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ABSTRACT

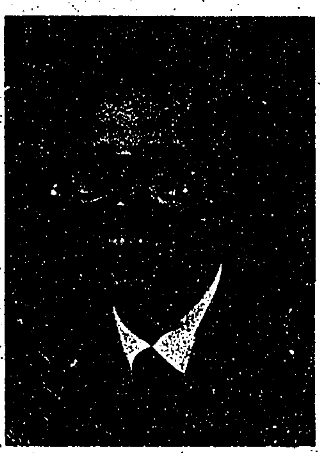
This periodical presents a transcript of a speech by Dr. James C. Fletcher, Administrator of the National Aeronautics and Space Administration (NASA), commemorating the Apollo-Soyuz Test Project and outlining the significance of this joint project; preliminary results of the Viking Mission to Mars, including details of the view of Mars from orbit, the entry and landing of the craft, the Lander system and sampling of the surface; announcement of the election of an American, Dr. Wayne R. Matson, as International Aerospace Education President; an announcement of the release of a career guidance filmstrip, "Take the High Road"; and a list of twelve recent NASA films. (CS)

NASA National Aeronautics and Space Administration

Report To Educators

Vol. 4 no 4 December 1976

The Significance of ASTP



On July 21, 1976, at the Embassy of the Union of Soviet Socialist Republics in Washington, D. C., Dr. James C. Fletcher, the Administrator of the National Aeronautics and Space Administration, spoke at ceremonies commemorating the joint US-USSR Apollo-Soyuz Test Project flight of the previous year:

I'm pleased to join you today in this commemoration of an event that, although it took place a year ago, remains very fresh in our minds.

The Apollo-Soyuz Test Project is only one of the many cooperative projects in which our two nations have joined. We are continuing joint efforts in a number of less publicized projects, including exchange of data on the planets, exchange of biomedical data from manned spaceflight, joint use of a Soviet biological satellite, and important collaboration in remote sensing of the natural environment.

But for most people, here and abroad, the first international manned spaceflight is an event that will retain a special significance for years to come. The docking of Apollo and Soyuz remains perhaps the most visible and dramatic evidence of our ability to cooperate in space. Even when the future course of events is clouded, this achievement offers hope and guidance.

The Apollo-Soyuz Test Project had very clearly defined goals of a technical and useful nature. It made it possible for us to develop an international space rescue capability; and has laid the foundation for further cooperation in manned spaceflight. Cooperation includes the potential for conserving our resources while we substantially increase our ability to

(continued on page 6)

Viking on Mars — The First Months

This article provides teachers with a scientist's account of the Viking mission and its preliminary results. It was prepared for **NASA Report to Educators** by Dr. Richard Stuart Young, Chief, Planetary Biology and Quarantine, Office of Space Science, National Aeronautics and Space Administration.

While Mars moves behind the Sun, out of communications reach of Earth, Viking Project scientists have an opportunity to review the data they have accumulated since Viking 1's arrival at the Red Planet last June. In late December, when conjunction ends, they will begin a year or more of extended research, which might lead to answers to the many questions that have arisen during the past months.

The View from Orbit. The Viking I mission was planned so that the spacecraft would remain in orbit for a period after its arrival at Mars, using its cameras and spectrometers to confirm the safety and scientific desirability of the landing site. That site had previously been selected from pictures obtained by Mariner 9 in 1971-72. These pictures had been studied in painstaking detail by geologists and cartographers for several years. Clearly, the selection of a safe landing site was vital. It had been decided that a low, smooth region which appeared to be a drainage basin for the huge canyon discovered by Mariner 9 looked both as safe and as scientifically interesting as could be found at that time. This region is known as Chryse.

On arrival at Mars, the Orbiter's cameras were turned on as soon as possible, and during the first 30 orbits of Mars about 1000 frames of the surface near

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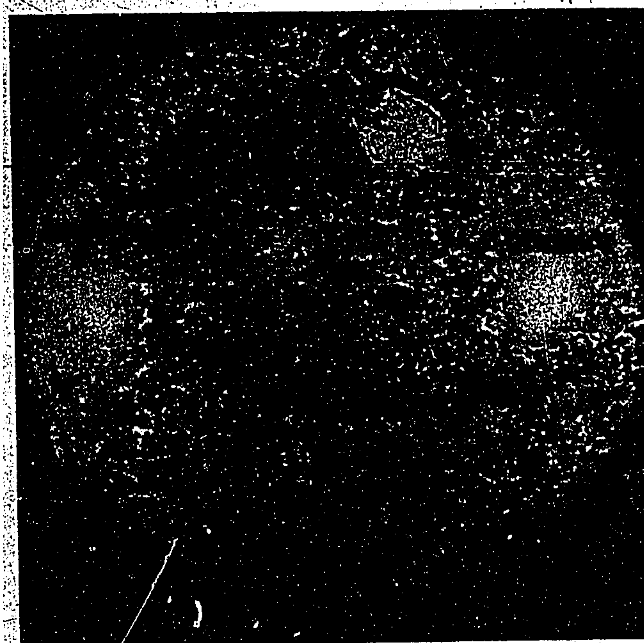

Viking on Mars—The First months
(cont.)

the proposed landing site (and two alternative sites) were taken with resolution of 100 meters (328 feet) to 1 kilometer (3,280 feet). The quality of the Orbiter pictures was superb, partly because of an improved imaging system but even more because of the greater clarity of the atmosphere than at the time of Mariner 9.

In general, the areas viewed appeared quite old (based primarily on crater counts), with little wind erosion. The proposed landing area in Chryse showed evidence of catastrophic episodes of flooding in the southern and eastern parts of the basin; however, there was no sign of accumulations of sedimentary material, which the scientists would have found interesting. Craters abounded in the area and considerable evidence was obtained to suggest a permafrost layer at some depth. The material ejected from craters appears to have flowed as a fluid down the crater slopes, as though the underground ice and soil had melted on impact.

During late June, it became increasingly evident that the Chryse (Southwest) region was too variable. It could not be certified as safe for landing.

The area in which Viking could land with 99% reliability was an ellipse 257 kilometers (160 miles) long and 97 kilometers (60 miles) wide. This required that a sizeable area be found with characteristics shown to be acceptable according to ground-based radar and to pictures whose best resolution covered a far greater area than a spacecraft 3.04 meters (10 feet) wide by 2.13 meters (7 feet) high.

After moving the orbit of Viking 1 toward the northwest and continuing imaging and ground-based radar scanning, a site was finally found at 47.5°W, 22.4°N, about 900 kilometers (560 miles) from the original site. Although it was still above average in roughness, the site was acceptable to both imaging and radar. Viking 1 landed at this site on July 20, 1976.

During the time in orbit, other observations were made. A grating spectrometer to detect water vapor was used in the same regions covered by the cameras. The ultimate objective was to study the Martian atmosphere for variations in distribution of water vapor based on terrain, season, and day-night (diurnal) cycles. The availability of water on a planet as dry as Mars is exceedingly critical from the point of view of biological activity. Thus knowing where the highest concentrations of water are was crucial to the selection of the second landing site (previously chosen on this basis in a region to the north known as Cydonia).

Observations made in July and August during the northern mid-summer on Mars correspond to the beginning of the maximum water vapor cycle in that hemisphere. Viking 1 observations showed very little water vapor in the southern hemisphere, but the amount increased across the equator toward northern latitudes. Diurnal cycles of water changing from ice to vapor was seen in some regions of the north. The vapor was believed to be close to the surface and may be morning surface fog or haze.

In addition to water vapor, temperature was also mapped during the same period by means of an infrared radiometer. The heterogeneous nature of the Martian surface makes simple modeling of the thermal structure of Mars impossible. The nature of the surface material, texture, and the presence of clouds and suspended particles all influence the temperature readings. At the Viking 1 landing site, measured temperatures to date do not get above 0°C (32°F), and they go down to about −100°C (−148°) at night. Nighttime polar temperatures are lower than anticipated and are, in fact, below the temperature needed to condense carbon dioxide at that surface pressure. This suggests that the local polar atmosphere may be enriched with non-condensible gases such as argon.

The Entry and Landing. Viking was placed in a Mars-synchronous orbit on the 19th of June, with its periapsis (low point) near the preselected landing site in Chryse. On the 30th revolution, the Lander was separated from the Orbiter by command from Earth. Three hours and 22 minutes later, it landed in its now-permanent location on Mars' surface. During this entry phase, measurements were made on the composition and structure of the upper atmosphere—above 100 kilometers (62 miles)—by means of a mass spectrometer sensitive to neutral gases with atomic mass units up to 60. The ionospheric temperature, composition, and concentration of atmospheric ions were determined by means of an instrument called a planar retarding potential analyzer. These instruments were mounted on the spacecraft aeroshell, as were pressure, temperature, and acceleration sensors, which produced data on atmospheric density, pressure, and temperature, as well as winds below 100 kilometers. The entry experiments were jettisoned with the aeroshell and functioned only during the entry phase before parachute deployment.

The retarding potential analyzer indicated that molecular oxygen is the major component of the ionosphere and carbon dioxide a minor component. The mass spectrometer indicated an upper atmospheric composition predominantly of carbon dioxide (CO_2), with traces of molecular nitrogen (N_2), argon (Ar), molecular and atomic oxygen (O_2,O), and carbon monoxide (CO). The temperature between 140 and 200 kilometers (87-125 miles) was around −53°C (−62°F). The pressure at the landing site was extrapolated to be at 7.3 millibars and the air temperature −32°C (−25°F). This pressure at the Viking 1 landing site is somewhat more than the average Martian surface pressure of 6.1 mb.

The data all reveal a lower atmosphere whose major constituent is CO_2. In addition, however, there appears to be a relatively small amount of argon, in contradiction to earlier reports obtained by the Soviet probe, Mars 6. This was a critical observation. A high argon content could have prevented an early analysis of the atmosphere by the Lander's mass spectrometer because its pump would have been harmed by more than 15% of argon, so the instrument would have had to be used to do the soil organic analysis before carrying out the atmospheric analysis. The finding of only a small amount (about 1%) of argon permitted the use of the Lander instrument at the best time.

The Lander—Surface and Atmosphere. Preliminary determinations of the Lander location have been deduced from radio tracking data from the Viking I Lander. The radio is, of course, the primary means of data transmission from Lander to Earth and from Lander to Orbiter to Earth. At the same time, the Lander and Orbiter radios could be used to make measurements from which certain physical information could be deduced, such as surface topography.

The early analysis of radio data has indicated that the Viking 1 Lander is about 3,389.5 kilometers (2,106 miles) from the center of planetary mass. It landed about 28 kilometers (17.4 miles) from its targeted landing site, well within the Lander "footprint."

Once on the surface of Mars, the Lander system was powered up and checked out. Power was obtained from batteries charged by two radioisotope thermoelectric generators (RTGs). The first instruments to function were the Lander cameras. These are facsimile cameras capable of high and low resolution imaging in stereo, color, black and white, and infrared. They build up images in a series of vertical scans.

Within seconds of landing, camera 2 began taking the first image on the Mars surface: a high resolution picture of the Lander footpad and the nearby terrain. Then it made a low resolution scan of the middle to far field including the sky. In general, Viking 1 appears to have landed on the western slope of a basin (Chryse) in gently rolling terrain strewn with rocks of various sizes. The area as seen from orbit appeared to contain scoured channels, but they are not visible from the site itself. Topographically, the area is relatively smooth with craters and ridges seen in relief. There is evidence of wind abrasion and transport as well as chemical weathering. The scene is distinctly red in color and even the sky is seen to be pink. Small sand dunes are visible in the middle ground and in the foreground where the first sample was taken.

The foreground was disturbed slightly during landing by the retrorocket fire. Although the cameras are capable of detecting motion, there is no evidence of motion in any of the pictures. There is also no evidence of large life forms or artifacts of life.

Gauges on each of Viking's three legs were used to determine the bearing strength of the surface material. The penetration of the footpads, the movement of the gauges, the crater caused by the cover of the sampling head (ejected when the arm was readied for use), and the crater caused by the sample boom latch pin when it was ejected, are all consistent with Earth materials with very low cohesion, small grain size, and densities in the range of 1.2-1.7 grams per cubic centimeter, similar to fine cave dust (loess) or talcum powder.

The modest meteorological station on board the Viking 1 Lander has provided sufficient preliminary data from its sensors to give some indication of atmospheric temperatures 1.6 meters (5.2 feet) above the surface, wind direction and velocities, and surface pressures, all on a diurnal cycle. Temperatures were seen to cycle between −86°C (−121°F) and −30°C (−22°F) on a diurnal cycle, during August. The mean surface atmospheric pressure was 7.65 mb with a diurnal variation of ±0.1 mb. The pressure is highest at night. The pressure was seen to be decreasing steadily during late summer, probably caused by the freezing out of the CO_2 from the atmosphere at the winter (south) pole. Since CO_2 is the major component of the thin Mars atmosphere, such polar deposition causes seasonal decreases in pressure: there is less material making up the atmosphere in winter than there is in summer. Winds ranged from essentially calm to about 9 meters/second (about 20 mph), varying on a very regular basis, from light easterly winds in the late afternoon with velocity decreasing to near zero by midnight.

By sampling the atmosphere directly, the Lander's mass spectrometer was capable of doing a sensitive gas analysis. A great deal of interest revolved around the question of nitrogen (N_2), which had not been detected to date, and around isotope ratios of argon, carbon, and oxygen. The first analysis indicated an atmosphere composed of about 95% carbon dioxide, 0.3-0.4% molecular oxygen, 2-3% molecular nitrogen, and 1-2% argon. Neon, krypton, and xenon were not detected, and an upper limit of 10, 20, and 50 parts per million (ppm) respectively was set on those gases. Ozone was not detectable by this instrument, and any present was filtered out in the analysis of N_2 and CO_2. It was felt that the data suggest a somewhat more massive atmosphere may have existed in the past and that there has been much less loss of gas to space than has occurred on Earth.

The Lander—Sampling the Surface. The three remaining experiments on Viking 1 required a sample of the Mars surface to perform their analyses.

On July 28, the first samples of Mars were scooped up by the long-armed soil sampler and deposited in the experiment funnels. The exact source of the samples was determined on the basis of the early pictures from Viking and was influenced by the need both to protect the sampler and to select scientifically interesting material. Samples were dug four times—one for the biology instrument, two for the GCMS (gas chromatograph mass spectrometer)—the second to guarantee a sample was taken—and one for the X-ray fluorescence spectrometer. Each experiment processed its sample according to its own needs.

The results of the inorganic (X-ray fluorescence) analysis showed that the soil is primarily iron, silicon, calcium, sulfur, and aluminum. Rare earths account for less than 3% total. The reddish color is presumed to be due to iron oxide.

After some difficulty in determining whether or not the GCMS had acquired a sample, a pyrolysis analysis was run, primarily to search for organic molecules in the soil sample. The first sample to be volatilized (pyrolyzed) gave no indication of organics, and an upper limit on any single organic molecule was put at 1 ppm. While such an observation did not preclude the possibility of living organisms in the soil, it did suggest the absence of a flourishing indigenous life. The pyrolysis done at 500°C (932°F), indicated the presence of appreciable amounts of bound water, most of which was stable at 200°C (392°F). This water of hydration creates an operational problem for the instrument, so that the second sample was pyrolyzed first at 350°C (662°F), to attempt to drive off most of the water and increase sensitivity to organics. In this mode, there were still no organics detected.

The biology instrument had also received a sample and was incubating it in each of the three experiments planned. Results have been obtained in all three.

In the LR (labeled release) experiment, a soil sample was moistened with water containing labeled (radioactive carbon-14) nutrients. The use of this nutrient by any microorganisms would be perceived by a build up of ^{14}C in the enclosed atmosphere. A considerable amount of $^{14}CO_2$ was produced after injection of the ^{14}C-labeled nutrient. This $^{14}CO_2$ production leveled off within the first few days. A second nutrient injection produced a smaller burst of $^{14}CO_2$ and then gradually the $^{14}CO_2$ from the head space in the chamber was reabsorbed. The level of radioactive carbon dioxide then began after a couple of days to very slowly creep upward until the experiment was terminated and the control experiment begun. The sudden burst of $^{14}CO_2$ in a nominal Earth soil would have been indicative of an extremely active life form. Under Martian conditions, it also suggests the presence of highly reactive oxidizing agents in the soil. In the control experiment (in which the soil was first heated to 160°C [320°F] for 3 hours) the sudden release of $^{14}CO_2$ was not observed, suggesting that the active run was biological in nature or that the chemical reactions were unstable at high temperatures.

The GEx (gas exchange) experiment tests for the presence of the products of metabolic activity. It was run in the "humid" mode first, in which water and nutrient was added to the chamber but not to the soil. The use of a gas chromatographic column permits the monitoring of a variety of gases in the chamber as a function of time. The analysis showed a rapid release of oxygen from the soil under these conditions. The O_2 released was some fifteen times that which could be accounted for from known sources. Carbon dioxide was also rapidly released. The nutrient level was then raised to wet the soil. No additional oxygen was released, and CO_2 gradually decreased. It was suggested that the Martian soil in this location is highly oxidized and under the influence of ultraviolet radiation may contain substantial amounts of peroxides or super-oxides. If true, this could explain the sudden releases of O_2 and CO_2 seen in the experiments.

The PR (pyrolytic release) experiment looks for evidence of the use of carbon dioxide or carbon monoxide to build organic compounds, similar to the way plants on Earth build organic compounds in photosynthesis. The experiment was first run in the light (a xenon lamp in the chamber) with the ultraviolet filtered out to prevent fixation of carbon-14 by any non-biological processes; other samples were run in the dark. Soil was incubated for five days. At the end of that time, the test cell was warmed to 120°C (248°F) to facilitate removal of unreacted $^{14}CO_2$ and ^{14}CO. The soil was then pyrolyzed at 650°C (1200°F). The volatilized molecules were swept into an organic vapor trap which collects the organic material and passes the unused radioactive gases into a carbon-14 detector. The organic vapor trap was then heated to 650°C, a temperature which combusts any ^{14}C organic material to $^{14}CO_2$, which was then passed into the same carbon-14 detector. The experiment on Mars has shown the presence of organic synthesis, again suggestive of biological activity, but because of the chemical activity of the soil, ambiguities exist which can be removed only by continued experiments on Earth and Mars.

In the normal course of events, a control experiment is run for LR and PR. GEx is a long-term experiment in which fresh gas and nutrient is added to the chamber and the exchange of gases monitored. This monitoring process can be quite diagnostic and interpreted as biological or non-biological in nature, given enough time and data. The LR and PR controls are simply reruns of the original experiment using heat-sterilized soil. Such controls have now been run and both are negative—a result which would, under terrestrial conditions, be suggestive of biology. However, the apparent highly oxidizing nature of the Martian soil requires that a great deal of ground-based testing be done so that all possible purely chemical explanations can be ruled out. Such work is currently underway.

Viking 2 landed at approximately 48°N by 225°W. on Mars, about 4,000 miles from Viking 1. The spacecraft is functioning well, and pictures show the site to be quite flat and rocky without the sand dunes seen in the first landing site. In general, the experiments at the Viking 2 site have produced essentially the same results as at Viking 1. Although the terrain is slightly different, the physical and chemical nature of the soil are very similar to the earlier analyses at the #1 site. Samples taken from underneath rocks in the #2 site, where they presumably have been protected for long periods of time from ultraviolet radiation, show essentially the same inorganic composition, more bound water, the same absence of organic matter, and less O_2 and more CO_2 evolution in the biology instrument.

One important difference between Viking 1 and 2 is the fact that the seismometer on Viking 2 is functioning; it is not on Viking 1. By conjunction in mid-November, no seismic events ("Marsquakes") had been detected, suggesting at least no great amount of tectonic activity on Mars.

These investigations will continue into 1977 and perhaps into 1978 depending on the nature of the data being returned and on the general "health" of the spacecraft and its experiments.

We are learning a great deal about the nature and history of another planet in our solar system—data which can be compared to similar observations of our own planet and which will ultimately allow us to understand better the evolutionary processes affecting our own planet.

The question of life on Mars remains, so far, unresolved, but hopefully further experiments, both on Earth and on Mars, will unravel the source of the chemical reactions evident in the biology instruments of both Landers.

Viking is clearly a milestone in the arena of human endeavor, one which may eventually be seen as the beginning of man's understanding of his place in the universe. ■

A clear day on Mars, as photographed by Viking 2. The large central rock is about 2 feet long.

The Significance of ASTP
(cont.)

explore the universe which is essential to the progress of our planet. But even without such important steps toward the future, Apollo-Soyuz was a venture that confirmed that space is an area suited to international brotherhood and separated from the political strife we often see here on Earth.

It was a mission, flawlessly executed, that gave us good reason for mutual trust and confidence. From the onset the Soviet Academy of Sciences provided our national space agency with complete and detailed technical information, answered our questions on its role in the project and on the Soviet support facilities. NASA technicians and astronauts were made welcome at Star Village, the Cosmonaut training base, and spent many hours of training using Soviet equipment. NASA personnel visited the Baikonur launch complex and viewed the Soyuz spacecraft being readied for flight. NASA, in turn, gave the Soviet space scientists information necessary for their participation and afforded their cosmonauts and technicians training here, just as our personnel were trained in the Soviet Union.

Manned spaceflight is both very challenging and very rewarding. Defining and managing the cooperation required for such a project as ASTP was itself a challenge. But in all regards it was a challenge successfully met with tangible and notable achievements.

Some of the best technical minds of both countries were applied to the new joint docking system, which replaced the equipment used previously in the two spacecraft.

Language training and careful attention to detail assured the safety of the crews and the success of the mission.

Among the mission achievements, the 9-day Apollo flight provided new data on the low-energy X-ray background in the sky. The background had been detected by earlier sounding rocket studies but little else was known until the ASTP findings.

Observations were made of the Earth—its topography, processes and dynamics—with particular attention to natural resources, water drainage, and earthquake potential. The cosmonauts and astronauts experimented with mixtures of living cells—biological research that would aid future manned spacecraft missions and their functions. They also conducted medical studies of weightlessness and the body's reaction to infection.

The Oklahomski of Tom Stafford and the Russian-flavored English of Aleksey Leonov were samples of the symphony of language that will fill space in the future. Orbiting Earth, space travelers of many nationalities will be talking to us from the Space Shuttle and perhaps from future Soviet spacecraft as well. Beyond this, when the people of our planet begin colonizing space, international cooperation will be a vital element in populating our solar system.

The ASTP mission demonstrated that different cultures and different political and economic systems work together to make ancient dreams reality. It showed that we can share both the knowledge and the cost of placing mankind permanently in space.

Those brief days in July of 1975 provide a base on which we may build mutual trust and confidence for the future. The scientific fruits of the mission were valuable but in the long run our experience of cooperation may prove the principal gain.

Anthropologist Margaret Mead has given this evaluation of our time: "We are at a point in history where a proper attention to space, and especially to near space . . . may be absolutely crucial in bringing the world together." I can say it no better. ■

American Serves as International Aerospace Education President

Dr. Wayne R. Matson, Executive Director of the American Society for Aerospace Education, was elected to the presidency of the International Aerospace Education Committee of the Federation Aeronautique Internationale at its 1976 meeting in Paris, France. Dr. Matson is the first American in the 71-year history of the organization to be elected president of the International Education Committee. FAI is the organization of national aero clubs which controls aviation and space competition, as well as helps promote aeronautics worldwide.

The International Committee, which is composed of the educational representatives of the member nations of the FAI, meets annually to discuss aviation and space education programs and progress. Dr. Matson has served as the U.S. Delegate for the past three years. As President, he presides over the annual meting in Paris and presents the international report on aerospace education to the General Conference of the FAI.

Dr. Matson was formerly a full-time NASA spacemobile lecturer and part time while earning his doctorate at Oklahoma State University. His recent work in aerospace education includes the creation of the National Council for Aerospace Education, the Directory and the Journal of Aerospace Education, and the American Society for Aerospace Education, as well as development of the International Civil Aviation Organization's aviation education program materials. For these accomplishments he has been awarded both the National Aeronautics Association's Frank G. Brewer Trophy and the FAI Nile Gold Medal, the nation's and the world's highest awards in aerospace education. ■

Career Guidance Filmstrip To Be Released

A 15-minute, color/sound filmstrip about aerospace careers, entitled "Take the High Road," has been produced by the American personnel and Guidance Association with the assistance of NASA's Educational Programs Division. It is scheduled for release February 1, 1977. The guidance counselor may borrow a copy for preview from the NASA Center which serves his state.

Recent NASA Films

Landsat, a Satellite for All Seasons, is a series of six films illustrating the use of the earth resources technology satellite in solving environmental problems. Each 14½-minute, color film comes with a Film Lesson Guide recommending classroom activities.

Remote Possibilities. HQ 280. Shows Landsat in "the big picture from outer space." The concept of remote sensing is explained.

The Wet Look. HQ 271. Explores how Landsat's remote sensing capabilities can help resolve water resource problems.

Pollution Solution. HQ 276. A look at environmental quality problems, such as strip mining, airborne pollution, and the movement of industrial waste, and how they can be helped by Landsat.

The Fractured Look. HQ 277. Examines ways to look for minerals and to monitor geological hazards.

Growing Concerns. HQ 278. Introduces Landsat as a partial solution to the world's need to monitor agricultural resources.

Land for People, Land for Bears. HQ 279. Illustrates Landsat supplying data for land-use planning and wildlife habitat mapping.

In addition, the following NASA films have been released:

Universe. HQ 220—color—28 min. Through unusual animation techniques, explores almost inconceivable extremes of size and time from galaxies to subatomic particles, from cosmic events to those that endure for only a billionth of a second.

Mercury/Exploration of a Planet. HQ 282—color—28 min. The flight of Mariner 10 to Venus and Mercury, moderated by Dr. Bruce Murray, Director of the Jet Propulsion Lab; includes an animated sequence on the origin of the solar system.

Three films were developed for showing developing nations, via the ATS-6 satellite, the potential of space-borne systems in helping them solve problems:

Survival. HQ 274—17½ min. Shows the use of space-age tools in predicting and coping with natural disasters such as earthquakes, tornadoes, fires, floods.

If One Today/Two Tomorrow. HQ 273—28 min. Review of the development of the use of mass communications technologies in education; they took us decades to acquire but are available to other nations right now.

Images of Life. HQ 272—28 min. Landsat's remote sensing technology and the ways it can be used to improve living conditions.

NASA films may be borrowed for group showings from the NASA center serving your area (see page 8), except for the states below:

National Audiovisual Center (GSA)
Washington, D.C. 20409
Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont

Where to Write for Services

NASA publications should be ordered from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Publication lists, film lists, and information about other services are available from the Educational Office at the NASA center serving your state. See the list below.

NASA Ames Research Center
Moffett Field, California 94035
Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming

NASA George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812
Alabama, Arkansas, Iowa, Louisiana, Mississippi, Missouri, Tennessee

NASA Goddard Space Flight Center
Greenbelt, Maryland 20771
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

NASA John F. Kennedy Space Center
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21000 Brookpark Road, Cleveland, Ohio 44135
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The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through December 31, 1976.

NASA REPORT TO EDUCATORS is published four times per year for the community of educators, especially at the elementary and secondary school levels. Contributions and recommendations are solicited from readers, and should be addressed to the Educational Programs Division, Office of Public Affairs, Code FE, National Aeronautics and Space Administration, Washington, D.C. 20546. Photocopying for school use is approved.

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