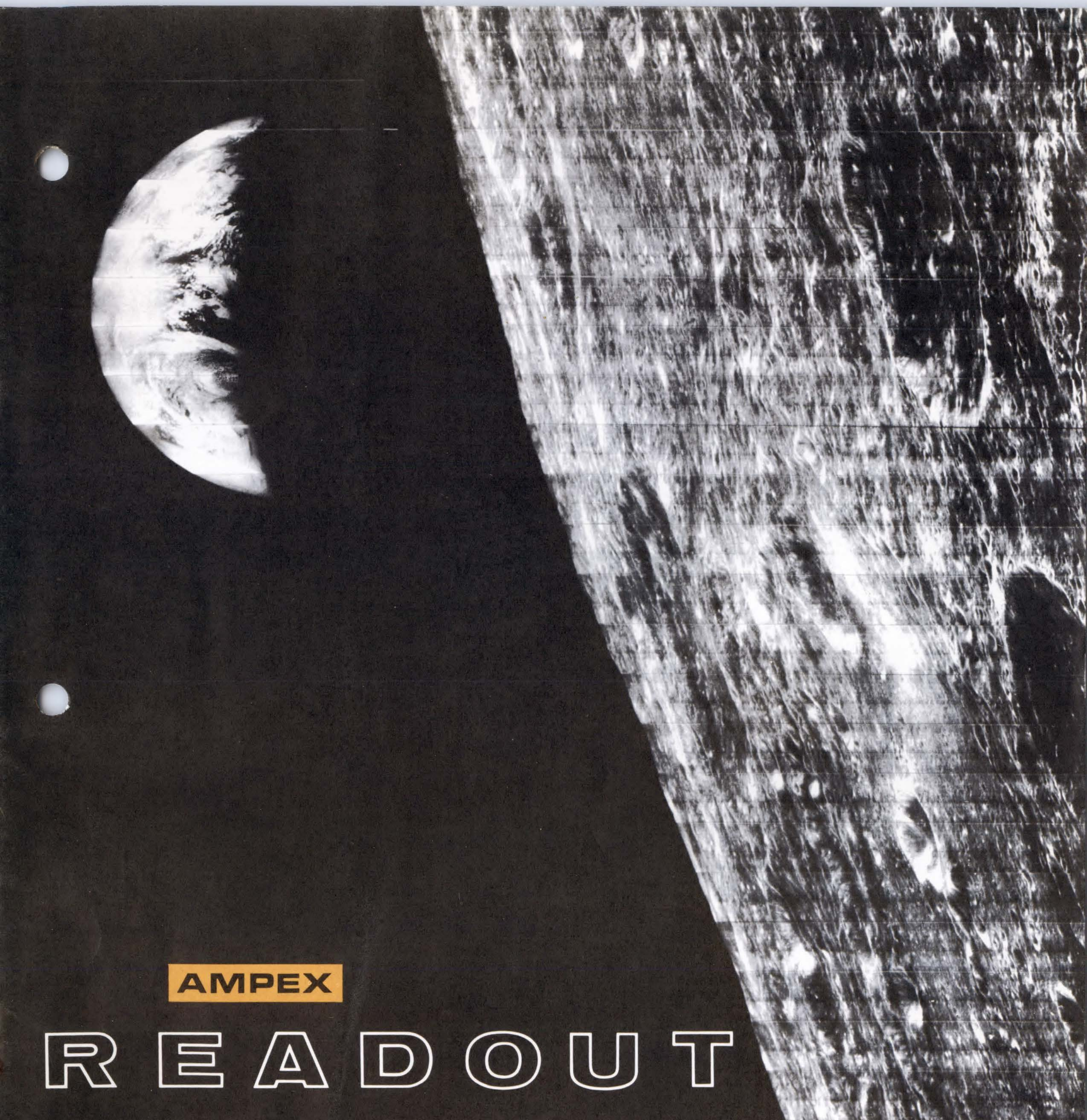
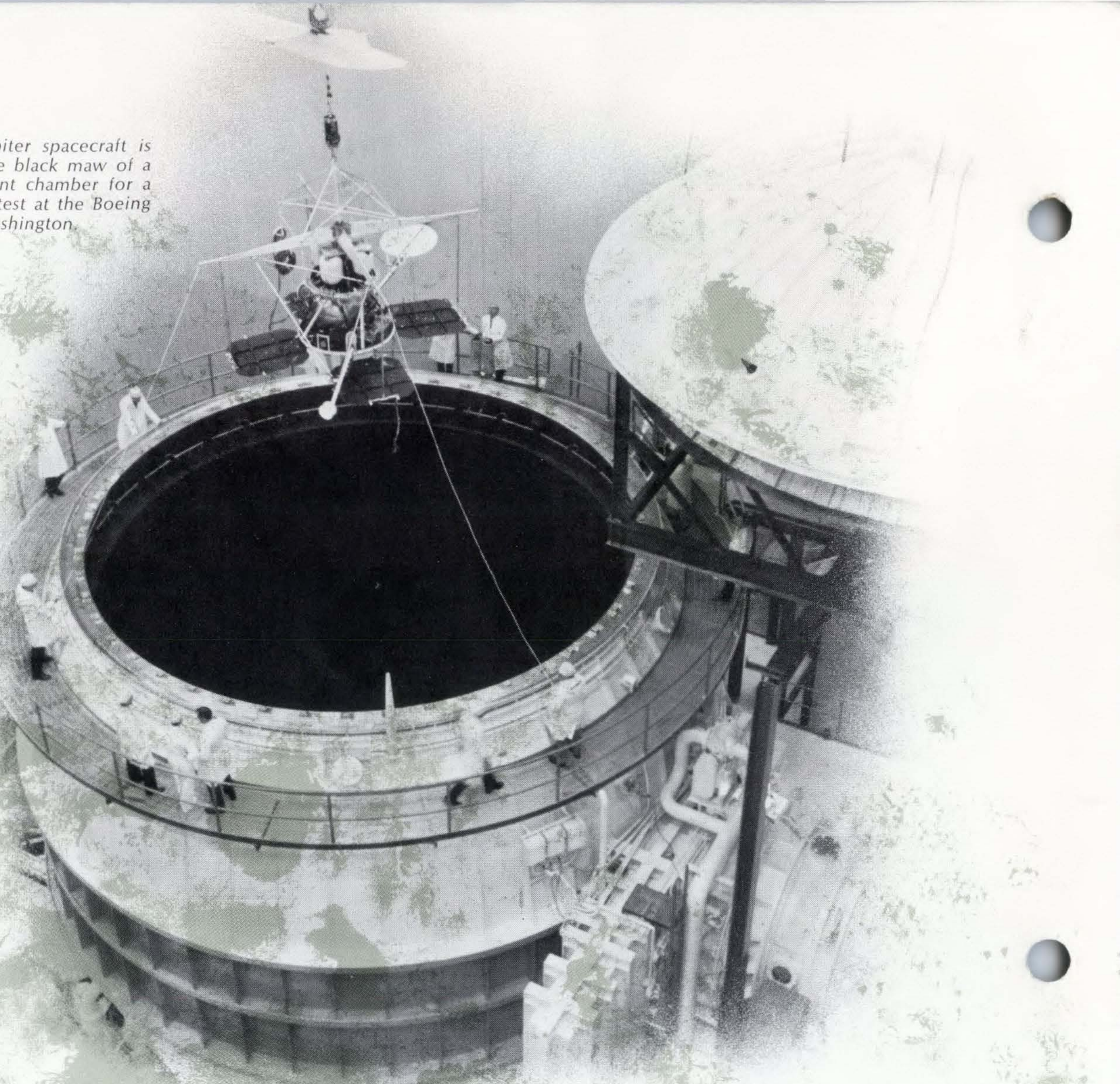


AMPEX

READOUT

In this issue:

- Lunar Orbiter
- Educational Television in Nebraska
- UHF Station: WDCA, Washington, D.C.
- Care and Storage of Computer Tape



A camera-carrying Lunar Orbiter spacecraft is shown being lowered into the black maw of a 50-foot-high space environment chamber for a three-week flight acceptance test at the Boeing Space Center near Seattle, Washington.

lunar orbiter

man's unmanned exploration of the moon

Where on the surface of the Moon can our Astronauts find a landing site not laced with deep crevices or jagged rocks?

How long can they survive when exposed to the Moon's radiation and micrometeoroid bombardment?

How accurate are our present calculations of size, shape and gravitational field of the Moon?

These questions and many others must be answered before man can safely land and move about on the surface of the Moon. The Lunar Orbiter project of the National Aeronautics and Space Administration is one of three unmanned programs set up to provide this vital information.

Fifty Years of Data in One Week

Recently, Oran W. Nicks, NASA's Director of Lunar and Planetary Programs, remarked: "One astronomer has said that more information has been obtained in the first seven days of the Lunar Orbiter I project than in the last 50 years of study of the Moon."

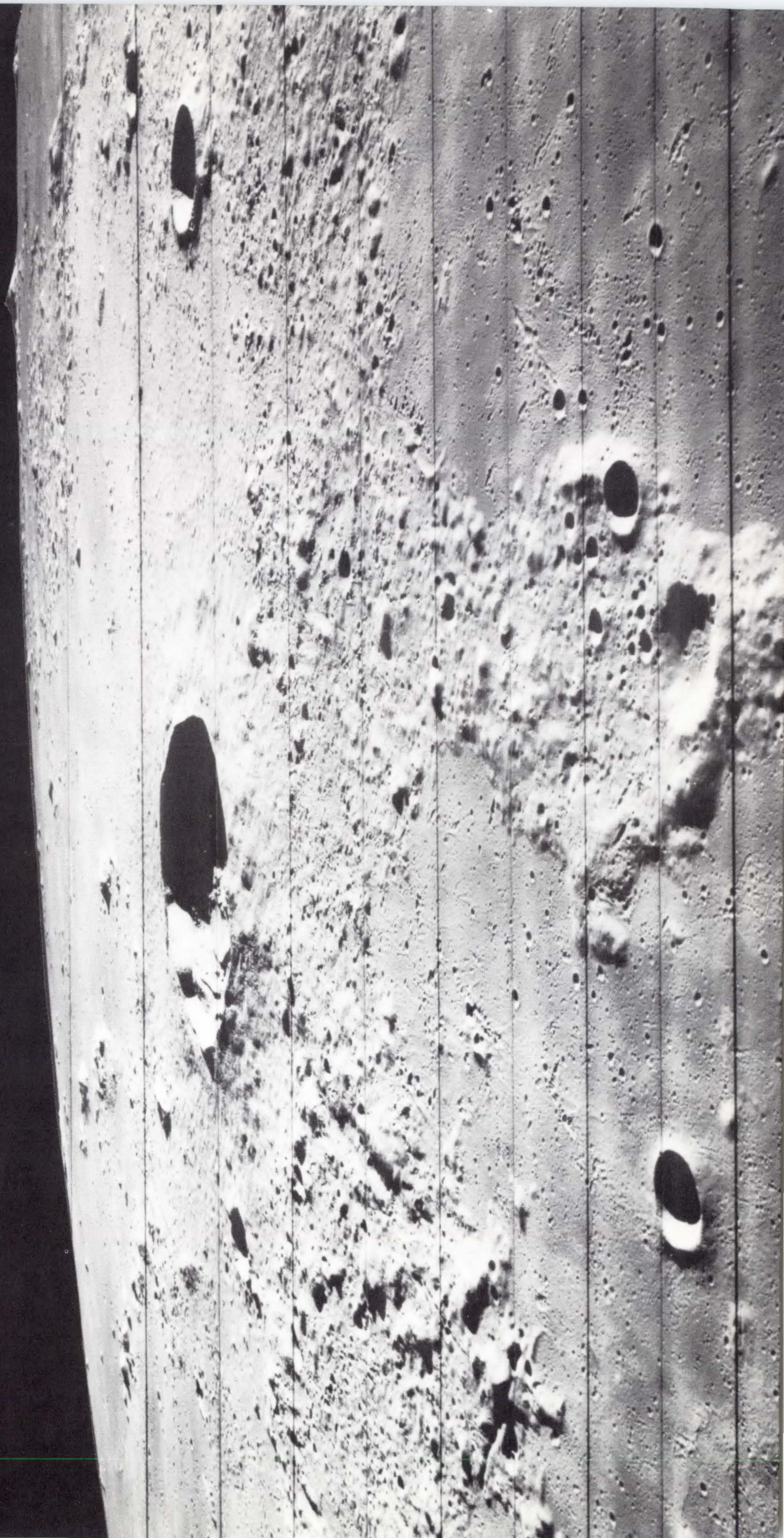
Truly, the matchless cooperation and inspired creativity exhibited in the design and construction of Lunar Orbiter spacecraft and supporting equipment by NASA, the scientific community, and American industry has helped us to take those longer strides that President Kennedy called for in 1961 when he first spoke of the Apollo landing of a man on the Moon and returning him safely to the earth.

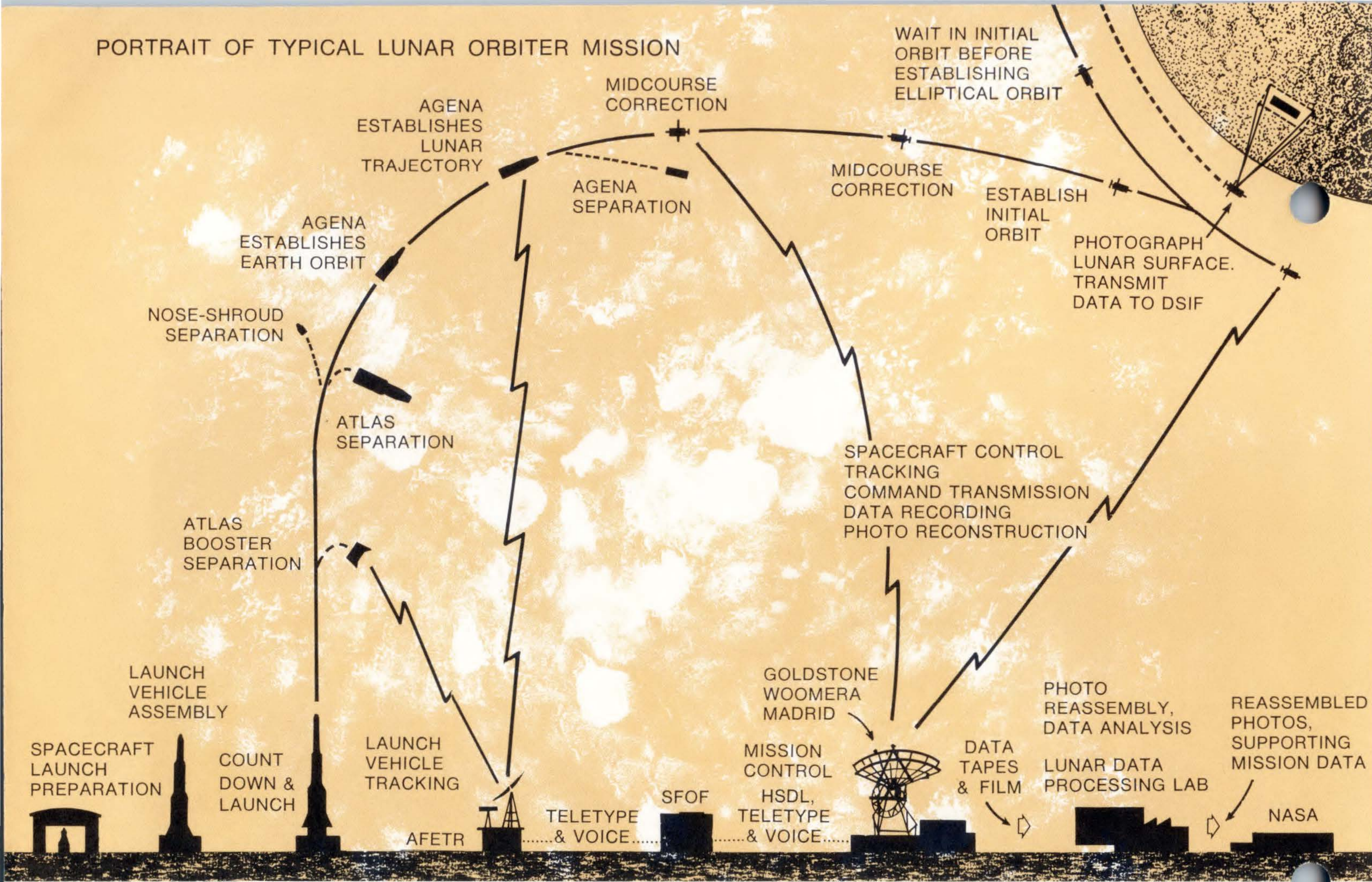
Preceding our men on the Moon, are three unmanned missions that are mapping possible landing areas, testing surface strength and composition, and establishing the launch, guidance and navigation technology for a successful manned excursion. Ranger (now completed) and Surveyor are managed by Jet Propulsion Laboratory in Pasadena, California. Overall Lunar Orbiter management is by the Langley Research Center, Hampton, Virginia. Jet Propulsion Laboratory provides tracking and data acquisition support for the Orbiter program.

RANGER, SURVEYOR, ORBITER

RANGER: Hard Landing. Ranger VII, VIII, and IX, gave us our first closeup views of the lunar surface. Multiple television cameras in the Ranger payload were activated minutes prior to impact. The resulting pictures showed the impact area in detail. Although the Ranger program provided more than 17,000 extremely valuable lunar pictures, its coverage was limited in area, and was not intended to provide sufficient information for a manned lunar landing. Besides pictures. Ranger's important contribution was establishing launch, guidance, and navigation technology necessary to travel to the Moon and hit a selected area.

SURVEYOR: Soft Landing. Surveyor spacecraft make soft landings on the Moon and also send back scientific and engineering data. During landing, touchdown dynamics and bearing strength are measured. After the landing, additional data of local surface conditions is collected while pictures are taken by eye-level television cameras scanning the surface. Surveyor I made a spectacular soft landing on June 1, 1966. The Surveyor III is planned for 1967. It will land in one of the areas selected by the Orbiter satellites for a manned landing to confirm the safe conditions at that point on the surface.





Lunar orbit is achieved about 90 hours after liftoff. The final photographic orbit places the spacecraft 28 miles from the Moon at the closest point, 1150 miles at the farthest point.

LUNAR ORBITER: A Flying Photographic Lab Scouts the Surface. Following the success of Ranger and Surveyor, the Lunar Orbiter is providing extensive photographic coverage of large specific areas of the lunar surface. As evidenced by its initial photographs, many large areas of the Moon may be too rough to accommodate a manned landing. The Apollo Lunar Module has a limited landing and maneuvering capability so that the final site (and nearby alternates) must be selected before launch. Lunar Orbiter assignments have been to seek areas large enough, flat enough, and smooth enough for a manned landing.

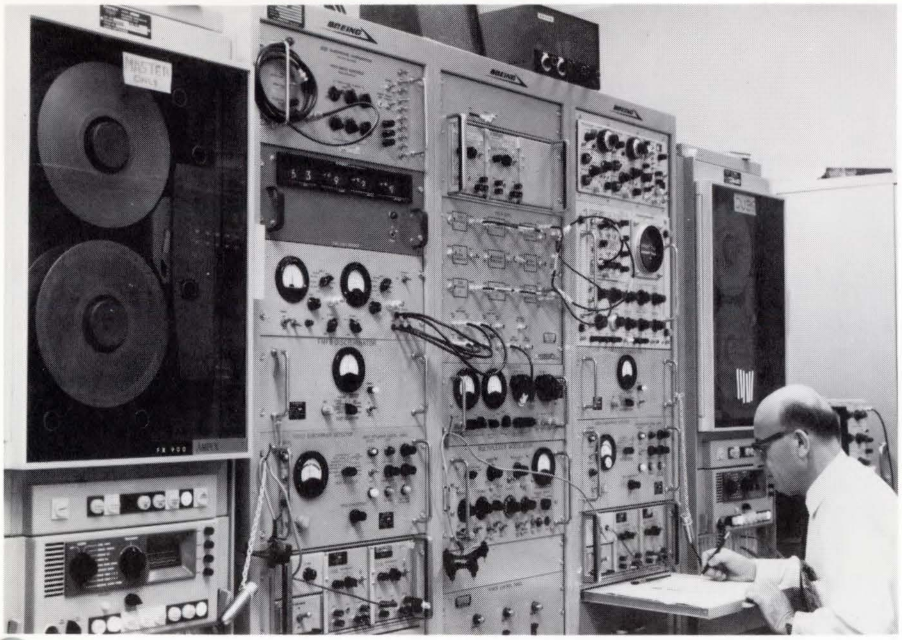
Lunar Orbiter I was launched in August, 1966. In the following 77 days it made 327 orbits and exposed 215 feet of film during 12 days of photography giving us our first detailed knowledge of large areas of the Moon, including our first pictures of the back side. To eliminate any possible radio interference between it and the follow-on missions, the Orbiter I was commanded to crash land on the back side of the Moon in October 1966. Then, in November of 1966, Lunar Orbiter II further delimited the possible landing areas. It covered more than 1.5 million square miles not covered by Orbiter I, including 15,000 miles in the Apollo landing zone. By mid-March 1967, it had made 650 orbits and by careful tracking from the earth, continues to aid scientific understanding of the lunar gravitational field. On the basis of the first two missions, Orbiter III photographed 12 specific areas to make a final selection of where the astronauts will land.

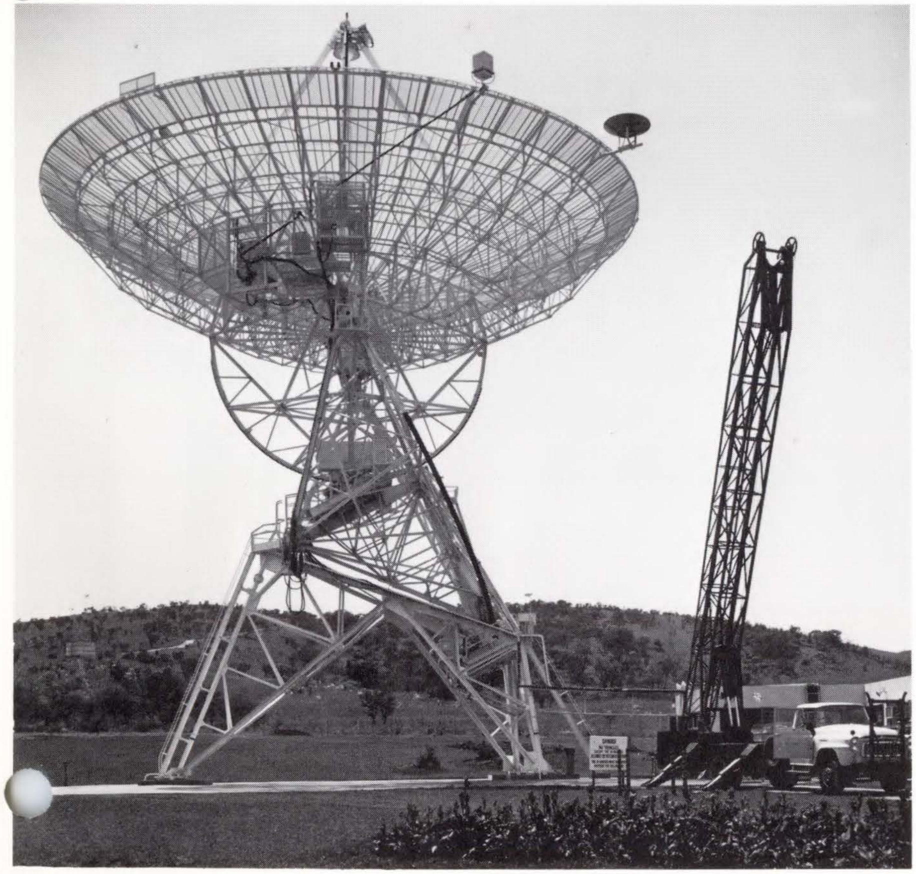
Surface detail of the Moon from the Orbiter program is comparable to the very limited sampling area taken by the Surveyor after landing. Both are far better than we can obtain from the earth. Maximum photographic resolution with earth based telescopes is on the order of 2500 feet, which means that we cannot recognize an object less than one-half mile in diameter. Even enlarging these telescopic photographs would not improve resolution. It would only result in an unrecognizable blur.

In contrast, each Lunar Orbiter provides more than 200 high resolution photographs with a resolution down to 3 feet. This means we can pick out details as small as a card table. Besides the high resolution pictures, wide angle or medium resolution pictures (about 25 feet) of the surrounding area are taken simultaneously (see diagram).

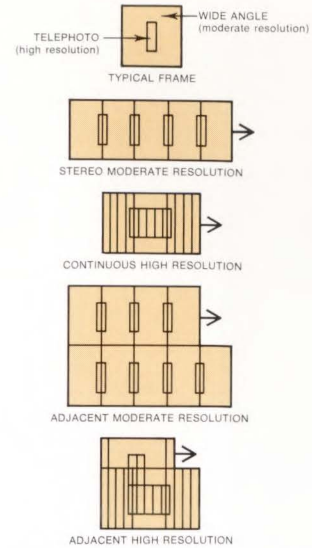
Gerald G. Leeson prepares to reproduce a tape on an Ampex FR-900 at NASA Houston containing pictures from the Lunar Orbiter I Moon shot. Leeson, Acting Supervisor, Lunar Orbiter Data Conversion System, is with Lockheed, a support contractor for NASA.

Two Ampex FR-900 predetection recorders at NASA's Langley Research Center. These recorders make copies of master tapes containing Lunar Orbiter pictures received from tracking stations. I. George Recant, Data Analysis Manager, Lunar Orbiter Project, is shown with the recorders and related Boeing Company equipment.





Eighty-five foot antenna at Goldstone Deep Space Network Station, California, which received Lunar Orbiter pictures and instrumentation data.

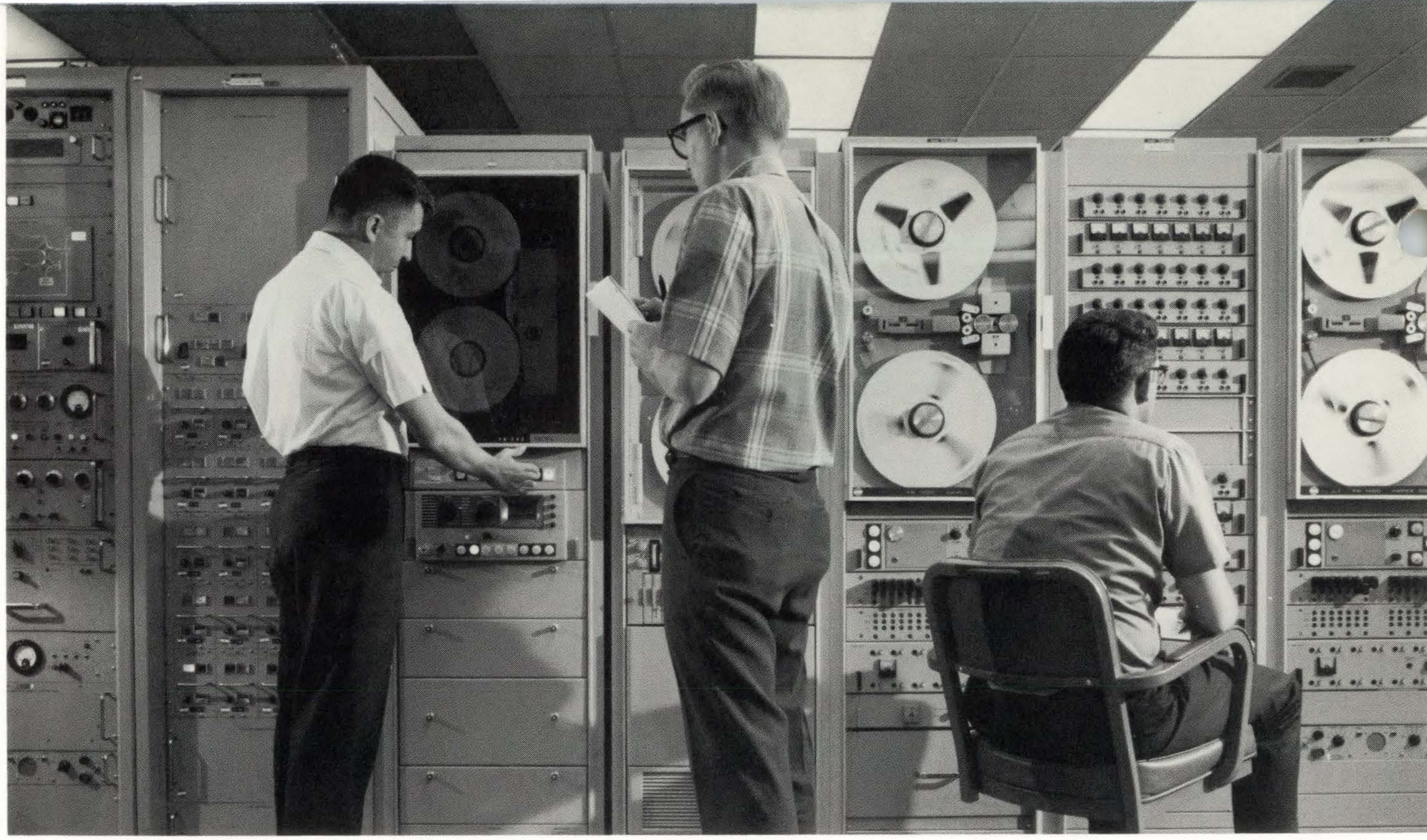


The Orbiter's camera can be ordered to take one picture at a time or to take various sequences: 4, 14, or 20 pictures in a row. And the time interval between exposures can be relatively long, to provide a 50.1% overlap of the moderate-resolution frames (for stereo), or shorter for a 5% overlap of the high-resolution frames. The diagrams indicate four possible mapping schemes. Along one edge of the film, pre-exposed data consisting of resolving power charts and scales are used to interpret the final photographs.

LUNAR ORBITER III ASSIGNMENTS: Affirming Apollo Landing Sites

The first assignment of Lunar Orbiter III was to confirm the suitability of a series of manned landing sites. From data collected by Lunar Orbiter I and II, scientists of NASA and the U.S. Geological Survey have concluded that five areas are considered to be the best candidates for a manned landing, pending additional confirmation from Orbiter III. Along with the five primary target areas, additional alternate sites were photographed. Ideally, NASA would like a string of potential landing sites about 26° apart on the lunar surface, starting from the most eastern landing zone and proceeding to the west. This is because optimum lighting on the lunar surface changes 13° a day and the requirement is for slant illumination of 7 to 20°.

ON BOARD CAMERA: Developing, Scanning and Transmission System. The Lunar Orbiter photography is done by a film camera system designed and built by Eastman Kodak Company. An initial decision was made by NASA and Boeing to use film rather than television as Ranger and Surveyor did. To achieve the same three-foot resolution with television, pictures would have to be made at a lower altitude, which would reduce the area covered, and the overall camera system would be much heavier. The Lunar Orbiter photographic subsystem contains two lenses (a telephoto and a wide angle), a Bimat (dry) developing system, and a scanner to convert pictures to electrical signals for transmission to the earth.



Goldstone Tracking Station, California. Ampex FR-900 at left records picture data. FR-1400's at right record tracking and environmental data.

Because of the high speed of this satellite when pictures are being taken (4000 mph), the camera subsystem has a motion synchronizing device to eliminate blurring of the image.

The flight pattern of Orbiter III permitted it to photograph the location of Surveyor I which soft-landed successfully in June 1966. Altogether, Orbiter III took 212 dual exposure frames. Some pictures were overlapped at least 50% to permit stereo optical analysis.

In addition to its photographic mission, Lunar Orbiter III, like its predecessors, is monitoring meteoroids and radiation intensity in the vicinity of the Moon. Information on the Moon's gravitational field is derived from a detailed analysis of the tracking data. Gravitational data is important in setting up a predictable orbit, both for future orbiter missions and the Apollo landings.

The actual picture taking mission lasted for eight days. Portions of photographs were transmitted to the earth in a priority photographic readout sequence during each orbit between periods of photography, to check picture quality and make preliminary analysis. However, the primary picture transmission is done after the photography is completed in reverse order from which they were taken. Picture transmission was completed by March 1967. Some data was not recovered due to a problem inside the photographic subsystem that developed in final phase of film readout.

In addition to the pictures, lunar environmental and spacecraft performance measurements are being taken at the same time by an instrumentation subsystem. When pictures are not being taken, this data is being transmitted on a 30-kHz carrier. But, during the 30-day photographic mission, it is added to the 10-MHz picture data carrier. Transmission of environment, performance, and scientific data is expected to continue for 11 months.

GROUND DATA ACQUISITION:

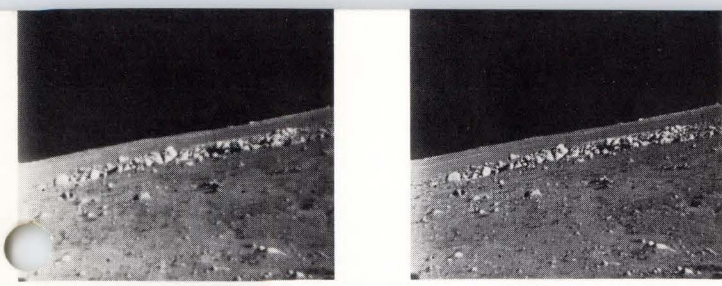
Parallel Recording on Magnetic Tape and 35mm Film

Tracking and data acquisition is the responsibility of the Deep Space Instrumentation Stations of NASA's Jet Propulsion Laboratory. These stations are located in Goldstone, California, Woomera, Australia, and Madrid, Spain. They are located about 120 degrees apart around the world so that at least one station will always be able to communicate with the spacecraft and receive data. Each station is equipped with an 85-foot dish antenna, signal receiving and signal processing equipment, two ground reconstruction equipment devices, one Ampex FR-900 predetection instrumentation recorder, and two or more FR-1400 instrumentation recorders. Readout of one complete picture frame from the satellite takes about 43 minutes. Under the best conditions, Lunar Orbiter III reads and transmits to the earth between two and three frames per orbit. This means that transmitting all 212 frames will take approximately 12 days.

At each station, the radio signals are received by the 85-foot antenna, amplified and processed to separate data from the carrier.

Within the station, the 10-MHz carrier from the receiver is routed simultaneously to an Ampex FR-900 predetection recorder and to photographic ground reconstruction equipment. The ground reconstruction equipment displays the pictures line by line on a kinescope, then photographs them with a special 35mm camera. This converts the raw video information into a photographic image. When transmission from each orbit is complete, the original, unprocessed data recorded on the FR-900 at Goldstone is replayed for transmission by microwave link to the space flight operations facility in Pasadena. Here, it is processed by similar ground reconstruction equipment. From these tape-to-film copies, the initial photographs are made for Mission Control use, and release to news media. After initial quick-look at the stations and Mission Control, prime mission tapes and film are flown to NASA's Langley Research Center for detailed analysis.

The FR-900 is a rotary head recorder like the Ampex videotape television recorders. By means of a rotating head, it records transversely across the width of 2-inch wide tape. Effective head-to-tape speed is 1500 inches per second, even though the actual longitudinal tape speed is only 12.5 ips. When recording Lunar Orbiter data, the 10-MHz carrier from the spacecraft is recorded directly on the tape, substituting for the internally generated 8.5-MHz carrier used in the other non-predetection recorder modes. (In the other recorder modes, this 8.5-MHz carrier is frequency modulated to provide an overall data bandwidth extending from nearly DC (10 Hz) to 5.5 MHz.) Overall bandwidth of the Orbiter picture data is 310 kHz modulated onto the 10-MHz carrier.



BEFORE ENHANCEMENT AFTER ENHANCEMENT

SURVEYOR MISSION A
LUNAR TERRAIN

By a novel computer process, Caltech's Jet Propulsion Laboratory clarified the indistinct Moon photograph sent by Surveyor I at left into the sharp, boulder-studded picture at the right.

Lunar Orbiter picture made with its wide angle lens. The priminent crater near the center is Kepler, which extends about twenty miles across and is more than one mile deep.

DATA EVALUATION:
A Variety of Analyses

At Langley, tape copies are immediately made of the unprocessed video data using two FR-900's. These tape copies are then replayed into the ground reconstruction equipment to prepare duplicate photographs for study by NASA and other scientists. Since the unprocessed video data on magnetic tape is in an easily reproducible form, many multiple photographic copies can be made. Primary data is still contained in the original films recorded at the stations, but in general, successive copies made by film techniques tend to show more degradation than the copies made from data in unprocessed (predetection) form on magnetic tape.

Instrumentation data on spacecraft tracking and ranging as well as housekeeping information and data gathered by meteoroid and radiation sensors, is also recorded in each station on two Ampex FR-1400 recorders. These data tapes are edited and a master mission tape is prepared for Langley, and other data reduction facilities interested in the scientific experiments.

Data analysis at Langley Research Center is done by a group of experts in various areas of lunar science and space technology. For initial screening and evaluation of the photographs, the evaluation group will include representatives of the NASA Lunar Orbiter Project, the Manned Spacecraft Center in Houston, Bellcomm, the Surveyor Project, the U.S. Geological Survey, the U.S. Air Force Aeronautical Chart and Information Service, and the U.S. Army Map Service. A primary task of this evaluation group will be to plan future Orbiter missions and Surveyor flights. Preliminary mapping will begin after slope and profile information is extracted.

To aid in selecting the Apollo landing site, statistical analysis of portions of the data will be made as rapidly as possible by the Manned Spacecraft Center in Houston by playing the FR-900 tapes into a digital computer. Since the data is in electronic form on magnetic tape, only a simple conversion into a digital format is required before detailed computer programs can be run. With this terrain information, the Manned Spacecraft Center in Houston will be able to make its final decision on the primary landing site and alternate sites for the Apollo project.

ADVANCING THE FOREFRONT OF KNOWLEDGE

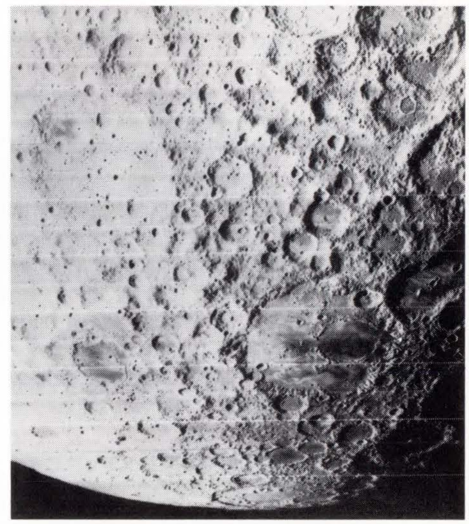
Besides the primary use in the Apollo project, Lunar Orbiter photographs and tapes will be studied over a long period of time for topographic, terrain studies, and systematic geologic investigation to obtain a more comprehensive understanding of the Moon itself.

The mountains of data collected by present and future Orbiter and Surveyor spacecraft will push forward the knowledge of man about his own earth and its only natural satellite. Lord Kelvin's words of nearly 100 years ago have direct application here: "I often say that when you can measure what you're speaking about and express it in numbers, you can know something about it. But when you cannot measure it and you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be."

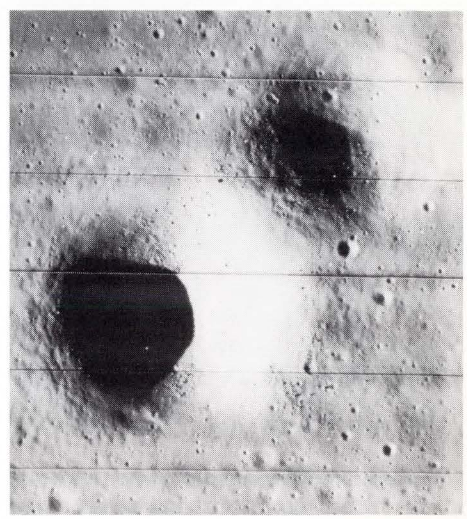
Data, both picture and environmental, received from these unmanned spacecraft clearly provides a degree of measured and numbered information in a quantity far beyond even the far reaching imagination of Kelvin and other 19th century investigators.

INDUSTRIAL TEAM LED BY THE BOEING COMPANY

The Lunar Orbiter prime contractor is The Boeing Co., Seattle, Washington, which designed, built and tested the spacecraft. Major subcontractors for the project are the Eastman Kodak Co., Rochester, New York, for the camera system and the Radio Corporation of America, Camden, New Jersey, for the power and communications systems. Prime contractor for the Atlas booster stage is General Dynamics/Convair, San Diego, California. Prime contractor for the Agena Second Stage is Lockheed Missiles & Space Company, Sunnyvale, California. Among the several dozens of supporting subcontractors is Ampex Corporation which supplied the FR-900 10-MHz predetection recorders and the FR-1400 1.5-MHz instrumentation recorders for lunar picture and data recording.



Southern half of the Moon's hidden side taken by Lunar Orbiter II with its wide angle lens from a distance of 900 miles on November 20, 1966. The area shown covers about 580,000 square miles.



An enlargement of a portion of the twelfth telephoto lens photograph taken of Site 3P-1 by Lunar Orbiter III. It covers a portion of the Lunar surface approximately three-quarters of a mile on a side. It was taken on February 15, 1967 and radioed to the Goldstone Deep Space Network Station.

Nebraska ETV a statewide approach to educational television .... for all citizens

- **In Alliance, Nebraska, Fifth Graders study the mysteries of space.**
- **A tax proposal is presented in an "open end" discussion between state legislators.**
- **Student nurses in Omaha and Lincoln receive televised physiology and anatomy courses.**
- **Teachers watch an in-service telecast in Grand Island describing new methods for teaching English.**
- **Agriculture extension experts answer questions from viewers on garden and lawn care.**
- **Home viewers watch an uninterrupted performance of a Beethoven symphony.**

A Many Faceted Operation Serves Statewide Needs

In Nebraska, one of the most ambitious and far reaching educational television systems has been set up. It extends to all levels of grade and high schools, colleges and universities, adult education and in-service training. With statewide organization, Nebraska is demonstrating what can be done to keep its citizens informed and prepared for the challenges of a changing world.

Successful educational television requires two basic things: good teaching materials prepared by experienced instructors, and a means to distribute these materials to as many people as possible. Nebraska has established separate agencies to help prepare the materials: one for elementary and high schools, one for universities, and one for nurses training. Two methods are used to distribute the materials: broadcasting via a seven-station statewide network, and local closed circuit distribution with portable videotape recorders. Both draw tapes from the comprehensive Great Plains Library and several out-of-state sources.

Since in general, the use of television represents a degree of change in existing educational techniques, it is well to understand that it functions simply as a tool to help people learn things faster and better. Rather than replacing teachers, it extends their time and talents to reach many more students.

Control board during teleproduction at KUON, University of Nebraska, Lincoln.

In Nebraska, the realization of television's role as an efficient teaching tool resulted from a study and experimental broadcasts made from 1955 through 1960 by the State Department of Education, the University of Nebraska and schools in the Lincoln area. It established that television can help teachers teach better and suggested several means by which televised teaching materials could be produced and distributed. During the same formative period, an educational television station at the University of Nebraska in Lincoln had been founded and became affiliated with the National Educational Television Network. KUON-TV was the eighth non-commercial television station in the United States. It has grown with Nebraska television and now serves as the hub and primary production center for the entire system.

Nebraska Educational Television Commission The Nebraska Educational Television Commission is a thirteen-member state agency created in 1963 to set up and administer six stations. These stations, with the existing University of Nebraska station, KUON, make up a seven-station statewide network. When the 1967/68 school year begins, the network will include operating stations in:

Lincoln, KUON-TV, Channel 12
Lexington, KLNE-TV, Channel 13
Omaha, KYNE-TV, Channel 26
North Platte, KPNE-TV, Channel 9
Alliance, KTNE-TV, Channel 13
Norfolk, Channel 19
Bassett, Channel 7

To complete statewide coverage, the Nebraska legislature is being asked to approve two additional low power channels at Merriman (in the northwest part of the state) and at Hastings, to provide a signal in areas which cannot be reached by the seven-station network. Also, future interconnection with educational television systems in neighboring states is considered an integral part of the overall plan. Channel 9, North Platte, is in another time zone. In this station, to help solve scheduling problems, three VR-1200 videotape recorders are used to delay all programming one hour during the entire 12-hour broadcasting day.

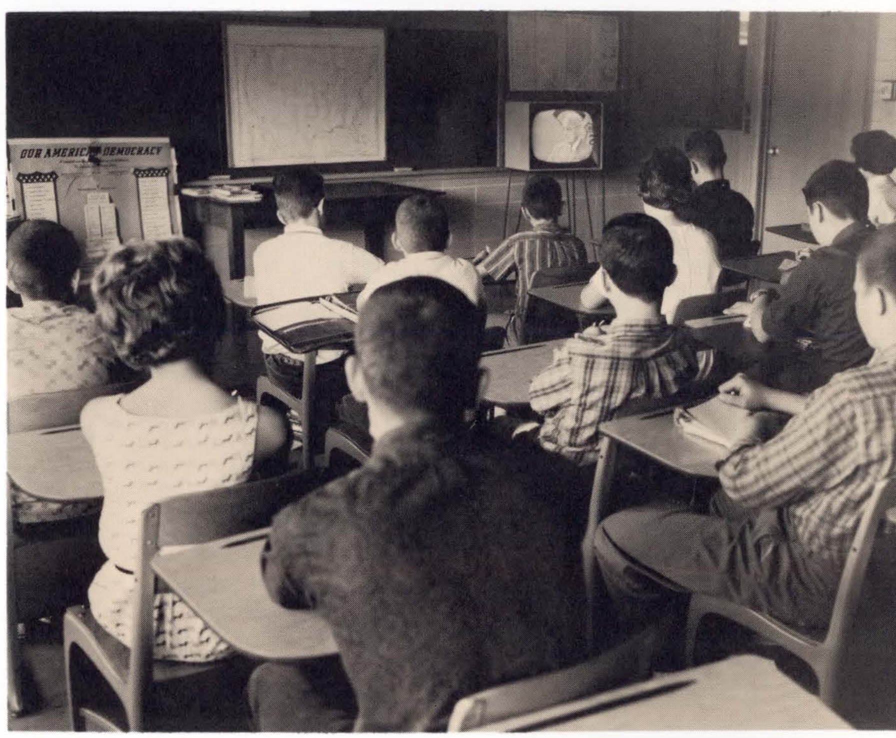
Nebraska Council for Educational Television, Inc. This council serves as the basic elementary and secondary in-school programming agency for the entire Nebraska television network. It includes 210 public and private school members with enrollments over 106,000 students. To date, it has developed 34 telecourses for kindergarten through twelfth grade which provide improved instruction and enrichment to augment existing teaching programs. For each telecourse, the council provides program and course guides developed by the participating schools with the support of the University of Nebraska's Teachers College and the State Department of Education. Supplementing the televised course materials are a variety of in-service programs to keep the teachers abreast of the latest curriculum developments and methods.

A counterpart to the Nebraska Council for Educational Television in the Omaha area is the Metropolitan Omaha Educational Broadcasting Association. Established in 1964, it includes all academic institutions (kindergarten through college) and several cultural agencies in metropolitan Omaha. Some 180 schools receive programming via KYNE-TV, Channel 26, produced through agreements with the Municipal University of Omaha and the Nebraska Council for Educational Television.

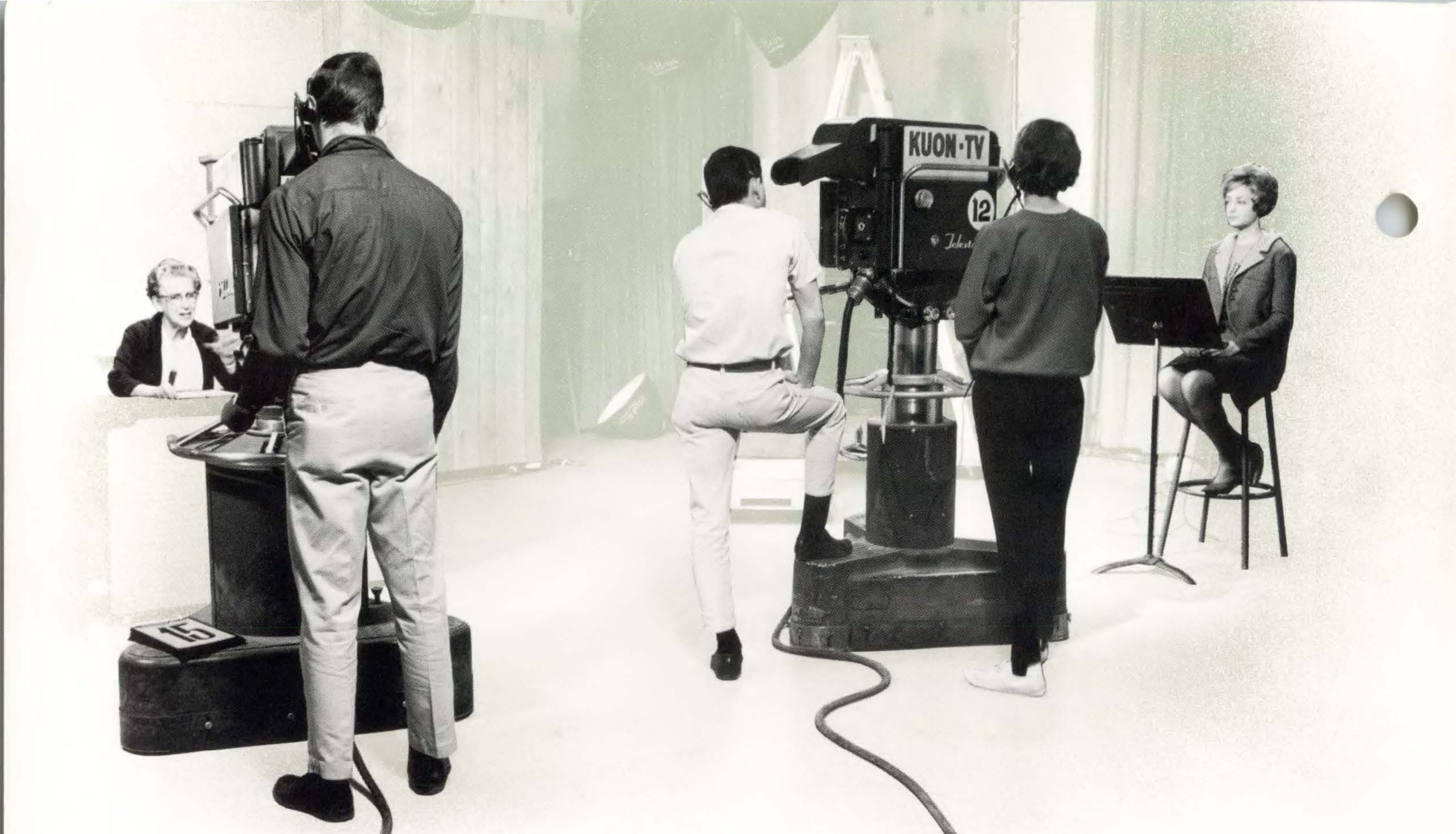
Nebraska Educational Television Council for Higher Education, Inc. In the area of higher education, a recently established programming agency brings together the presidents of all 26 higher education institutions in Nebraska. This is the nation's first statewide all-inclusive collegiate educational television organization. Its basic function is to improve higher education by providing a means for outstanding faculty members, specialized laboratory equipment, or unique facilities at any Nebraska junior college or university to be shared by any other institution. This means that expert instructors in fields such as language, science, or the new mathematics, in effect become a part of the faculty of each school. Resources and visual aids unavailable in the classroom are as close as the television receiver.

Producing a tape with a simple camera/recorder set up at a school in Nebraska. Equipment is Ampex 322 camera and VR-7000 recorder.

Fully equipped mobile van built and equipped by Ampex for the University of Nebraska. Since mid-1966, this mobile production facility has made 105 tapes in its 4000 miles of travel in and around Nebraska. Equipment includes three Marconi Mark V camera chains and an Ampex VR-1100 Videotape recorder.



Students at Millard Lefler Junior High School, Lincoln, Nebraska, view a social studies lesson on KUON-TV, Channel 12.



Miss Esther Montgomery tapes a lesson in English literature in KUON-TV studios.

University of Nebraska coaches study "instant replay" tapes of their athletes during practice sessions.

Nebraska Video Nursing Council This agency was organized in 1965 to provide programming for the seven nursing schools of Nebraska and Western Iowa. It provides courses for 450 nursing students and is being constantly expanded. Televised courses include anatomy, physiology, microbiology, history of nursing, and chemistry. The council works in cooperation with the Nebraska State Board of Nursing and various teaching hospitals throughout the state, to pool resources via television and provide courses specifically designed for student nurses.

Great Plains Instructional Television Library This was a pioneer facility in providing televised lessons on videotape to schools throughout the nation. It is the largest instructional television distribution and exchange center in the world. Each year its services have doubled. This school year it is providing more than 7500 lesson units to schools, colleges, CCTV systems, and educational television stations in the entire United States, including Alaska.

The library now has 77 complete courses with accompanying teacher guides and materials. Recently, it acquired 23 complete junior college courses. It has a continuous program of course evaluation and acquisition, and can duplicate tapes for all major videotape recorder models and speeds. Great Plains uses KUON-TV for most of its production and duplication of tapes.

In North Platte, Nebraska, Channel 9 uses three Ampex VR-1200 recorders to delay all programming for one hour to solve scheduling problems caused by being in another time zone.

A Lincoln business executive presented a series of programs for young businessmen from network studios entitled "Preparing for Your Promotion."

Production Centers at KUON-TV & KYNE-TV

The pioneer educational television station KUON-TV at the University of Nebraska, now serves as the hub and primary production center for the entire Nebraska educational television network. KUON offers a complete teleproduction facility including two studios, ten videotape recorders, eight cameras, and all other equipment necessary to produce professional educational programming. In an average year, KUON produces more than 400 taped programs for both instructional and non-instructional broadcasting.

Recognizing that materials on video tape may go through several copying steps before being shown in the classroom, KUON has elected to produce the majority of its present productions on high band recorders. Station equipment includes two high band VR-2000's, with several accessories including Electronic Editor to speed teleproduction. In addition to the high band recorders, the University has a VR-1100, a VR-1000B, two VR-1000C's and three VR-660's. The broadcast compatible VR-660 portable recorders are used by schools and universities throughout the state. To distribute taped materials in local closed circuit systems, the state has ten Ampex VR-7000 portable recorders.

For mobile production, KUON employs a completely self-contained teleproduction van with a VR-1100 videotape recorder, three Marconi Mark V cameras, plus complete switching, monitoring, and accessory equipment to permit recording a full production at any location. KUON has produced more than 105 tapes with the mobile unit since its acquisition in mid-1966.

Besides its function as a production center for the Nebraska network and a duplication facility for Great Plains Library, KUON also broadcasts adult programming to the local community and provides closed circuit programming for the many colleges and divisions of the University. A three-channel distribution system connects classrooms and laboratories in twelve campus buildings. Over 3000 student hours are transmitted weekly to multiple class sections. Programming extends through all academic disciplines including dental instruction and teacher training. For teacher training, the portable VR-660 and VR-7000 units are used to record teacher trainees in practice training sessions. Then the tapes are immediately replayed for evaluation by the instructor and critique by the class. In the evening, KUON broadcasts a full schedule of adult programming, including tapes received from its affiliation with the National Educational Television Network.

In the Omaha area, KYNE-TV provides for the Metropolitan Omaha Educational Television Association the same production and broadcasting services that KUON provides the Nebraska network. Facilities include completely equipped production studios, with three cameras, and two Ampex VR-1100 videotape recorders.

Connections With Other State Networks

Undoubtedly, Nebraska's efforts are among the most extensive and far reaching of any state educational network. Similar networks and statewide organizations are in various stages of development in New York and in Texas. Nebraska's neighboring states of Kansas, Colorado, South Dakota, Iowa, and Missouri, are now setting up their own educational television systems. Nebraska is actively studying the possibility of interconnecting with these nearby networks. The exchange of televised instruction in the form of video tape between these various states has been already carried on for some years through the Great Plains Library.

Looking Ahead . . .

Statewide educational television has passed the experimental point in Nebraska. Many other states are currently studying the Nebraska concept and will undoubtedly profit from the many years of pioneering effort carried on in the Corn Husker State. Looking to the future, Nebraska's established leadership is evident, too. Plans call for extensive adult education programs, public health and public information programs, in-service training for police, firemen, and other professional personnel, and a series of special programs to acquaint Nebraska citizens with the various public services available.

A KUON-TV recording engineer duplicates a videotape for Great Plains Instructional Television Library on Ampex VR-2000 recorders.

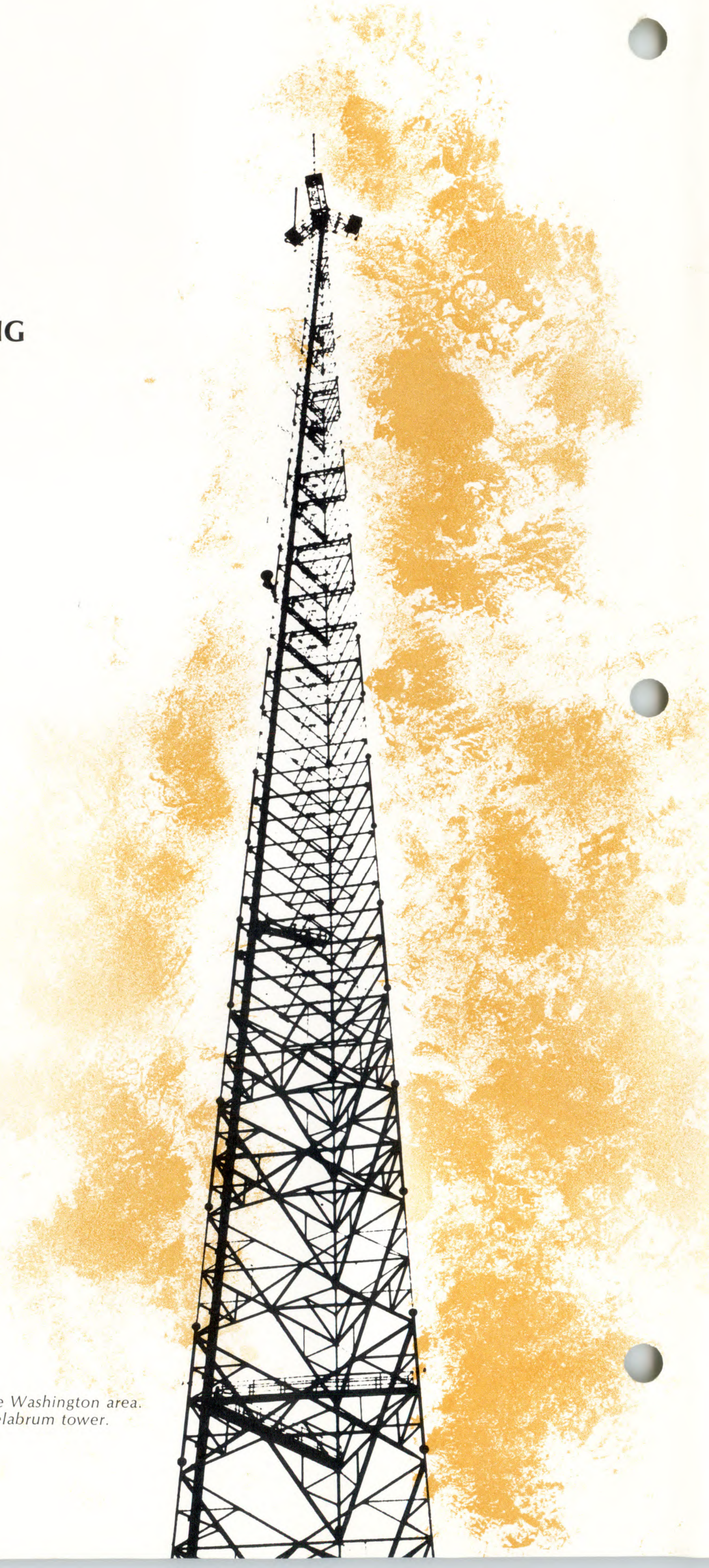
UHF: WDCA

COUNTERPOINT PROGRAMMING AND FIRST LINE EQUIPMENT BRING EARLY SUCCESS

UHF, like color, is very much here at last. After gaining an initial impetus from the 1963 legislation requiring new receivers to be all-channel, the number of UHF equipped homes in a metropolitan area such as Washington is now up to 60% (600,000 homes), and increasing daily. In the markets where UHF stations are operating successfully, it is estimated that within three years there will no longer be any VHF or UHV . . . it will only be television.

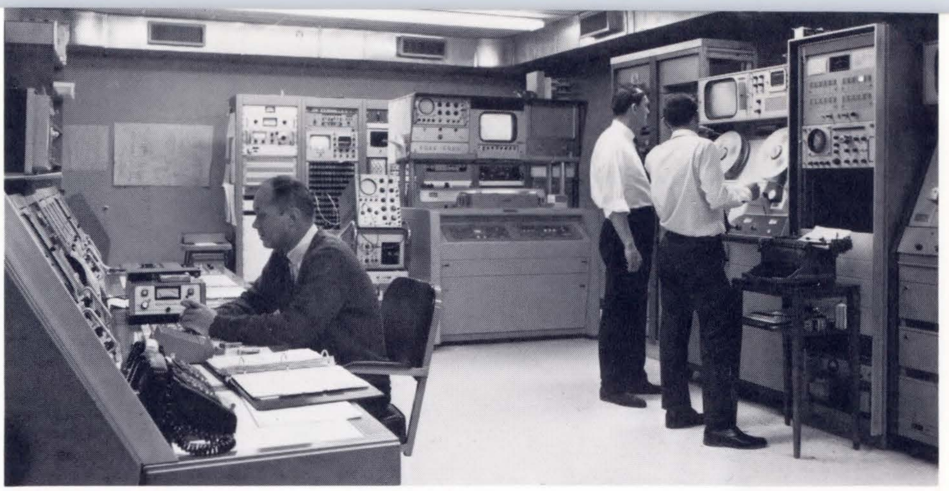
As with any type of television broadcasting, UHF must have programming to attract the viewers. If WDCA, Channel 20 in Washington, D.C., is any example, UHF has the kind of creative outlook to provide the programming needed.

WDCA is unquestionably a success. Its policy of Counterpoint Programming is being accepted by the Washington television audience. Equally important, local and national advertisers are using the station to an increasing extent. In the words of Milton Grant, President and General Manager: "WDCA has become a Washington showcase both for a successful UHF operation and an Ampex Corporation package of broadcast equipment selected from the best of each manufacturers line. On opening night, April 20, 1966, WDCA went into fourth place in the ARB rating service. In fact, it was the first station with enough audience to qualify for a rating in the next edition of the ARB book published after it went on the air."



WDCA's antenna, the highest tower in the Washington area. It is the world's first self-supporting candelabrum tower.

WDCA's Chief Engineer, John Perry, checks patching on the station's board.



The WDCA master control room showing Ampex VR-1200 high band color recorder, VR-1100 and VR-1000C recorders. Because of semi-automated equipment, the entire operation of keeping a picture on the air can be run by three people.

Master Control Board with control unit for Marconi SAMS switcher, overlooks studio area.

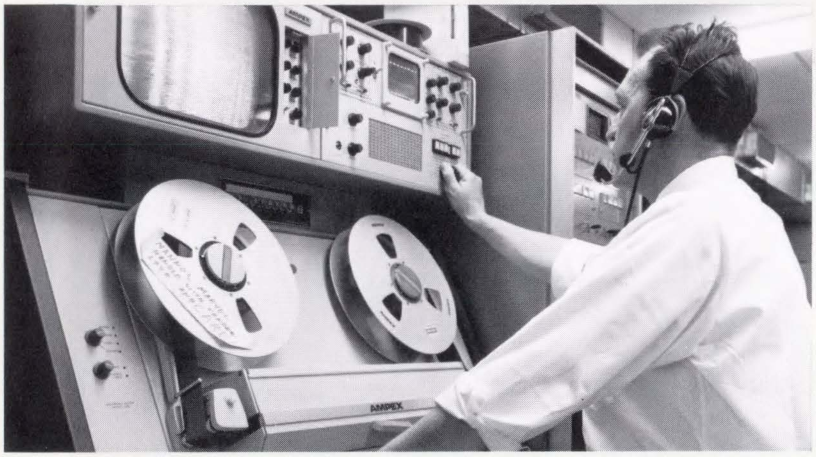
...unterpoint Programming

WDCA's approach emphasizes Counterpoint Programming. This means that when the other area television stations are showing the usual prime-time situation comedies, variety programs, westerns or movies, WDCA will carry, for example, a sports special. Before beginning operation, WDCA made a careful survey of the market to determine which type of coverage was most desired, over and above what other local stations provided. The most consistent preference was for sports coverage. To fill this gap in local programming, WDCA presents two hours of sports each day and plans to expand that schedule.

Along with the more traditional football and basketball, WDCA broadcasts unusual sports such as bullfights and stock car racing. Channel 20 has received its biggest audience reaction to the bullfights, which are broadcast on Saturday nights. Sheldon Golub, Promotion Director, states: "About half the responses have been from people who want the bullfights taken off, while the other half has favored them." Traditional sports in prime time have included Notre Dame Football, Washington Redskin Highlights, Virginia Sailors Pro-Football, Maryland, Navy, Howard and other local college basketball, and Baltimore Clipper Hockey. Wrestling from the Capital Arena ... Washington was recently added to the ...ports schedule. It has become so popular that WDCA now syndicates the program on video tape for stations in eight other markets.

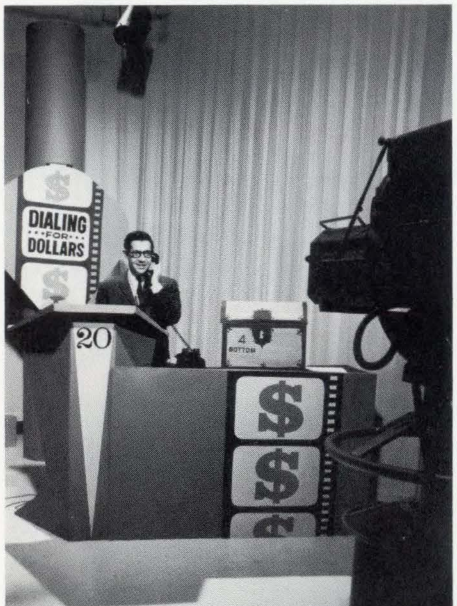
Teleproduction of a commercial in Studio A, using a Marconi Mark IV camera and Ampex VR-1200 recorder.

Mobile teleproduction van designed and built by Ampex Corporation. This $190,000 unit contains a VR-1100 recorder, Marconi Mark IV camera, and a microwave system to transmit from up to 40 miles from the station.



Station engineer replaying a program on the Ampex VR-1200 high band color videotape recorder.

Milton Grant, President of Capital Broadcasting, also serves as General Manager of the station.



WDCA's popular "Dialing for Dollars" program with host Herb Davis. Using talent like Davis and Milton Q. Ford on a free lance basis gives the station a wider range of performers in its impressive list of live programming.

Movies broadcast by WDCA also are in keeping with its Counterpoint Programming concept. Among the 1200 films purchased by WDCA are a large sampling of foreign films, including a series of classic British and Italian movies of recent years. Supplementing the movies are other dramatic shows including "Profiles in Courage," "Playhouse 90," "Play of the Week," and "Open End."

Television Advertising at Radio Rates

A good part of WDCA's success with advertisers has been its offer of "big-time television at realistic rates." Fifty-six business firms now buy time on WDCA, including many smaller firms in the Washington area who haven't used television much before because of the higher rate card of other stations. Examples are The Kinney Shoe Company, Marlboro Chrysler-Plymouth, and E. J. Korvette, all on 52-week schedules.

System Engineered Equipment Package

When Capital Broadcasting Company, owner and operator of WDCA, began its planning in late 1962, it set out to fill programming needs not being served by other local stations, and to present the highest quality television picture that first-line television equipment can bring. Working closely with Ampex's Special Products Department from the early stages, the joint recommendation of both the owners and Ampex was for an equipment package selected from among the best of several leading manufacturers: Marconi cameras, Ampex VR-1200, VR-1100 and VR-1000C videota recorders, Riker switches, RCA slide projectors, and GE color film cameras. This equipment was assembled into a system and delivered as a package. Besides supplying the entire studio package, Ampex built and designed a completely equipped mobile production van for the station's extensive remote coverage. The van contains an Ampex VR-1100 recorder, and Marconi cameras. It is equipped with a microwave system for transmission to the station from as far as 35 to 40 miles away.

Integral to the design of the studio and mobile equipment was the requirement to operate with a minimum of personnel to cut costs and make the station profitable as quickly as possible. Milton Grant, President and General Manager of the station, states: "The equipment package makes for the most efficient commercial operation. Using this first line equipment throughout our station and mobile van has helped to make us competitive with the other stations in the Washington market."

Housing the equipment is one of the most modern broadcast buildings built in recent years. Antenna design, too, is in keeping with the forward looking operation of the station. It is mounted on the tallest tower in Washington, the world's first self-supporting candelabra tower. It reaches a height of 1, feet above sea level. Two other UHF antennas can be mounted on it as well as several FM and mobile radio antennas.

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Technical Information: CARE AND STORAGE OF COMPUTER TAPE

By George Armes, Ampex Corporation

More has been written and published on the care and storage of magnetic tape than most other aspects of its use, yet the vast majority of tape related problems continues to be the direct result of improper care and handling of tape. The care and storage of computer tape (or any precision tape) can be summed up with two simple statements: KEEP IT CLEAN; KEEP IT COMFORTABLE. It is an established fact that computer tape doesn't "wear out." Computer tape is retired from service when dropouts exceed an acceptable number. Virtually all dropouts are caused by tape imperfections that lift the tape away from the head, thereby losing the signal. As packing densities and speeds continue to increase, the need for a cleaner, smoother tape surface becomes more imperative. At 800 cpi, each individual character must be supported by a very small portion of the oxide surface compared with a packing density of 200 cpi. An easy way to appreciate this significance is to recall the computer tape/highway analogy. "A standard reel of ½-inch x 2450-foot computer tape, with one nodule or surface defect that will cause a dropout at 800 cpi, is equivalent to a highway 50 feet wide by 557 miles long with one grapefruit sitting on it."

In addition to the shift toward higher packing densities, the new 9-channel format highlights the important consideration of tape edge protection. Figure 1 shows the track layout of both 9-channel and 7-channel tape. Note that the edge tracks of the 9-channel system are much closer to the tape edge, and the guard band (distance between adjacent tracks) is narrower on the 9-channel.

The industry tolerance on ½-inch computer tape is 0.498 inch ± 0.002 inch. This means a tape within specifications could conceivably have the edge tracks of the 9-track configuration fall within 0.001 inch of the edge of the tape. (Remember, the total tolerance of slitting is 0.004 inch.) This alone emphasizes the importance of protecting the edges of computer tape to minimize errors. The majority of dropouts occur on edge tracks of computer tape and are related in one way or another to physical deformation of the tape. Such defects could be nicks, raised edges, wavy edges, etc. Another point is that oxide shed and subsequent redeposits are the result of minute fractures to the edge of the tape. This can occur while the tape is wound in the pack and protected by the reel flanges, if the tape is mishandled.

Keeping Tape Clean. Plastic computer reels are a balanced design incorporating functional requirements and economy. To maintain the price of computer tape as low as possible without sacrificing utility, the standard computer reel is molded from polystyrene. This does not afford the same degree of tape protection as the more rugged, all-metal precision reel used for instrumentation tapes. Computer reel flanges will deflect more readily during handling, and extra precaution must be taken to minimize damage to tape edges. For this reason a functional canister was developed to support and protect the reel and tape during handling and shipment. As libraries grew, many users questioned the necessity of maintaining the bulky canister. Various types of reel bands were introduced to replace the plastic canister and cut storage space. One important fact that has been overlooked, however, is that the canister and reel comprise an overall functional design to protect the tape. The computer reel was designed for shipment, handling, and use solely in conjunction with suitable plastic canister. A reel band of any design is not a functional substitute for a plastic canister.

Computer tape edges are most fragile, and must be protected at all times. Reels should always be handled by the hub and never by the flanges, because this will squeeze the flanges into the tape pack. The normal shuttling operation of a computer will invariably leave the tape pack in an uneven state, with tape edges protruding slightly (Figure 2). Further, plastic computer flanges are not rigid enough to withstand flexing if exposed to rough handling.

Keeping Tape Comfortable. Various recommendations have been published regarding maximum safe limits of temperature and humidity for storage of tape. The easiest way to remember the optimum conditions is that tape performs best under "people conditions": 70°F, 50% RH. Since it is not always practical to maintain tape libraries under these laboratory conditions, what are some realistic tolerances for these parameters? The effects on computer tape from exposure to varying temperatures are gradual, and it is impossible to assign a specific, maximum limitation whereby the tape would immediately go from good to bad if this limit were exceeded. Figure 3 portrays the effects in a different manner than previously used.

This chart plots degree of risk versus environmental conditions. It shows that tape exposed to a condition outside the range normally specified is not necessarily damaged to the point where it is no longer reliable. The normal, "safe range" for computer tape is 60°F to 90°F, and 40 to 60% RH. If, for example, a tape is exposed to temperatures of 100°F for a period of 10 to 12 hours, it can be used after "normalizing" in the proper computer environment for 24 hours. The point is, the tape will represent a higher degree of risk and will be more prone to problems resulting from base film distortion than if the tape had not been exposed to temperatures exceeding 90°F.

Extremes of temperature or humidity cause physical changes in the base film, but do not degrade the magnetic properties or binder. Polyester film, the most stable base film available, will expand or contract under wide environmental changes. The coefficient of Thermal expansion for polyester is 1.5×10^{-5} inch/inch/degree F, and the coefficient of Hygroscopic expansion is 1.1×10^{-5} inch/inch/percent RH. If tape is exposed to 120°F, for example, this will represent a ΔT of 50°F (120°F minus 70°F), and the base film will expand accordingly. This is within the reversible limits of polyester, and if the base film were unrestrained it would expand and contract with no permanent set. However, since the base film is restrained within the tape pack, it cannot move freely; and as it attempts to expand, tremendous pressures are built up within the tape pack, distorting the base film. This pressure can conceivably cause layer-to-layer adhesion. The resulting erratic tension pattern on the tape also creates a condition that is likely to cause tape cinching.

Recertification and Renovation. With the rising expense of maintaining an active tape library, many installations are turning to recertification and renovation of used tapes. Recertification, *per se*, means determining the number of errors on a tape at a given packing density. In order to be effective, it is first necessary to clean the tape to remove surface accumulated dirt, redeposits and trash. There is no way possible to "rejuvenate" computer tape. Computer tape can be cleaned and surface deposits can be removed, but scratches, grooves, edge damage, etc., cannot be corrected by a cleaning operation. Remember, too, that the oxide coating does not lose its magnetic potency through aging. Tape loses its reliability by the accumulation of surface contaminants and physical imperfections. A necessary adjunct to cleaning and recertification is precision winding. The proper tension pattern on computer tape is absolutely necessary for reliable operation.

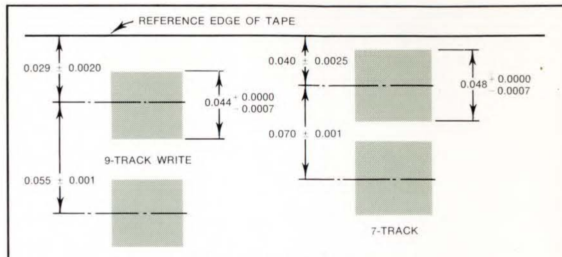


Figure 1. Relation of 7-track and 9-track layout.

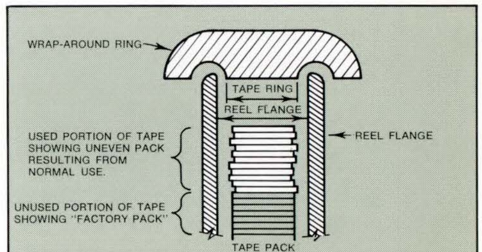


Figure 2. Cross-section of computer reel with wrap-around ring.

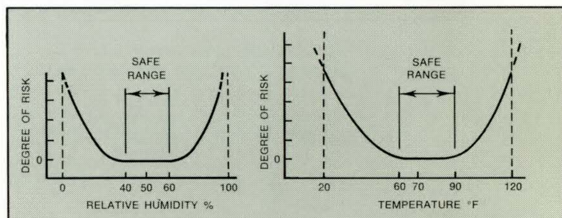


Figure 3. "Comfort Index"

DO'S AND DON'T'S FOR COMPUTER TAPE

DO

. . . strip ends of tapes that have been damaged.
. . . clean the tape and remove all residual adhesive when replacing EOT and BOT markers.
. . . conduct periodic inspection of all utility tapes for damaged tape, reels and containers.
. . . keep the tape storage area free of all dust and contaminants—paper form shed is the worst.
. . . use only labels with non-residual adhesive and no shedding—"come clean" type.
. . . rewind end-to-end.
. . . clean tape path as frequently as possible.
. . . inspect takeup reels frequently and replace as required.

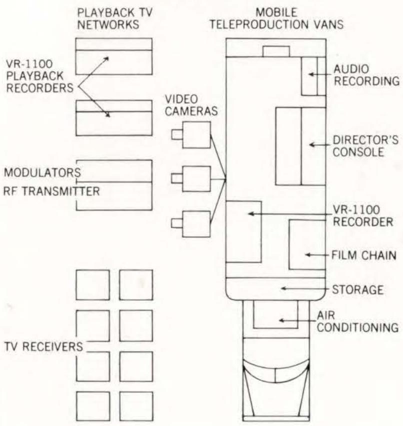
DON'T

. . . smoke or eat in data centers (especially critical in tape libraries).
. . . place any notes, markers, etc., in the container with tape.
. . . use clear cellophane mending tape for any purpose in or around the data center.
. . . use old or damaged takeup reels.
. . . handle tape reels by the flanges.
. . . allow tape to touch clothing.

newest high-speed breakthroughs to the brain: **audio / video / plus**

Ampex Special Products Engineering Group demonstrates its complete "can do" capabilities in today's most imaginative training systems; unfettered by usual electronics brand bondage; augmented by the most advanced tape recording arts. Services include total design, plus contract installation. Send your name to keep posted.

training networks



Seventeen training centers of United States Continental Army Command (CONARC) are now equipped with Ampex videotape replay networks feeding hundreds of classrooms.

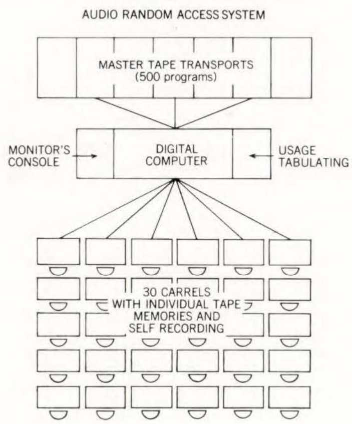
This is one of the largest and most flexible CCTV systems in the world. It records, edits and distributes visual training programs at delivery or revision speeds not possible with film.

Five mobile videotape recording "cruisers" produce up-to-the-minute military training tapes anywhere in the field. Ampex made these vans completely self sufficient, with auxiliary power, air conditioning, professional console, mixing and editing capabilities for video and audio.

Playback systems with Ampex VR-1100 reproducers, RF modulators and transmission permit instant relocation or addition to classroom receivers.

Ampex experience in installation of commercial TV stations (from the ground up) proved valuable here.

learning centers

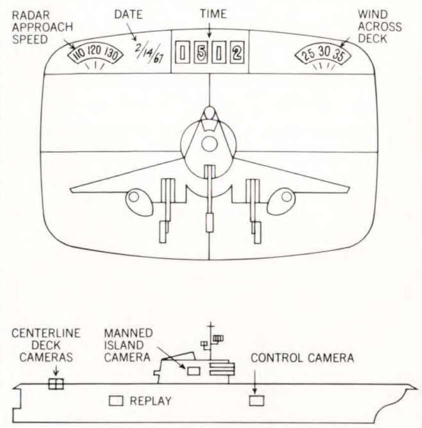


A unique new random-access learning system—designed and developed by Ampex—will permit dial-selection of any of 500 audio lecture, music, documentary or language programs, by students at 30 individual carrels. Continuously. Non-competitive.

It uses a digital computer with high-speed loop tape transports feeding to buffer tape memories in each carrel. Reaction, selection and buffer transfer takes less than 60 seconds. So no matter how often one tape is chosen, its master is never "out." Students can listen, stop, rewind, etc., at leisure; and self-record on a second track. Program and student usage is tabulated for educational research purposes.

This project is made possible by a U.S. Dept. of Health, Education & Welfare grant to Oak Park and River Forest High School, Ill. Another system—a low cost Ampex videotape recorder-teaching model for primary schools—is now operational at Los Alamos, N.M.

special-purpose systems



Installation going aboard the new U.S. Aircraft Carrier President John F. Kennedy means that Pilot Landing Aid Television (PLAT) is now on every U.S. Navy carrier.

This Ampex system helps pilots correct landing techniques while the landing is fresh, by "instant replay." Actual action tapes help train future pilots. Approaches are shown perfectly sychronized with conditions data via split-screen, for detailed review. Since PLAT was introduced landing errors have been greatly reduced.

A similar system is now helping short-field land operations of U.S. Marine Corps pilots. Videotape will also economically replace film for recording repeated events (e.g., catapult, weapons launchings), and aircraft maintenance libraries (e.g., Eastern Airlines).

Other special-purpose systems by Ampex include theatre sound systems, Videofile* system, plus systems for medicine, research and aerospace.

keep posted on new training systems

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