recording control room of The United States Army Band at Ft. Myer, Virginia, showing a bank of master recorders in the background. The main console is a twelve-position, three-channel custom unit.

The United States Army Band leads the Inaugural Parade for President Lyndon Baines Johnson on January 20, 1965.





*Lt. Col. Samuel R. Loboda (center), Leader and Commanding Officer of The United States Army Band and Chorus, directs a three-to-two channel dub-down session with Sp. 7 Alan L. Olson (left). Sp. 6 Jerry Nedilsky (right) engineers the session.*





Typical remote music reinforcement set-up with simultaneous special effects tape playback. Up to fourteen microphones may be employed for a performance of The United States Army Band and Chorus. For this performance, three ganged mixers provide the mixing and a recorder is set for playback.



Editing a three-to-two channel second generation dub on a two-channel master recorder.

## Recorded Sound Reinforcement and Special Effects

Live performance also places a burden of technical excellence on Band technicians. Today's band leader has available to him a wealth of electronic effects through the magic of magnetic tape. Problem: perform the Overture 1812 on the grounds of the nation's capitol, as written, including the usual cannon fire, without disturbing Senators and Representatives as they conduct the nation's business. Solution: pretaped guns, played back in sync with the live music, through special speakers which direct the sound at the audience, not the capitol windows. From the delightful singing of a nightingale in Respighi's "Pines of Rome" to not-so-delightful singing of a jet engine in Alford's "Skyliner March," more life-like than the original sounds themselves, magnetic tape provides the answers.

Gone are the days of the Sunday "concert in the park," with 20-piece bands playing Sousa and Wagner to audiences not much larger than the bands themselves. Today's audience? Three-hundred thousand at Fourth-of July concerts at the Washington Monument, five-thousand in a high school gymnasium in Arlington, Virginia, ten-thousand on the steps of the Watergate at the foot of the Lincoln Memorial, thirty-thousand on the rolling grass slopes of a park in Lancaster, Pennsylvania. How to meet the acoustical problems of these modern conditions? With modern electronic equipment, extremely high quality mixer amplifiers, microphones, equalizers, panners, power amplifiers, and speaker systems, integrated with a philosophy that says: "...if the audience knows it's amplified, it wasn't done properly." Wireless and miniature microphones now free the soloists from

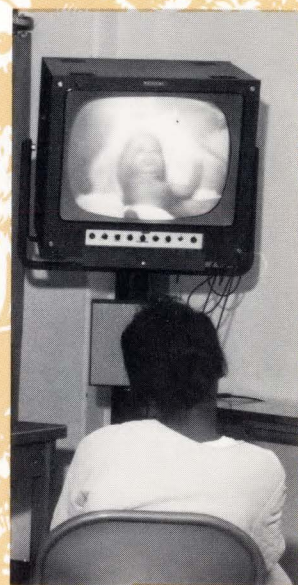
their anchors at the base of a microphone stand, stereophonic mixers and power amplifier/speaker combinations so smooth and real that they trick audiences into believing they are hearing live sound, special speaker systems beam sound into an audience area almost as though it were light. New and strange words... ambiophony, acoustic taper, ring modes, these are as permanent a part of today's band vocabulary as forte, tacet, and crescendo.

And the world of video tape? As though created to present the breathtaking spectacle of an 80-piece military band with 40-voice male chorus visually as well as aurally, The United States Army Band and Chorus employ this medium in every way possible. Not being equipped for color production of its own, the lack of facilities did not prevent the organization from winning an Emmy Award for its first feature television production, "Night of the Miracle," in Washington.

## The Future

And what of tomorrow? Miniature equipment, complete recording and amplification systems no larger than a suitcase; closed circuit television for instant visual contact between performers and production staff; new and better acoustic environments; absolute sound control, perfect electronic projection into an audience; lighting and visual effects keyed to reinforced music; and just over the horizon, the unexplored world of electronic music. All these are well into the planning stages or already on the drawing boards, accomplished by a technical staff charged by the Band's Leader and Commanding Officer with: "You will advance the state of the electronic art for this Band."

# a television





## communications system

## . . . aids medical education in georgia

ANDREAE VESALII  
BOMBERGII  
medicorum Patavinæ professoris, suorum de  
Humani corporis fabrica librorum  
EPITOME.



THE teaching credentials that television presents to medicine, education, and industry are impressive. It overcomes distances and time. It shows us things that our eyes alone cannot see. It extends the time and talents of instructors to reach far more students. It allows the best lessons to be played to the greatest number of students or trainees at the most convenient time. It permits non-technical personnel to prepare fully rehearsed professional presentations with a live quality. It records transitory or dangerous events remotely without hazard to teacher or students. It transmits pictures silently and unobtrusively from laboratories, large classrooms, operating rooms, and psychiatric testing areas to viewing sites elsewhere.

All of these advantages and several more are being put to use on a routine basis with a television communications system at the Medical College of Georgia in Augusta. From its beginning six years ago in the Department of Pharmacology, television has now been extended into general use by most other departments of the College. Currently, television assists in teaching medical students, residents, nurses and nurses aids; records psychiatric conferences; presents instructional materials to respiratory and maternity patients; records fluoroscopic images; and remotely monitors, from a safe position, patients receiving radiation therapy.

Two factors are largely responsible for its increased use. The first is the growing awareness by the staff that television is an effective teaching tool. Secondly, the cost of videotape

recorders and associated equipment has now been reduced to a point within the reach of most colleges and universities. Videotape recorders offer simplified production, instant playback, and a reusable recording medium at relatively low cost. At present, the College has five Ampex VR-660 recorders, one VR-7000 recorder, eight cameras, more than 40 monitors, and a full complement of associated equipment.

### Teaching Students

In teaching medical students, television is playing an increasing role. Laboratory experiments, many with magnification of a particular area, are recorded, then played back to small groups of students who are able to see the material clearly without crowding or loss of attention. In teaching diagnostic techniques, patient examinations are frequently recorded on tape when it is undesirable for students to be present. For testing, television is used to show the student an examination of a patient, his X-rays, and historical data.

By recording a wide range of patients, the videotape recorder has enabled students to see patients who might not have been available at the time required in the course of study. Recording patients with unusual or seldom recurring diseases represents an especially valuable use of this technique.

Medical students at the College have accepted television presentations very well. This is particularly true when shorter sequences are used in conjunction with a traditional lecture by a classroom instructor.





Recording and control equipment in the Psychiatric Department is all contained on two mobile carts, each with an Ampex VR-660 recorder, three monitors, a control board, and associated devices. These carts can be easily moved to a patient's room or to other locations as needed.

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Former public health nurse Ocie Johnson replays a tape on an Ampex VR-660 to instruct expectant mothers in proper diet, bathing, breast feeding, and baby needs. This series has been extremely successful in combining Nurse Johnson's ability to communicate to maternity patients with the immediacy and familiarity of television.

### Recording Psychiatric Interviews

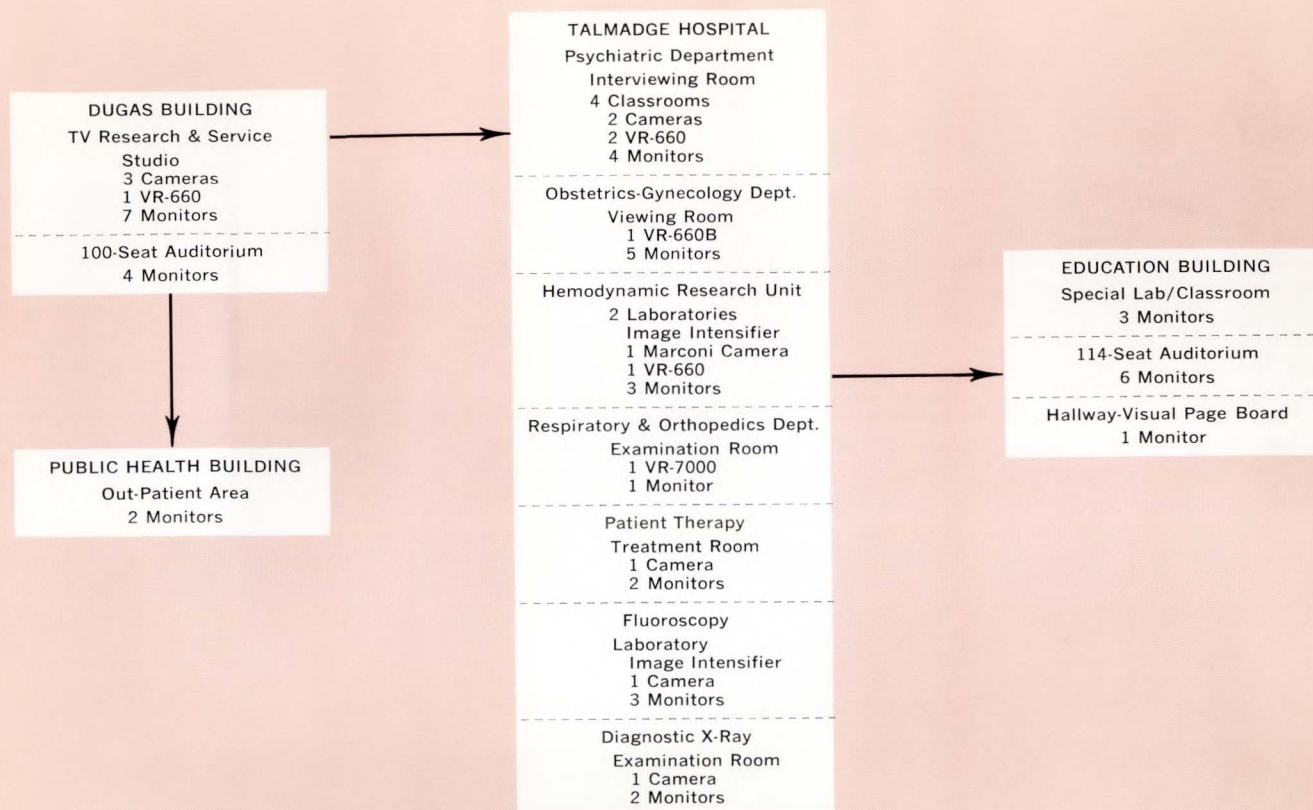
In the Psychiatric Department, two Ampex VR-660 recorders are used on a day-to-day basis to record psychiatric patient interviews and consultations. Here again, simple-to-use television cameras and the instant playback of videotape recorders allow interviews to be studied immediately afterwards without waiting for film development. Selected portions can be assembled into a history file on the patient or into a visual description of a particular syndrome. If desired, the original unedited tapes can then be erased and reused. Psychiatric recording is done in a room with two cameras placed behind a one-way glass which appears as a mirror to the patient. No special studio-type lights are used.

The basic use of television in psychiatry at the Medical College of Georgia is by residents who tape their conferences with patients and review them with the staff as a teaching and corrective technique. The College has also experimented with allowing a patient to see an immediate replay of his interview, thereby obtaining a second reaction. This type of therapeutic self-confrontation remains at the experimental stage, but is receiving increased emphasis at the College and at several other medical institutions.

### Patient Instruction

Using a single camera and an Ampex VR-7000 recorder, the Obstetrics-Gynecology Department has developed a series of tapes for pa-





#### MEDICAL COLLEGE OF GEORGIA TELEVISION COMMUNICATIONS SYSTEM

tient instruction. One very successful program has been carried on by a former Public Health nurse who shows expectant mothers basic material on child delivery and child care in the home. This has been particularly effective because many patients are not inclined to read booklets or brochures, but will respond to the immediacy and familiarity of a television screen. Reports from outlying Georgia counties have been extremely favorable as to the results of this technique.

A similar program using a low cost VR-7000 portable recorder to present material to respiratory patients has been developed by the Respiratory Disease Center at the Medical College. This program too, has been very successful and well received by patients and by their families.

#### Fluoroscopic Applications

Television fluoroscopy of catheter procedures is being used by the Division of Thoracic Surgery, and the Hemodynamic Research Unit. An image intensifier transfers the fluoroscopic image of the patient to a television monitor. This allows a moving X-ray to be observed by the operator and physician as well as students and physicians at remote locations. An intercom system allows immediate consultation between the physician in the laboratory and the radiologist. Recordings of these procedures are made simultaneously on a VR-660 videotape recorder and 16mm motion picture camera.

The advantages of television to fluoroscopy are several. Of primary importance, the experiment is available for immediate playback. As soon as the catheterization ends, the physician can replay the tape to confirm his diagnosis or reexamine selected portions. Tapes are available as a teaching device to show resident students what to look for in making their own examinations. Also, extended diagnosis and research are possible since the tapes can be compared with earlier ones to trace the course of a disease. They can be replayed as many times as necessary to confirm findings, without repeated X-ray exposure to the patient.

#### Radiology Applications

In the Radiology Department, a television camera mounted behind the lead wall views the patient while the technician watches a monitor at the X-ray control console. This type of remote monitoring is an excellent example of television use where there is any danger to technicians from repeated radiation exposure.

Three image intensifiers have recently been installed in the Radiology Department for use in fluoroscopy. The equipment is similar to that in the heart catheterization area. It is used primarily for gastric/intestinal examinations and related studies. The system includes intercoms and television monitors in faculty offices. This permits a resident to receive instantaneous consultative help if he finds an unexpected problem.

#### Nurses and Nurses Aid Training

Television has also found application in training nurses and nurses aids. Using the capabilities of the College's television facilities, many standard procedures are presented to student nurses to save the instructors time and reach more students. Tapes are prepared by the Division of Television Research and Science.

#### Television Production Studio

To produce televised instructional material, the Division of Television Research and Service has a small but fully equipped television studio. The impressive catalog of taped material includes more than 250 hours of locally produced courses for the Department of Anatomy, Medicine, Obstetrics and Gynecology, Pediatrics, Pharmacology, Physiology, Psychiatry and Neurology, Radiology, Surgery, Ophthalmology, Orthopedics, Medicine, Maternity, and Infant Care, Respiratory Service, and the School of Nursing. Typical titles include Technical Procedures in the Labor Room, Tetanus in the Umbilical Cord, Basic Pharmacology of Autonomic Drugs, Cardiac Pulses in the Dog, Middle Aged Woman with Tension Headaches, Depressed Patient at Time of Admission, Focal Seizure in a 60 Year Old Female, Hypothyroid Patients, Examination of the Feet, Examination of the Cardio-Vascular System, Prenatal and Postpartum Instruction, Breathing Patterns, and Asthma in Children.



### Distribution of Television Material

Acceptance by the faculty and students at the Medical College of Georgia has led to an elaborate network of cabling throughout the institution, with more buildings to be added in the future. During an average month, the Division of Television Research and Service replays 70 or 80 different tapes representing 45 to 50 hours of instruction to a total of 2000 to 2500 persons. This does not include the playbacks made in the Psychiatry Department using the videotape recorders and the monitors located there, or the many tapes played for instruction to maternity and respiratory patients. In total, the College has more than 40 television monitors on nine floors of the Talmadge Hospital, in the Educational Building, Public Health Building and Dugas Building.

### Other Activities

As with other successful television facilities in universities and colleges throughout the country, the Television Division at the Medical College of Georgia is called upon for many special activities. A tape entitled "Medical College of Georgia, Yesterday-Today-Tomorrow," and a welcoming address by Dr. O'Rear for new students, fall into this category. These and similar locally produced materials are frequently replayed during alumni and parent days as part of the College's public and community relations efforts.



*In the Psychiatric Department, two cameras that are located behind one-way mirrors at the end of the room pick up an interview for recording on an Ampex VR-660 recorder.*



*Out-patients in the Public Health Building receiving basic information on respiratory diseases via an Ampex VR-7000 recorder and monitor.*



*Control room in the Division of Television Research and Service, where tapes are replayed on an Ampex VR-660 recorder. In an average month 75 to 85 tapes with 45 to 50 hours of material are distributed to over 2200 students and residents. Teleproduction studio is in adjoining room.*

*Medical students in a classroom watch a procedure being replayed via television.*





## Color Television Systems: NTSC, SECAM, PAL

By Joseph Roizen, Ampex Corporation

Color television was introduced in the United States over fifteen years ago with a mechanical sequential scanning system developed by CBS Laboratories. Before it gained wide acceptance, it was replaced by an all-electronic system pioneered mainly by Radio Corporation of America, then fully developed in a joint venture by a group of industrial electronics laboratories in the United States. The system that evolved became known as NTSC, which stands for National Television Systems Committee. Like most things designed by a committee, it ended up with a few deficiencies. At first, these held back the expansion of color television, but eventually NTSC technology improved significantly, both in program fidelity and home reception. Today, most programs broadcast in the United States are in color.

Even with the improvements, European television experts who looked into the American system felt that it had some basic design flaws and that a new approach was necessary for better results. Also, since Europe operates on a different power frequency (50 Hz), and television line standard, there was no particular reason why they needed to come up with a color system compatible with the American standard. Some conversion would be required in any event.

Today, two color systems have developed in Europe: SECAM and PAL. Each has now been adopted by various groups of countries. The decision to adopt either of these systems was brought about by a mixture of technology and politics. Here is an examination of their characteristics.

### SECAM

The first system developed was the French SECAM which stands for "Sequential and Memory." It is the result of Henri de France's pioneering work. The principle behind the SECAM system is that our eyes see changes in brightness much easier than changes in color. The complexity of the NTSC system comes about as a result of transmitting, simultaneously, **all** brightness (luminance) and color (chrominance) information, giving us more color information than we are really able to resolve.

SECAM simplifies things by transmitting all the luminance, but only the alternating components of chrominance information on every other television line. A delay line in the receiver stores chrominance information from the previous line. Subsequently, it is added to provide full chrominance information on each line. This cuts vertical color resolution in half: every line contains redundant color information from the previous line, even though the color on that line may have changed in the image being scanned. However, in practice, it is difficult to detect the difference between a SECAM image and that produced by the full simultaneous NTSC system.

Its method of transmission makes SECAM quite immune to many of the errors that NTSC is subject to. The time base stability requirement is no greater than that of an ordinary monochrome image. This allows SECAM color

to be recorded and replayed on a fairly unmodified videotape recorder.

The home receiver for SECAM requires no hue or saturation control, since these elements are inherently preset by the system. The receiver has a normal contrast and brightness control, giving the viewer about the same number of adjustments found on a black and white set.

SECAM's deficiencies lie in the presence of a low-level subcarrier which is noticeable in a monochrome image, since the color subcarrier is not suppressed as in NTSC or PAL. It also isn't received as well in fringe areas. Cost is another factor. Both SECAM (and PAL) receivers are now expected to cost between five and ten percent more than an NTSC receiver. The additional cost is due to the integrating delay line necessary to assemble the final image on the color screen. France, the Soviet Union and a few other Eastern European countries have now adopted SECAM as the standard method of color transmission.

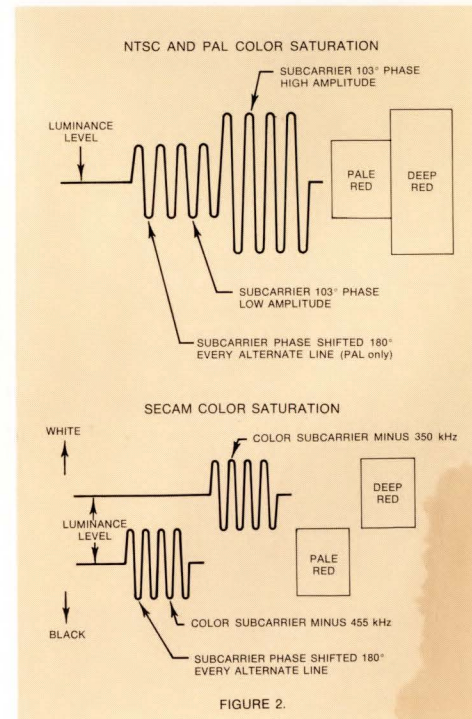
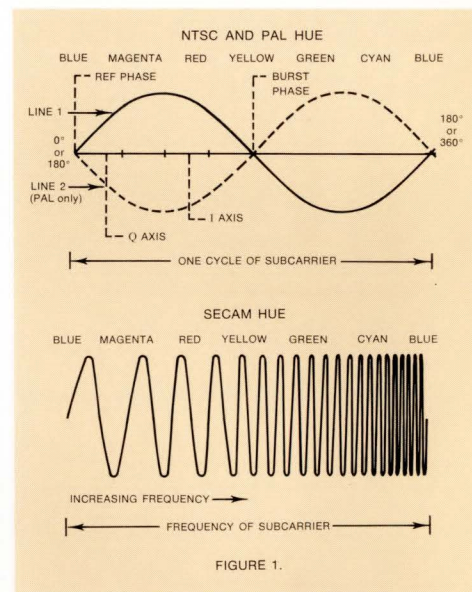
### PAL System

The PAL system was developed by Dr. Walter Bruch of the Telefunken Company in West Germany. It grew out of the work done in 1951 by B. D. Loughlin in the Hazeltine Laboratories in the United States. PAL stands for "Phase Alternate Line." It describes a technique by which every alternate television line has the phase of the chrominance information and the keying burst signal switched by 180°. The system was developed to eliminate what was considered to be the major deficiency of the NTSC system.

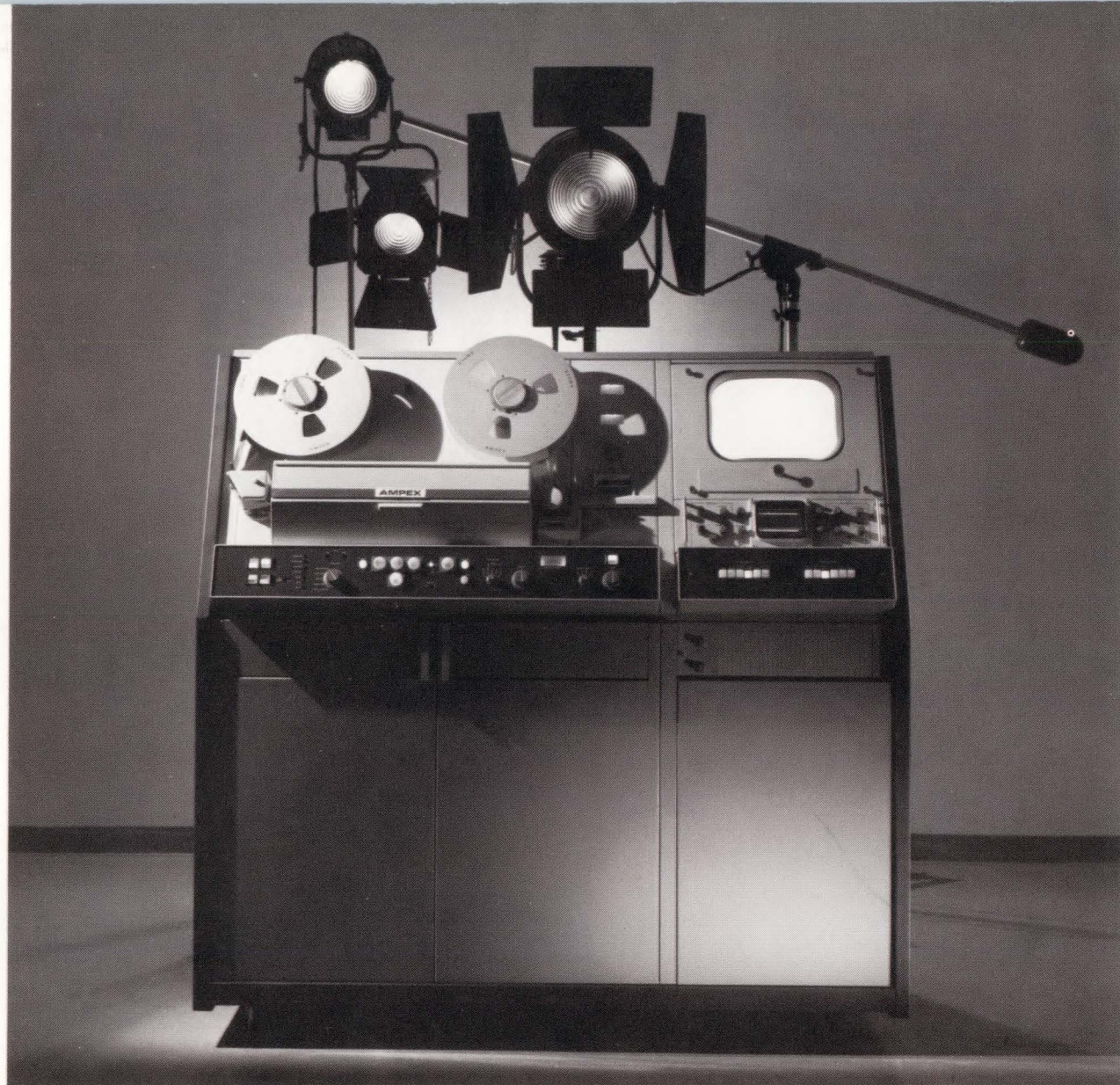
The dominant hue of an NTSC picture is defined by the phase of the color subcarrier (see Figure 1). Any shift in phase due to equipment defect, transmission errors, multi-path interference or differential phase problems can show up as a definite shift in hue from the desired color. This error is particularly objectionable in flesh tones, where even very small changes in phase angle produce green or purple faces. The PAL system overcomes this deficiency by alternately shifting the chrominance subcarrier and its burst reference on subsequent television lines. If a positive error exists on Line 1, that same error will translate into a negative error on Line 2 when the subcarrier phase is shifted 180°. The summation of these two opposite errors, either through optical integration on the face of the color kinescope (and in the viewer's eye), or by electronic means through the use of a SECAM-type one-line delay line will cancel out the error and render the proper hue to the image. Subjectively, errors as high as 70° of phase shift of either polarity, which create very severe hue shifts on an NTSC image, will not cause a noticeable change in the dominant wave length of the color (hue) being presented by the PAL receiver.

PAL receivers, therefore, don't need a hue control, but will still have a color saturation control. The PAL receiver will be somewhat more expensive than an NTSC receiver. The additional cost will vary somewhat, based on whether it is a simple receiver using optical integration or a deluxe receiver using delay line techniques. In any case, the additional costs are not expected to exceed 12%.

Video recording of the PAL system involves about the same degree of complexity that is necessary for NTSC. Although the system is somewhat more immune to phase distortion, it still requires the time base correctors that are used in the American system. Phase errors of NTSC become translated into saturation changes in PAL (Figure 2). Most of the Western European countries have adopted the PAL system and will operate color services on 625 lines with a 4.43-MHz subcarrier. Other 625-line areas, such as Australia, are expected to follow suit. Both the United Kingdom and Germany are planning to introduce public color service before the end of 1967.







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