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'Leadership and America's Future in Space'

Ride report proposes strategy of evolution, natural progression

A strategy of evolution and natural progression would allow the United States to regain and retain leadership in space science, exploration and enterprise, according to a long-awaited report prepared by Dr. Sally K. Ride.

But that strategy is only one the U.S. space program should consider as it defines its course into the next century, Ride wrote in "Leadership and America's Future in Space," presented this month to NASA Administrator Dr. James C. Fletcher.

"The strategy emphasizes evolving our capabilities in low-Earth orbit, and using those capabilities to study our own world and explore others," the report states. "With these capabilities, we would position ourselves to lead in characterizing and understanding planet Earth; we would also position ourselves to continue leading the way in human exploration."

Report excerpts on Pages 4 and 5

"There is no doubt that exploring, prospecting, and settling Mars should be the ultimate objectives of human exploration," the report concludes. "But America should not rush head-long toward Mars; we should adopt a strategy to continue an orderly expansion outward from Earth."

The 63-page illustrated report is the culmination of a year-long study by Ride and a task group of 70 other contributors. The astronaut, who will leave NASA on Sept. 26 for a fellowship at Stanford University, was detailed from JSC to Headquarters in August 1986 as Special Assistant to the Administrator for Strategic Planning.

"You have well and truly discharged the difficult task I asked you to undertake," Fletcher said in a letter to Ride. "You have opened a bright window on the issues of leadership in space and the means to reach —and sustain—that position."

JSC Director Dr. Aaron Cohen said the report was an important step in reasserting the nation's prowess in space exploration.

"The Ride report underscores the fact that we cannot take American leadership in space for granted," he said. "We are just beginning to emerge from a very difficult period for the space program. A key to that emergence is to understand what we can realistically do in space. We must then go do it, balancing boldness and wisdom as we go."

JSC employees listed as significant contributors to the report were John Aaron, Kenneth Atkins, Michael Duke, Kyle Fairchild, Steve Hawley, Wendell Mendell, John Muratore and Barney Roberts.

In the report, Ride asserts that the U.S. civilian space program is at a crossroads, aspiring toward the visions of the National Commission on Space but faced with the realities set forth by the Rogers Commission. Instead of arguing about whether to adopt a visionary goal or concentrate on Space Shuttle and Space Station operations, she suggests, the space program needs to develop both a long-range direction and the fundamental capabilities that would enable it to move in that direction.

Shuttle-C definition proposal request out

NASA has issued a request for proposals inviting industry to compete for two-phase systems definition study contracts for Shuttle-C, a Shuttle-derived heavy-lift launch vehicle.

Shuttle-C will use the propulsion elements of the current Space Shuttle with the orbiter being replaced by an STS cargo element. With a minimum lift capability of 100,000 pounds to low-Earth orbit, the vehicle would provide additional payload capability to the Shuttle fleet, maximizing effective use of the National Space Transportation System, other existing systems and available test and launch facilities. The most immediate value of the Shuttle-C would be for Space Station assembly and logistics. It also would be available for future science missions, especially to the outer planets.

Proposals for the system definition studies are due at Marshall Space Flight Center on Sept. 21. Based on the proposals received, NASA expects to select two or more contractors to perform the systems studies, with fixed-price contracts expected to be awarded in November.

Funds available for Phase I of this two-phase effort are approximately $3 million. Proposals also will include a priced option for Phase II which, if implemented, is estimated at approximately $13 million total. Phase II will depend on availability of funding and national policy decisions on heavy-lift launch vehicle development.

A major purpose of the study is to determine whether the vehicle would be cost effective in assembling and operating the Space Station.

Marshall Space Flight Center will have management responsibility for the Shuttle-C study effort.

Work begins on Grumman facility at Ellington Field

The Grumman Corp. began demolishing buildings at Ellington Field on Aug. 25 to make room for a planned $50-million complex to house the company's Houston Operations.

The ultimate size and scope of the complex will hinge on Space Station Phase C/D contracts to be awarded in November.

Grumman has signed a 40-year lease with the City of Houston for a 66-acre tract at Ellington, with options for an additional 79 acres and an extension of the lease until the year 2067.

As now planned, the Grumman complex could include a 130,000-square-foot office building, a 120,000-square-foot simulation and robotics laboratory and a 250,000-square-foot assembly and test building.

THAT'S MY DADDY—Lindsey Michelle Hieb gets a close-up view of an astronaut—her father, Mission Specialist Rick Hieb—as he suits up for a training exercise. Lindsey Michelle and her mother, Jeannie, got their chance to see dad at work during a recent visit to the Weightless Environment Training Facility.

Voyagers *mark decade of exploration*

With one of its two spacecraft enroute to distant Neptune and the other exploring the outer Solar System, the *Voyager* mission celebrated its 10th anniversary of launch Aug. 20.

Voyagers 1 and *2* have logged a total of 7.6 billion miles over the past decade, executing flybys of the giant planets Jupiter, Saturn and Uranus. The two unmanned craft have relayed a staggering amount of data on each of the planetary systems, in the process discovering such phenomena as new moons, rings and the first active volcano in space.

After *Voyager 2*'s encounter with Neptune in August 1989, the two spacecraft will continue out of the solar system in search of the heliopause, the outer boundary of the Sun's energy influence.

The mission was originally conceived because of a rare alignment of the planets that occurs only every 170 years. The alignment allowed a single spacecraft to visit each of the four giant gaseous planets, using the gravity of each planet in a slingshot-like effect.

Voyager 2 was launched Aug. 20, 1977, followed by *Voyager 1* on Sept. 5 of that year. Because of its trajectory, *Voyager 1* overtook its twin and arrived first at Jupiter on March 5, 1979. *Voyager 1* flew by Saturn on Nov. 12, 1980. Its flight path at that planet then took *Voyager 1* up and away from the ecliptic, the plane in which most of the planets orbit the Sun.

The 1987 astronaut candidates are: (front row, from left) James S. Voss, Jan D. Davis, Gregory J. Harbaugh, Andrew M. Allen and Kevin P. Chilton; (second row, from left) Mae C. Jemison, C. Michael Foale, William F. Readdy, Thomas D. Akers, Kenneth D. Bowersox and Bruce E. Melnick; and (back row, from left) Mario Runco, Jr., Donald R. McMonagle, Curtis L. Brown and Kenneth S. Reightler, Jr.

Rigorous training ahead

Astronaut candidates are here

By Steve Nesbitt

Displaying eagerness and interest, the 15 members of NASA's newest class of astronaut candidates were officially welcomed to JSC on Aug. 24, beginning a year-long training and evaluation period.

JSC Director Dr. Aaron Cohen told the candidates that despite what they may hear elsewhere, NASA is alive and well and making progress toward next June's scheduled launch of *Discovery* and the crew of STS-26.

Throughout the day Monday and much of Tuesday, the candidates heard from JSC officials on everything from the organization of the astronaut office to the status of the Space Shuttle program.

Dan Brandenstein, chief of the astronaut office, gave an overview of the organization and objectives of the office and put to rest some of the myths surrounding the job of astronaut. Contrary to popular belief, Brandenstein told the group, the job of an astronaut is not all flying, playing golf and going to the beach. While it can be fun, he said, the job requires hard work and dedication.

The candidates met with local reporters Monday afternoon, getting their first exposure to the media attention that likely will follow most of them throughout their careers as astronauts.

The new group will be busy during most of September learning T-38 egress and survival skills in the event of an aircraft bailout. A week of wilderness survival training in Washington state early in the month will be followed by parachute/parasail training at Vance Air Force Base in Oklahoma and water survival training at Homestead Air Force Base, Florida, late in September.

Workbook study, self-paced computer training and briefings, as well as T-38 flying will dominate the remainder of 1987 as the candidates tackle the difficult task of learning Space Shuttle systems and mission operations.

Bulletin Board

SARSAT van to visit Sept. 23 and 24

SARSAT van, a traveling exhibit that details the satellite-aided search and rescue project (COSPAS/SARSAT), will be on display at JSC's Rocket Park on September 23 and 24. COSPAS/SARSAT is an international cooperative program between the United States, Canada, France and the Soviet Union. The U.S. program includes NASA, the National Oceanic and Atmospheric Administration (NOAA), the Coast Guard and the Air Force. The large walk-through trailer features six exhibits. Bob Buckley will be available to answer questions.

Houston Gulf Flight Festival nears

Preparations are under way for Houston Gulf Flight Festival '87. The festival will run from 10 a.m. to 4 p.m. Sept. 19 and 20 at Houston Gulf Airport, 2750 FM 1266, League City. There will be airplanes to explore, fly-bys by the National Guard, a mock recovery by the Coast Guard, parachuting events and other activities. Local businesses will provide displays, and refreshments will be available. For more information, contact Susan Spencer, Clear Lake Area Chamber of Commerce, 488-7676.

Planning starts for NACA Reunion IV

Preliminary announcements are in the mail for NACA Reunion IV, Sept. 30 through Oct. 2, 1988, in San Jose, Calif. All former NACA employees, their spouses and military personnel who were detailed to NACA are urged to attend. Any eligible person who hasn't received the preliminary announcement is urged to contact Harvey Hartman in the Personnel Office, x35266, or write the organizing committee at Box 6-1988, Mountain View, Calif., 94042.

Children's Theater presents Mymba Baboons

The JSC-EAA Children's Theater will present The Mymba Baboons circus act at 10 a.m. Sept. 19 at the Gilruth Recreation Center. Refreshments will be served at 10 a.m., followed by Clown Capers at 10:15 and The Mymba Baboons at 10:45. Tickets are $2, and may be purchased at the Bldg. 11 Exchange Store (x35350) through Sept. 16. For more information, call Susan Starkweather, x36608.

Health Related Fitness refresher offered

The JSC Health Related Fitness Program has designed a 10-week reinforcement course (HRFP II) to revitalize program graduates whose activity levels have fallen after graduation and to refresh those who have remained active. The new course will begin Sept. 29. The exercise prescription will encourage a gradual progression in aerobic training from 30 minutes four days a week to 45 minutes five or six days a week. For more information, contact Larry Wier, x30301.

Next BAPCO meeting is Sept. 15

The next meeting of the Bay Area PC Organization (BAPCO), the local IBM PC user's group, will be at 7:30 p.m. Sept. 15 at the Holiday Inn on NASA Road 1. The group is open to anyone interested in microcomputers. BAPCO meets regularly on the third Tuesday of each month. For more information call Earl Rubenstein, x33124, or Jack Calvin, 326-2983.

Commodore computer users to meet

NASACOMM, a Commodore user's group, holds meetings on the first and third Wednesdays of each month at 7:30 p.m. in Rm. 204 of the Gilruth Recreation Center. Anyone interested in Commodore computers is invited to attend. For more information, call Bill Moore at 335-6251 or 485-3462.

Gilruth Center News

Call x30304 for more information

Fall Classic softball tournament—Men's Open C softball on Sept. 19 and 20. Entry deadline is Sept. 16; entry fee is $95.

Weight safety—Class is required for anyone wishing to use the Weight Room. Dates are Sept. 3 and 17. Cost is $4.

Karate—Karate lessons start Nov.2, meeting every Monday and Thursday from 7 to 8 p.m. for four weeks. Cost is $25.

Aerobics & exercise—Both classes are on-going. Come by the Gilruth Center to sign up.

Country and western dance—Dance class starts Sept. 14 and continues every Monday night from 7 to 8:30 for six weeks. Cost is $20 per couple.

Tennis lessons—Lessons start Sept. 14 and meet every Monday for eight weeks from 5:15 to 6:45 p.m. Cost is $32.

Guitar, banjo and drum lessons—Classes start Sept. 14, meeting every Wednesday for six weeks from 6 to 7 p.m. Cost is $25.

Defensive driving—Course is offered Sept. 19 from 8 a.m. to 5 p.m. and costs $20.

Cookin' in the Cafeteria

Week of August 31 — September 4, 1987

Monday — Chicken & Rice Soup; Wieners & Sauerkraut, BBQ Ham Steak, Steak Parmesan, Beef & Macaroni (Special); Green Beans, Carrots, Au Gratin Potatoes. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin. Selection of Salads, Sandwiches and Pies.

Tuesday — Tomato Soup; Potato Baked Chicken, BBQ Spare Ribs, Mexican Dinner (Special); Squash, Broccoli, Ranch Beans, Spanish Rice.

Wednesday — Seafood Gumbo; Liver & Onions, Baked Turbot, BBQ Ham Steak, Baked Meatloaf w/Creole Sauce (Special); Beets, Brussels Sprouts, Green Beans, Whipped Potatoes.

Thursday — Beef & Barley Soup; Chicken & Dumplings, Corned Beef w/Cabbage, Smothered Steak w/Cornbread Dressing (Special); Spinach, Cabbage, Cauliflower au Gratin, Parsley Potatoes.

Friday — Seafood Gumbo; Pork Chop w/Yam Rosette, Creole Baked Cod, Tuna & Salmon Croquette (Special); Brussels Sprouts, Green Beans, Buttered Corn, Whipped Potatoes.

Week of September 7 — 11, 1987

Monday — Labor Day Holiday.

Tuesday — Beef & Barley Soup; Turkey & Dressing, Country Style Steak, Stuffed Cabbage (Special); Corn Cobbette, Okra & Tomatoes, French Beans.

Wednesday — Seafood Gumbo; Catfish w/Hush Puppies, Roast Pork w/Dressing, Pepper Steak (Special); Broccoli, Macaroni & Cheese, Stewed Tomatoes.

Thursday — Cream of Tomato Soup; Beef Tacos, BBQ Ham Slice, Hungarian Goulash, Chicken Fried Steak (Special); Spinach, Pinto Beans, Beets.

Friday — Seafood Gumbo; Liver & Onions, Deviled Crabs, Roast Beef w/Dressing, Tuna & Noodle Casserole (Special); Whipped Potatoes, Peas, Cauliflower.

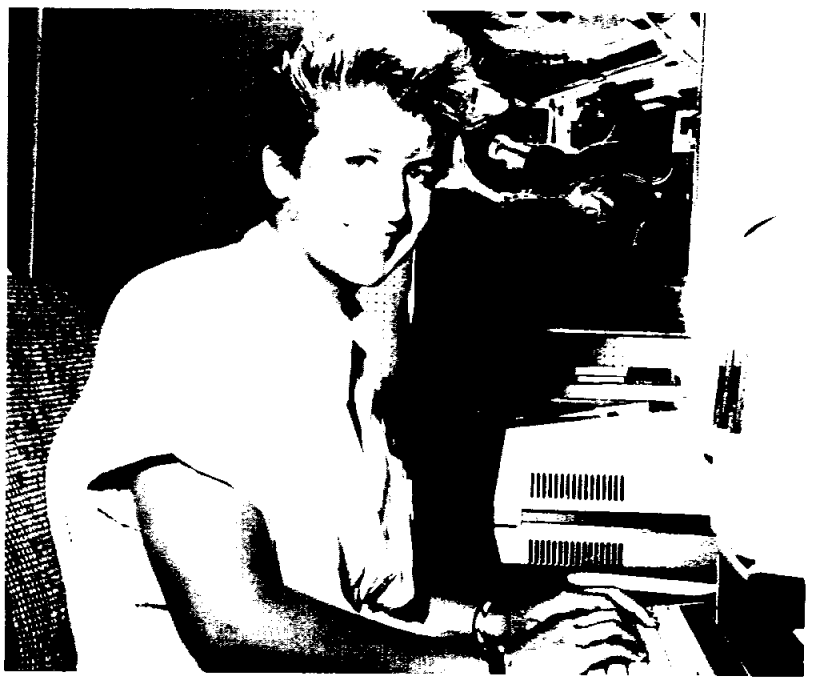
Hinners takes on Chief Scientist duties

Dr. Noel Hinners has added the duties of NASA Chief Scientist to his responsibilities as Associate Deputy Administrator/Institutions.

Dr. Frank McDonald, who has been chief scientist since September 1982, has returned to the Goddard Space Flight Center as Associate Director/Chief Scientist.

Hinners becomes the principal adviser to the Administrator and senior management on agency-wide aspects of NASA's scientific activities. Prior to joining NASA in 1972 as director of lunar programs, Office of Space Science, Hinners was chief of the lunar exploration department, Bellcom, Inc. From 1974 to 1979, he was Associate Administrator for Space Science. In April 1979, Hinners was director of the Smithsonian Institution's National Air & Space Museum, prior to being appointed director of Goddard in 1982.

McDonald began his NASA career in 1959 as head of the Energetic Particles Branch in the Space Science Division at Goddard. In 1970, he became chief of the Laboratory for Energy Astrophysics at Goddard. He was detailed to the White House Office of Science and Technology Policy as a senior policy analyst in 1982.



Julie Kramer says one of the things she will remember most about her job at JSC is the long hours spent in front of computer terminals.

Purdue gives JSC co-op first memorial award

A JSC co-op who just finished an 11-week assignment in the Crew Interface Analysis Section is returning to Purdue University this fall with the help of a special scholarship.

Julie Kramer is the first recipient of the $1,000 Space Shuttle Memorial Scholarship from Purdue, which created the award after the *Challenger* accident to help students involved in the space program.

"Purdue has produced so many astronauts and engineers that to them (the accident) was especially felt," she said.

Kramer is a sophomore aerospace engineering student. Her most recent tour in the Crew Station Branch involved viewing and volumetric analysis of the Space Station cupola work area design. During her first co-op tour in the fall of 1986, she worked on thermal analysis. She also works on Get-Away Special (GAS) payloads while at school.

She said she expects to return to JSC in January 1988 for a six-month tour of duty in structures, and hopes to work here full-time after she has completed her education.

"I pretty much can't get away from NASA," she said.

Kramer said that while it will help her make ends meet, the scholarship money is not the most important thing to her.

"To me, it was more the prestige of being able to say I had gotten the Space Shuttle Memorial Scholarship," she explained.

Gillam retires as Commercial Programs head

Isaac T. Gillam IV, NASA Assistant Administrator for Commercial Programs, will retire September 1 after a 34-year career in the federal service.

Gillam was named to head NASA's newly created Office of Commercial Programs in September 1984 and has led the agency's efforts to expand U.S. private sector investment and involvement in civil space-related activities.

Lawrence Herbolsheimer, Deputy Assistant Administrator in the Office of Commercial Programs, will serve as Acting Assistant Administrator until a permanent replacement is selected.

Herbolsheimer joined NASA in June 1986. He previously served in various senior management positions in the public and private sectors.

Prior to heading the Office of Commercial Programs, Gillam served as assistant associate administrator in the Office of Space Flight, responsible for customer relations and policy.

He also served at NASA Headquarters as special assistant to the NASA administrator and participated in the establishment of national space policy under assignment to the White House Office of Science and Technology Policy.

From June 1978 to October 1981, Gillam was director of the Dryden Flight Research Facility after serving as the center's deputy director and director of Shuttle operations.

Gillam, an Arkansas native and a veteran of 10 years service in the U.S. Air Force, has received NASA's highest award, the Distinguished Service Medal.

He has accepted a position to work for OAO, Greenbelt, Md., an aerospace firm, following his retirement from federal service.

Jeana Yeager and Dick Rutan, the two pilots who flew the *Voyager* airplane non-stop around the world, experience the relative spaciousness of the Space Shuttle cockpit with Astronaut James C. Adamson. The *Voyager* pilots visited JSC on Aug. 10 and toured the Mission Control Center, Space Station Mockup, Weightless Environment Training Facility and Space Shuttle Full-Fuselage Trainer.

SMARTS team members use the Rotational Hand Controller and Translational Hand Controller to simulate a rendezvous. From back to front are Palmer Chiu, Eric Mitchell, John Whynott and Steve Staas.

WE HAVE

Spacecraft Mission Analysis Real-Time Simulator

By Kelly Humphries

The creators of a new minicomputer program being developed by the Mission Planning and Analysis Division expect the software to revolutionize proximity operations and rendezvous planning.

SMARTS—short for Spacecraft Mission Analysis Real-Time Simulator—is an advanced orbital operations program that simulates the manual phases of on-orbit rendezvous and proximity operations, said Eric Von Mitchell, the JSC employee coordinating its development.

Simulating such activities is an important part of designing the best flight trajectory for the Shuttle to rendezvous with an orbiting payload, determining how much the Orbiter's Reaction Control System (RCS) jets will contaminate any sensitive surfaces on the payload, and budgeting the Orbiter's limited propellants, Mitchell said.

It's true that computer programs had been previously developed for those purposes, Mitchell said, but none would provide all of that information in one pass, none would operate on a minicomputer, and none would perform the tasks as quickly and easily.

Multipurpose tool

"We wanted a tool that would give us all of our answers when we used it one time," explained Allan DuPont, head of MPAD's Orbital Operations Section.

"In the past, we had a tool that was very high fidelity but was very complicated to use," he said. "The Space Vehicle Dynamic Simulator (SVDS) gave us good results but you had to spend hours and hours setting it up and submitting the run—which might take a day to come back—only to find out you'd made an input error."

With SMARTS, Mitchell said, not only is the run easier to set up, but it produces all the information needed to evaluate a proximity operations scenario—trajectory, propellant consumption and plume effects—in both numbers and pictures.

Results in a day

"We're talking about *at least* a tenfold savings of time," DuPont said. "Something that may have taken a week to get done, if not two weeks, we can pretty much assure ourselves we can do in one or two days. Once we get SMARTS set up to where we can run it in a 'batch' mode, where you just let it run on its own, we can get several of these runs in one day."

Timeliness was also a factor in the creation of SMARTS because of increasing demands for plume effects data and the section's impending loss of user support for SVDS, DuPont said. The project was completed in only a year and a half.

"Eric has done a great job. We're talking about a very short time frame of getting this whole thing done. He has been instrumental in keeping everyone on schedule, thinking of ways to keep getting innovation, and creating the kind of graphic displays we wanted," DuPont said.

Mitchell, a NASA employee for seven years, is quick to share the credit with John Whynott, Steven Staas, Scott Hames and Palmer Chiu, the McDonnell Douglas Astronautics Co. contract employees with whom he worked. Chiu is now a NASA employee.

"I've had some really great guys working with me," Mitchell said. "McDonnell Douglas essentially laid the foundation for what we have now. They took the initiative to rewrite the code written by Sam Wilson of TRW and put it on the Hewlett-Packard 9000. A lot of hard and good work has gone into this."

The SMARTS mathematical models are the results of a project that began in 1977 with the original McDonnell Douglas proximity operations group, Staas said. Two separate models—one for the different regions of the plume dynamic pressure flowfield generated by each of the Shuttle's RCS jets, and one for the simple geometric shapes such as spheres, boxes, plates and cones that make up complicated payload geometries—are combined to simulate the pressures exerted on each part of the target payload, Staas said.

This "patched source flowfield model" then interacts with the payload model to simulate the plume effects on the target payload's location and attitude, Staas said. The model originated from a more complicated model that is considered to be the most accurate, Whynott explained. But that model takes too much computer time to run.

Goal is productivity

"That's one of the things we have to worry about in real-time, man-in-the-loop simulations," Staas said. "Sometimes, you have to trade ultimate accuracy of the models for something that can run in a real-time simulation on the hardware you have to work with."

DuPont said improving the productivity of his staff was the most important goal of the SMARTS project.

"We could be talking about hundreds of thousands of dollars in savings over the next several years," he said. "Of course, in doing all of that we've also created a tool that is going to be useful for training purposes."

SMARTS is expected to be useful in training because it runs on a relatively compact computer, utilizes Rotation and Translation Hand Controllers (RHC and THC) and shows real-time visual effects that include all views available to an astronaut guiding the Shuttle from the aft flight deck. Its ease of use could allow pilot trainees to learn basic orbital flight techniques quickly and easily, or experienced pilots to enhance their skills, at a lower cost than a full-scale simulator, Mitchell said.

The Mission Operations Directorate requested an early copy of the program for evaluation, DuPont said, and final delivery to MOD is scheduled for the end of September.

Training potential

"This is the first time I've seen this implemented on a small minicomputer with a man in the loop," said Don Pearson of the MOD Orbit Dynamic Section. "We expect to use this processor to get us in the ballpark as preparation for SES (Shuttle Engineering Simulator) runs."

With expected enhancements, SMARTS has the potential to become a total system for rendezvous and proximity operations for both on-board vehicle flying and ground planning with an emphasis on automated operations, DuPont said.

"Plume impingement is proving to be the most important aspect of proximity operations other than collision avoidance," DuPont explained. "When we first started analysis in Apollo days we didn't talk about proximity operations. We had two vehicles, usually they were nearly the same size, and the plumes—as far as forces and moments go—didn't affect each other appreciably. The jets were small 100-pound thrusters. We didn't worry much about contamination.

Plumes contaminate

"The first time we began to see plume effects was during Skylab. They had erected the little shield above the crew compartment to block off the Sun's heat. As the command module would approach, jet firings would cause the shield to flap violently to the point where we were worried about it tearing off."

"Then we got to the Shuttle era where you have a large vehicle, 900-pound thrusters blowing on small payloads like Shuttle Pallet Satellite (SPAS) with big panels, and the effects began to be tremendous. As we get to the Station, we're finding that the Station is so large the forces and moments are not that big a factor. But, because we're talking about something that has to be there long-term—it has windows, it has experiments and we're going to be going to it time after time—layering with contaminants becomes a very important issue."

In addition to SMARTS' man-in-the-loop simulations, SMARTS' future applications and capabilities may include totally automated proximity operations and automated rendezvous planning, Mitchell said, specifically orbital traffic control, tethered satellite systems operations, an active control system on the Space Station for orbit maintenance and control of automated orbital maneuvering vehicles (OMVs).

"We're talking about *at least* a tenfold savings of time. Something that may have taken a week to get done, if not two weeks, we can pretty much assure ourselves we can do in one or two days."

—Allan DuPont

THE RIDE REPORT: 'Leadership and uses all in strategy

[Editor's note: The following two pages contain excerpts from "Leadership and America's Future in Space: A Report to the Administrator," prepared by Dr. Sally K. Ride.]

Leadership in Space

For two decades, the United States was the undisputed leader in nearly all civilian space endeavors. However, over the last decade the United States has relinquished, or is relinquishing, its leadership in certain areas; one such area is the exploration of Mars. With the *Mariner* and *Viking* missions in the 1960s and 1970s, this country pioneered exploration of Mars—but no American spacecraft has visited that planet since 1976. Our current plans for future exploration of Mars include only the *Mars Observer* mission, to be launched in 1992. In contrast, the Soviets have announced a program of extensive robotic exploration of the Martian surface, beginning in 1988 and extending through the 1990s.

The Soviets are now the sole long-term inhabitants of low-Earth orbit. The first, and only, U.S. space station, *Skylab*, was visited by three crews of astronauts before it was vacated in 1974; the U.S. has had no space station since. The Soviets have had eight space stations in orbit since the mid-1970s. The latest, *Mir*, was launched in 1986 and could accommodate cosmonauts and scientific experiments for nearly a decade before the U.S. Space Station can accommodate astronauts in 1995.

The United States has clearly lost leadership in these two areas, and is in danger of being surpassed in many others during the next several years....

Leadership does not require that the U.S. be preeminent in all areas and disciplines of space enterprise. In fact, the broad spectrum of space activities and the increasing number of spacefaring nations make it virtually impossible for any nation to dominate in this way. Being an effective leader does mandate, however, that this country have capabilities which enable it to act independently and impressively when and where it chooses, and that its goals be capable of inspiring others—at home and abroad—to support them. It is essential for this country to move promptly to determine its priorities and to make conscious choices to pursue a set of objectives which will restore its leadership status.

Leadership results from both the capabilities a country has acquired and the active demonstration of those capabilities; accordingly, the United States must have, and also be perceived as having, the ability to meet its goals and achieve its objectives.

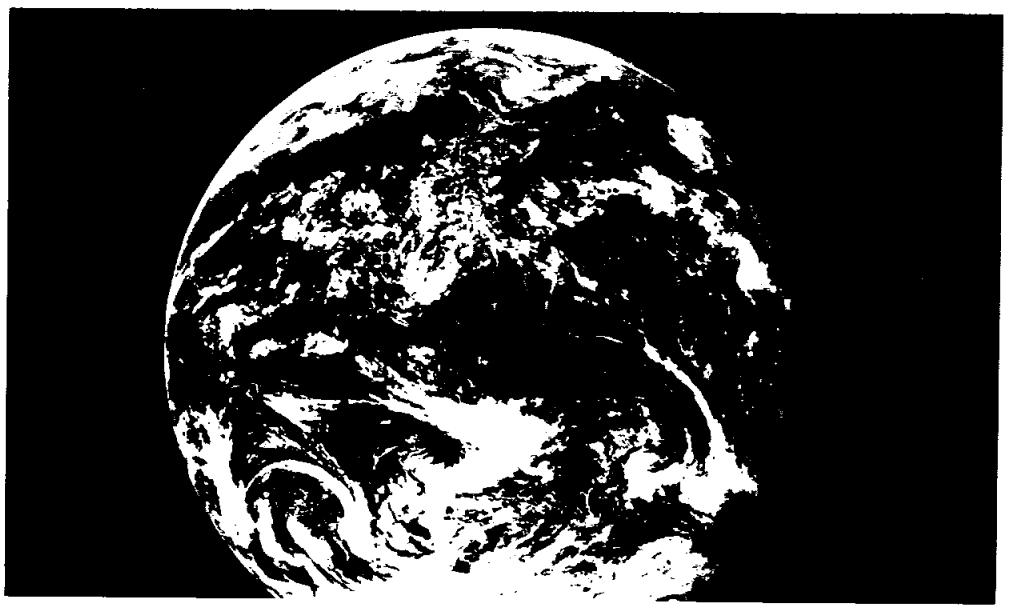
A U.S. space leadership program must have two distinct attributes. First, it must contain a sound program of scientific research and technology development—a program that builds the nation's understanding of space and the space environment, and that builds its capabilities to explore and operate in that environment. The United States will not be a leader in the 21st Century if it is dependent on other countries for access to space or for the technologies required to explore the space frontier. Second, the program must incorporate visible and significant accomplishments; the United States will not be perceived as a leader unless it accomplishes feats which demonstrate prowess, inspire national pride, and engender international respect and a worldwide desire to associate with U.S. space activities....

Perhaps most significant, leadership is also a process. That process involves selecting and enunciating priorities for the civilian space program and then building and maintaining the resources required to accomplish the objectives defined within those priorities. NASA can contribute to this process by: (1) establishing a vision and goals consistent with national space interests; (2) developing and recommending objectives and programs that support those goals; (3) articulating, promoting, and defending them in the political and fiscal arenas; and (4) effectively executing approved programs.

Leadership Initiatives

To energize a discussion of long-range goals and strategies for the civilian space program, four bold initiatives were selected for definition, study, and evaluation:

1. **Mission to Planet Earth**: a program that would use the perspective afforded from space to study and characterize our home planet on a global scale.
2. **Exploration of the Solar System**: a program to retain U.S. leadership in exploration of the outer solar system, and regain U.S. leadership in exploration of comets, asteroids, and Mars.
3. **Outpost on the Moon**: a program that would build on and extend the legacy of the Apollo Program, returning Americans to the Moon to continue exploration, to establish a permanent scientific outpost, and to begin prospecting the Moon's resources.
4. **Humans to Mars**: a program to send



Mission to Planet Earth

Mission to Planet Earth is an initiative to understand our home planet, how forces shape and affect its environment, how that environment is changing, and how those changes will affect us. The goal of this initiative is to obtain a comprehensive scientific understanding of the entire Earth System, by describing how its various components function, how they interact, and how they may be expected to evolve on all time scales....

We currently lack the ability to foresee changes in the Earth System, and their subsequent effects on the planet's physical, economic, and social climate. But that could change; this initiative would revolutionize our ability to characterize our home planet, and would be the first step toward developing predictive models of the global environment.

... the global observational system would include a suite of nine orbiting platforms:

- Four sun-synchronous polar platforms: two provided by the United States and one each provided by the European Space Agency (ESA) and the Japanese National Space Development Agency (NASDA). The first platform would be launched in 1994 and all four platforms would be in orbit by 1997. These platforms would provide global polar coverage with morning and afternoon crossing times.
- Five geostationary platforms: three provided by the U.S. and one each by ESA and NASDA. These platforms would all be launched and deployed between 1996 and 2000.

The integrated system would measure the full complement of the planet's characteristics, including: global cloud cover, vegetation cover, and ice cover; global rainfall and moisture; ocean chlorophyll content and ocean topography; motions and deformations of Earth's tectonic plates; and atmospheric concentration of gases such as carbon dioxide, methane, and ozone.

Space-based observations would also be coordinated with ground-based experiments and the data from all observations would be integrated by an essential component of this initiative: a versatile, state-of-the-art information management system. This tool is critical to data analysis and numerical modeling, and would enable the integration of all observational data and the development of diagnostic and predictive Earth System models.

This initiative requires advances in technology to enhance observations, to handle and deliver the enormous quantities of data, and to ensure a long operating life. Sophisticated sensors and information systems must be designed and developed, and advances must be made in automation and robotics (whether platform servicing is performed by astronauts or robotic systems).

To achieve its full scope, this initiative requires the operational support of Earth-to-orbit and space transportation systems to accommodate the launching of polar and geostationary platforms. This does not represent a large number of additional launches, but it does require the capability to launch large payloads to polar orbit; Titan IVs would be used to accomplish this. Since the envisioned geostationary platforms would be lifted to low-Earth orbit, assembled at the Space Station, and then lifted to geosynchronous orbit with a space transfer vehicle, well-developed orbital facilities are essential. By the late 1990s, the Space Station must be able to support on-orbit assembly, and a space transfer vehicle must exist.

NASA, with its technical and scientific expertise, is uniquely suited to lead Mission to Planet Earth. Only from Earth orbit can we gain the perspective necessary to observe the Earth System and the interaction of its components on a global scale. We now understand what to observe and how to observe it.... Championing this initiative would establish the United States at the forefront of a world-recognized need to understand our changing planet.

Evaluation of initiative

NASA should embrace Mission to Planet Earth. This initiative is responsive, time-critical, and shows a recognition of our responsibility to our home planet. Do we dare apply our capabilities to explore the mysteries of other worlds and not also apply those capabilities to explore and understand the mysteries of our own world—mysteries which may have important implications for our future on this planet?

Solar System Exploration

This initiative would build on NASA's long-standing tradition of solar system exploration and would continue the quest to understand our planetary system, its origin, and its evolution. Solar system bodies are divided into three distinct classes: the primitive bodies (comets and asteroids), the outer (gas giant) planets, and the inner (terrestrial) planets. Each class occupies a unique position in the history of the solar system, and each is the target of a major mission in this initiative....

1. ***The Comet Rendezvous Asteroid Flyby (CRAF)*** mission would investigate the beginnings of our solar system, studying a Main Belt asteroid and a comet, which represent the best-preserved samples of the early solar system. Because of their primordial nature, comets can provide critical clues about the processes that led to the origin and evolution of our solar system...

After a 1993 launch and a six-month cruise, the spacecraft would fly past the asteroid Hestia at an altitude of about 10,000 kilometers. *CRAF's* visual and infrared asteroid imaging systems would conduct investigations of Hestia's surface composition and structure. *CRAF* would then continue its journey for a rendezvous with a periodic comet, Tempel 2. The spacecraft would maneuver to within 25 kilometers of the comet's nucleus and begin a series of observations, which includes shooting two penetrators into the nucleus itself for detailed *in-situ* measurements. The spacecraft would fly in close formation with the comet until it nears the Sun and becomes active; then the spacecraft would maneuver farther away to observe the comet's coma and tail.

2. ***The Cassini*** mission would explore Saturn and its largest moon, Titan. The giant outer planets offer us an opportunity to address key questions about their internal structures and compositions through detailed studies of their atmospheres.... This expanded mission would be launched in 1998 for the long interplanetary voyage to arrive at Saturn in 2005 with a full array of investigative instruments. An orbital spacecraft and three probes would conduct a comprehensive three-year-study of the planet and its rings, satellites, and magnetosphere. One atmospheric probe would be launched toward Titan. The expanded *Cassini* mission would also carry one probe to investigate the Saturnian atmosphere, and one semi-soft lander which would reach the surface of Titan.

3. ***The Mars Rover/Sample Return*** missions would, in journeys covering hundreds of millions of miles, gather samples of Mars and bring them back to Earth. Because of its relevance to understanding Earth and other terrestrial planets, and because it is the only other potentially habitable planet in our solar system, Mars is an intriguing target for exploration.

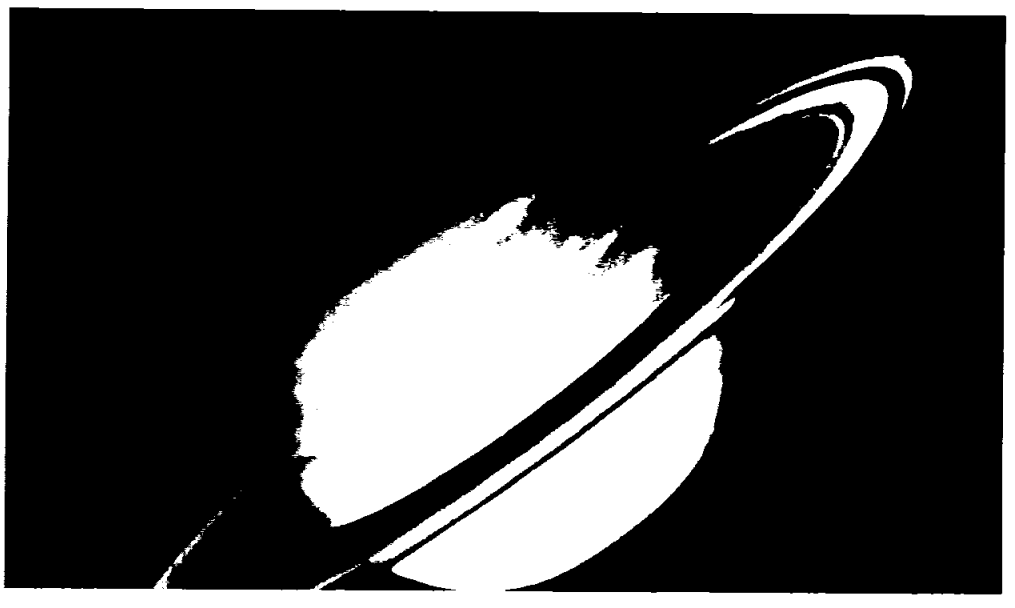
The Mars Rover/Sample Return mission scenario ... would involve a soft landing on the Martian surface, deployment of a "smart" surface rover to select and collect samples, delivery of the samples to an ascent vehicle, and transfer of the samples from Mars orbit to a return vehicle. The samples would then most likely be returned to a sample handling module on the Space Station for analysis.

The initiative would include three such missions: two launched in 1996, probably sending redundant rovers and ascent vehicles to ensure return of a sample in 1999, and one launched in 1998/99 with return in 2001.

As it is defined, this initiative places a premium on advanced technology and enhanced launch capabilities to maximize the scientific return. It requires aerobraking technology for aerocapture and aeromaneuvering at Mars, and a high level of sophistication in automation, robotics, and sampling techniques....

Evaluation of initiative

Planetary exploration need not be NASA's primary focus, but it offers opportunities to exercise leadership in the international arena through organizing and participating in coalitions to achieve objectives which are consistent with U.S. goals, and it can provide important precursor information for either of the larger human exploration initiatives.... Although not necessarily at the pace suggested in this initiative, planetary exploration must be solidly supported through the 1990s.



America's Future in Space' examines four possible initiatives, of evolution and natural progression for civilian exploration

astronauts on a series of round trips to land on the surface of Mars, leading to the eventual establishment of a permanent base.

The intent is not to choose one initiative and discard the other three, but rather to use the four candidate initiatives as a basis for discussion. For this reason, it was important to choose a set of initiatives which spanned a broad spectrum of content and complexity.

The ground rules for this study are important to understand, since they influenced the detailed definition of the initiatives. The ground rules, set forward at the outset of this study, were:

- The initiatives should be considered *in addition* to currently planned NASA programs. They were not judged against, nor would they supplant, existing programs.
- Each initiative should be developed independently. There is, of course, considerable synergism between certain initiatives. For example, one possible progression for human exploration could be the development of a lunar outpost, followed by an expedition to Mars. However, in order to provide a clear starting point for discussion, the four were considered to be distinct.
- The initiatives should achieve major milestones within two decades.
- The Humans to Mars initiative should be assumed to be an American venture. It was beyond the scope of this work to consider joint U.S./Soviet human exploration....

Programmatic Assessment

From now until the mid-1990s, Earth-to-orbit transportation is NASA's most pressing problem. A space program that can't get to orbit has all the effectiveness of a navy that can't get to the sea. America must develop a cadre of launch vehicles that can first meet the near-term commitments of the civilian space program and then grow to support projected programs or initiatives.... If we do not make a commitment now to rebuild and broaden our launch capability, we will not have the option of pursuing any of the four initiatives....

The same can be said for advanced technology.... The technology required for bold ventures beyond Earth's orbit has not yet been developed, and until it is, human exploration of the inner solar system will have to wait.

Life sciences research is also critical to any programs involving relatively long periods of human habitation in space.... Without an understanding of the long-term effects of weightlessness on the human body, our goal of human exploration of the solar system is severely constrained....

All the initiatives require that the Space Station evolve additional capabilities, but the needs of the Planetary initiative (a sample return module) and the Earth initiative (servicing capability, operation of a space transfer vehicle) are relatively modest. The Lunar initiative requires gradual evolution to support the assembly, servicing, and checkout of lunar transfer vehicles. This requires more people in orbit (and therefore more Space Station modules and logistics traffic), spaceport facilities, and a propellant depot. The Mars initiative also relies on those spaceport facilities and additional crew accommodations, and although it will not occur quite as soon as in the Lunar initiative, the assembly of the large Mars cargo and piloted vehicles will be a significant task....

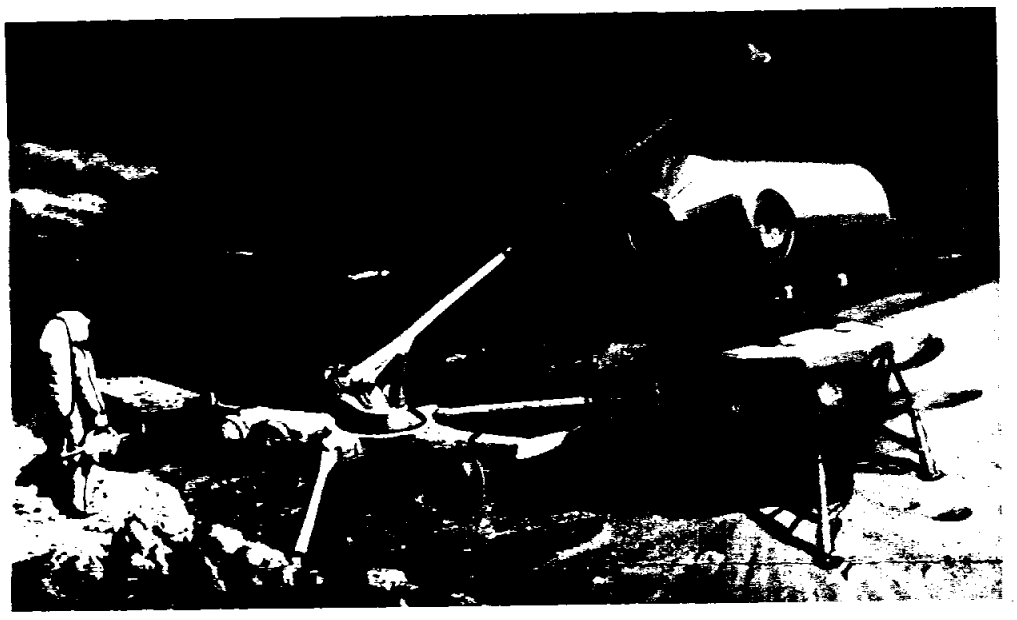
The initiatives also require investments in technology development and investments in institutional and human resources.... The level of investment required is directly proportional to the magnitude and complexity of the initiatives.... The need for a dedicated, enthusiastic, and technically competent workforce must not be minimized; the Lunar and Mars initiatives would both require a significant increase in human resources....

Conclusion

In today's world, America clearly cannot be the leader in all space endeavors. But we will be the leader in very few unless we move promptly to develop a strategy to regain and retain leadership in those areas we deem important.... Thus, the strategy we choose must lay a strong foundation of scientific research and technology development, and must include visible, significant accomplishments that demonstrate the successful pursuit of our stated goals....

It would not be a good strategy, good science, or good policy for the U.S. to select a single initiative, then pursue it single-mindedly. The pursuit of a single initiative to the exclusion of all others results in leadership in only a limited range of space endeavor.... It is not NASA's role to determine the strategy for the civilian space program. But it is NASA's role to lead the debate, to propose technically feasible options, and to make thoughtful recommendations.

It is in this spirit that we suggest the outline of one strategy—a strategy of evolution and natural progression.



Outpost on the Moon

This initiative builds on the legacy of Apollo and envisions a new phase of lunar exploration and development—a phase leading to a human outpost on another world. That outpost would support scientific research and exploration of the Moon's resource potential, and would represent a significant extraterrestrial step toward learning to live and work in the hostile environments of other worlds....

The Moon's unique environment provides the opportunity for significant scientific advances; the prospect for gains in lunar and planetary science is abundantly clear. Additionally, since the Moon is seismically stable and has no atmosphere, and since its far side is shielded from the radio noise from Earth, it is a very attractive spot for experiments and observations in astrophysics, gravity wave physics, and neutrino physics, to name a few....

This initiative proposes the gradual, three-phase evolution....

Phase I: Search for a Site (1990s)—The initial phase would focus on robotic exploration of the Moon. It would begin with the launching of the *Lunar Geoscience Observer*, which will map the surface, perform geochemical studies, and search for water at its poles.... Mapping and remote sensing would characterize the lunar surface and identify appropriate sites for the outpost....

Phase II: Return to the Moon (2000-2005)—Phase II begins with the return of astronauts to the lunar surface.... The initiative proposes that a crew be transported from the Space Station to lunar orbit in a module propelled by a lunar transfer vehicle. The crew and equipment would land in vehicles derived from the transfer vehicle. Crew members would stay on the surface for one to two weeks, setting up scientific instruments, a lunar oxygen pilot plant, and the modules and equipment necessary to begin building a habitable outpost. The crew would return to the orbiting transfer vehicle for transportation back to the Space Station.

Phase III: At Home on the Moon (2005-2010)—Phase III evolves directly from Phase II, as scientific and technological capabilities allow the outpost to expand to a permanently occupied base. The base would have closed-loop life support systems and an operational lunar oxygen plant, and would be involved in frontline scientific research and technology development....

By 2010, up to 30 people would be productively living and working on the lunar surface for months at a time. Lunar oxygen will be available for use at the outpost and possibly for propellant for further exploration.

This initiative envisions frequent trips to the Moon after the year 2000—trips that would require a significant investment in technology and in transportation and orbital facilities in the early 1990s.

The critical technologies for this initiative are those which would make human presence on the Moon meaningful and productive. They include life-support system technologies to create a habitable outpost; automation and expert systems and surface power technologies to make the outpost functional and its inhabitants productive; and lunar mining and processing technologies to enable the prospecting for lunar resources.

The transportation system must be capable of regularly transporting the elements of the lunar outpost, the fuel for the voyage, and the lunar crew to low-Earth orbit. This requires a heavy-lift launch vehicle and a healthy Space Shuttle fleet. The transfer of both cargo and crew from the Space Station to lunar orbit requires the development of a reusable space transfer vehicle....

The Space Station is an essential part of this initiative.... Supplies, equipment, and propellants would be marshalled at the Station for transit to the Moon. It is therefore required that the Space Station evolve to include spaceport facilities....

Evaluation of initiative

The Lunar initiative is a logical part of a long-range strategy for human exploration .... this initiative is quite flexible. Its pace can be controlled, and more important, adapted to capability. It is possible to lay the foundation of the outpost in the year 2000, then build it gradually, to ease the burden on transportation and Space Station at the turn of the century.

Humans to Mars

This bold initiative is committed to the human exploration, and eventual habitation, of Mars. Robotic exploration of the planet would be the first phase and would include the return of samples of Martian rocks and soil. Early in the 21st Century, Americans would land on the surface of Mars; within a decade of these first piloted landings, this initiative would advance human presence to an outpost on Mars....

This leadership initiative ... would clearly rekindle the national pride and prestige enjoyed by the U.S. during the *Apollo* era. Humans to Mars would be a great national adventure; as such, it would require a concentrated massive national commitment—a commitment to a goal and its supporting science, technology, and infrastructure for many decades.

This initiative would:

1. Carry out comprehensive robotic exploration of Mars in the 1990s. The robotic missions would begin with the *Mars Observer*, include an additional *Observer* mission, and culminate in a pair of *Mars Rover/Sample Return* missions. These missions would perform geochemical characterization of the planet, and complete global mapping and support landing site selection and certification.
2. Establish an aggressive Space Station life sciences research program to validate the feasibility of long-duration spaceflight. This program would develop an understanding of the physiological effects of long-duration flights, of measures to counteract those effects, and of medical techniques and equipment for use on such flights....
3. Design, prepare for, and perform three fast piloted round-trip missions to Mars. These flights would enable the commitment, by 2010, to an outpost on Mars.

The Mars missions described in this initiative are one-year, round-trip "sprints," with astronauts exploring the Martian surface for two weeks before returning to Earth. The chosen scenario significantly reduces the amount of mass which must be launched into low-Earth orbit, and by doing so brings a one-year round trip into the realm of feasibility. This is accomplished by splitting the mission into two separate parts—a cargo vehicle and a personnel transport—and judiciously choosing the launch date for each.

The personnel transport would be assembled and fueled in low-Earth orbit, and would leave for Mars only after the cargo vehicle had arrived in Mars orbit. It would carry a crew of six astronauts, crew support equipment, and propellant for the outbound portion of the trip. Once in Mars orbit, it would rendezvous with the cargo vehicle, refuel, and prepare for descent to the surface. The landing party would spend 10 to 20 days on the Martian surface, and then rendezvous with the personnel transport for the trip back to Earth orbit. Recovery in Earth orbit would return the crew to a Space Station rehabilitation facility....

... The Mars expeditions require the development of a number of technologies, including aerobraking (which significantly reduces the amount of mass which must be lifted to low-Earth orbit), efficient interplanetary propulsion, automation and robotics, storage and transfer of cryogenics in space, fault-tolerant systems, and advanced medical technology....

Even with separate cargo and personnel vehicles ... each of these sprint missions requires that approximately 2.5 million pounds be lifted into low-Earth orbit.... It is clear that a robust, efficient transportation system, including a heavy-lift launch vehicle, is required....

A successful Mars initiative would recapture the high ground of world space leadership and would provide an exciting focus for creativity, motivation, and pride of the American people. The challenge is compelling, and it is enormous.

Evaluation of initiative

This task group has examined only one possible scenario for a Mars initiative—a scenario designed to land humans on Mars by 2005. This time scale requires an early and significant investment in technology....

More important, NASA would be hard pressed to carry the weight of this ambitious initiative in the 1990s without severely taxing existing programs....

Settling Mars should be our eventual goal, but it should not be our next goal.... We should adopt a strategy of natural progression which leads, step by step, in an orderly, unhurried way, inexorably toward Mars.

Roundup Swap Shop

All Swap Shop ads must be submitted on a JSC Form 1452. The forms may be obtained from the Forms Office. Deadline for submitting ads is 5 p.m. the first Wednesday after the date of publication. Send ads to Roundup, AP3, or deliver them to the Newsroom, Bldg. 2 Annex, Room 147. No phone in ads will be taken.

Property & Rentals

Lease: CL 2-1 condo, security, pool, tennis, $400 plus utilities. 480-5583 or 482-7156.

Lease: CLC Camino South 4-2-2d, fenced, A/C, carpeted, no pets, deposit, references required. 488-1301.

Lease: Bacliff Villas 3-1-1A, A/C, fenced, no pets, deposit, references required. 488-1301.

Lease: Baywind II split design, FPL, W/D, fans, stove, refrigerator w/ice-maker, $350/mo., $150 deposit. Bill, x35169 or 480-2756.

Lease: CL 2-2 condo, W/D conn., near daycare, pools, 2 weeks free, $330/mo., deposit. 280-9822.

Lease: Windswept 2-2.5 townhouse in Scarsdale, approx. 1,500 sq. ft., clubhouse, tennis, pool, $450/mo. Jim, 333-6152 or 480-9344.

Sale: 13.5 E. Texas acres, gently rolling, wooded, fronts city blacktop, near Tyler and Henderson, assumable, Texas Vet. loan. McLeaish, 480-7745.

Rent: League City 3-1.75-2, fenced, near schools, shopping, recreation, library; good cond., exterminated, no pets, $450/mo. Reynolds, 554-6200.

Sale: 1 acre shaded plus 3-1-1, shop, utility, screened, patio, deep well, cyclone fence, 40 mi. west of Memorial City, FM 362, $49,900. Cookie, x30328 or 474-5610.

Lease/Sale: Baywind I, 2-1.5-2 upstairs condo, W/D, fans, new paint, carpet cleaned, swimming, club, sauna, near shops/schools, variable length lease, option to buy, $325/mo. OBO. Lachhman, x33235.

Rent: Galveston Victorian Gulf-front condo, sleeps 6, furnished, pools, whirlpools, tennis. 480-5270.

Lease/Sale: Baywind I, 2-1.5-2, W/D, $325/mo. plus electricity, 1-mo. deposit. 333-3992.

Lease: Lake Livingston 3-2 waterfront house, sleeps 8, furnished, pier, fishing, skiing, swimming, weekend and weekly rates. 482-1582.

Sale: League City 4-2-2, colonial, large corner lot, fenced, new carpet/paint, storage building. 332-2386.

Sale: League City, 2-acre home site. 332-2386.

Rent: Bacliff 2-2 house, renovated, W/D, $350/mo., deposit. Terry, x37727 or 481-5659.

Sale: Cypress Lakes lots, 80'x140', 17 mi. east of Cleveland, fishing, access to Mudd Lake, Horse Lake, Trinity River Beach, swimming pools, country club. Assume payments of $100.95/mo., deposit. Joe, x33729.

Lease: CLC 2 BR condo, FPL, W/D conn., pools, near daycare, 2 weeks free, $350/mo. 486-0315.

Sale: League City 3-2-2, landscaped, new paint, FPL, fenced, near school, pool, tennis, 9.5 fixed FHA, low equity. David, x35464.

Sale: '77 mobile home, 2-2, set up at TAMU, 14'x65', central A/H, new carpet, $9,500. Doug, x30964 or 480-2929.

Lease: Ellington Field/Sycamore Valley 4-2-2, fenced, drapes, fans, 10 min. to NASA, 3 miles to Almeda and Baybrook malls, large yard, $550/mo. plus deposit. Dilip, 484-5343 or x31592.

Lease: Forest Bend, 2-story townhouse, 2-1.5-2 CP, 1,000 sq. ft., dining room, French doors, woven woods, Deco brick, fans, refrigerator w/ice-maker, W/D, fenced, utility room. Mike, 280-2364 or Sandra, 280-2361, or 333-5426.

Lease: West Galveston Island 3-2 beach house, furnished, day/week. Ed, x37686 or 482-7723.

Lease: Friendswood/Forest Bend, 4-2-2, fresh paint, storm windows, fenced, CCISD, walk to pool, school, good cond., $490/mo. plus deposit. 280-0021.

Lease: Galveston 2-2 beach house, beach 100 yds., boat landing 4 blocks, marina w/pool, $500/week, weekend rates available. Fendell, 481-0679.

Sale: Mobile home, 14'x80' Fleetwood, 3-2, central A/H, furnished, appliances. 474-4228.

Sale: 4-2-2 house, fans, microwave, miniblinds/drapes, new paint, carpet, pool and tennis 1 block, JSC 5 mi. Roger, x36802 or 334-6866.

Rent: 3-2 brick house, 2-dr. garage, CCISD, available 9/1, $550/mo. 334-3254.

Lease: Dixie Hollow/Pearland, 3-2-2, fans, utility room, new paint, refrigerator, W/D, $495/mo. 482-6609.

Rent: Forest Bend/Friendswood 3-2-2, fenced, new paint, carpet, FPL, $495/mo. 482-6609.

Lease: Egret Bay 2-1-2 condo, W/D, FPL, fans, covered parking, storage, pools, boat ramp, 3 mi. from NASA, furniture available, $375/mo., 1 mo. free, deposit. 333-4751.

Lease: Scarsdale 3-2-2, between Baybrook and Almeda malls, refrigerator, drapes, storm windows, alarm, fans, near hospital, daycare, schools, 20 min. to JSC, $495/mo. plus deposit. Ed, x32586.

Lease/Sale: 3-2-2 in NW Houston, family room, living room, fans, miniblinds, some appliances, malls nearby, available 9/5/87. Joe, 282-3255.

Sale: Friendswood/Forest Bend townhouse, 3-2.5, den, corner, storage, pool, $43,500. 333-2322.

Cars & Trucks

'79 Olds Cutlass station wagon, good cond., new tires, stereo/tape cassette, $2,200. 280-9822.

'72 Dodge mini motor home, 19', 360 V-8, sleeps 6, $2,775. Norm, x38947 or 488-0035.

'63 Chevy 2-dr., 63K mi., 2nd owner, ex. cond., BO. Smith, x31552 or 471-2419.

'74 Toyota Land Cruiser, new tires, good running cond., $2,700. Mike, 474-4712.

VW dune buggy, 1500 cc. engine, licensed, inspected, runs well. H. M. Acock, x37821 or 488-1453.

'85 Pontiac Firebird, V-8, auto, AM/FM cassette, A/C, new Eagle GT tires, good cond., $6,900. Kandy, x36728.

'86 Gay Pontiac 600 E, loaded, 12K mi., 4-dr., ex. cond., $4,900 OBO. Antonio, x30220.

'81 Caprice Classic Chevy, 4-dr., 74K mi., good cond., good tires, new timing chain, tune-up, cruise, all auto., $3,200. Clay, x34568 or 481-1507.

'75 Cadillac Coupe DeVille, runs well, needs paint and A/C compressor, $800 OBO. Dean, x37761 or 488-7032.

'82 Toyota 4-dr. Corola sedan, A/C, auto., AM/FM, new tires, good cond., $2,000. Ben, x31588 or 488-1326.

'82 Olds 2-dr. Cutlass Supreme, V-6, $2,500. Whitnah, x36607 or 481-2854.

'79 Camaro, rebuilt engine w/10K mi. 334-5419.

'71 Mercedes-Benz 280 S, 4-dr. sedan, professionally restored, ex. cond., $8,600 OBO. Bozeman, x34513.

'70 MG Midget, good cond., 70K mi., one owner, $2,500. 482-6027.

'83 Camaro Berlinetta, ex. cond., V-8, auto. and loaded, 65K mi., $5,400. 482-6027.

'78 Jeep CJ7, straight 6, 4-spd., lockouts, winch, stereo, 33" tires and soft top, $4,200. 482-2810.

'82 Chevy Cavalier, 4-spd. man., A/C, AM/FM tape, $2,000 OBO. Gene, x38917 or 996-9089.

'82 Olds Delta 88, AM/FM stereo, 4-dr., A/C, cruise, tilt steering, velour interior, good cond. Al, x39386 or 649-5768.

'59 Mercedes-Benz 220 S, $2,700 OBO. David, x35464.

'79 Plymouth window van, 7 passenger, seats easily removable, dual A/C, gas tanks, auto., AM/FM, ex. cond., $3,200. 534-3554.

'86 Toyota 2-WD truck, loaded. G. Musso, 282-5211.

'80 Grand Prix, A/C, PW, AM/FM cassette, new paint. Chuck, x38416 or 333-3360.

'79 Mercury Bobcat Runabout, 67K mi., vinyl top, looks and runs well, radio, auto., $795 OBO. 998-8485.

'81 Camaro Berlinetta, 8 cyl, 305-4BBL, Chevy close-ratio 4-spd. standard, 355 Positrac, R4, A/C, Comp., trailer cooling pkg., PS, PB, tilt, cruise, full instruments. Charlie, x33301 or Ed, 488-1070.

'85 Chevy S-10 Blazer, 2.8 V-6, 25K mi., tilt, cruise, AM/FM cassette, trailer hitch, Tahoe pkg., rally wheels. Mary, x37766 or 482-7144.

'80 Chevy Monza, 2-dr., needs transmission work, 4-spd. manual, $500 OBO. 488-4915.

'73 Ford Gran Torino, 1 owner, 82K mi., runs well, spare tire, factory shop manuals, $1,100. 488-2953.

'63 Ford Galaxy 500 sedan, new paint, runs well, $1,850. James, x36525.

'80 Camaro Berlinetta, T-tops, PS, PB, 305 V-8, auto., new A/C, more, $2,675. Norm, x38947 or 488-0035.

Boats & Planes

'70 Coronado 23' sailboat, 6 hp. Johnson, 3 sails, galley, head, dinghy, CB, sleeps 4, $5,300 OBO. 474-5414.

15.5' Glastron Alpha sailboat, galvanized trailer, pop-up rudder, $500 or trade for above-ground pool. Kyle, x33654.

20' Bayliner, rebuilt 130 hp. I/O, E-Z Load trailer, 30 gal. tank, needs carburetor work, $2,700. 482-2810.

Hobie 18' catamaran, sails, trailer included, $2,800. 479-5340.

25' Coronado sailboat, head, 3 sails, radio, life preservers, good marine cond., in water, ready to sail, $5,495 OBO. Rocky, x32541.

12' John boat, flat bottom, $250. G. Musso, 282-5211.

16' catamaran, Chrysler, racing rig, new GCAT MOD sails and tramp., custom rudders (NACRA 5.6 design), pivoting center boards, main beam trailer. Ed, 488-1070 or Charlie, x33301.

18' Glastron I/O Bowrider, Volvo Penta AQ170B (Major, Spr. 86-54 hrs.), Volvo Penta 270 Outdrive, new boots and U-joints, engine oil cooler, Shoreline galvanized trailer, full instruments. Ed, 488-1070 or Charlie, x33301.

18' catamaran, AMF TRAC sailboat w/trailer and extras, like new, $3,650. 333-3056.

Cycles

'85 Honda Sabre V65, 1100 cc., shaft drive, digital console, overdrive, 125 hp., 1,200 mi., ex. cond., $3,000. Tony, x34360 or 538-1955.

'86 Yamaha, 80 cc., 3-wheeler, never used, for kids, $750. Tony, x34360 or 538-1955.

'81 Yamaha, 750 Virago, 5K mi., EC, $1,200. Allen, x31466 or 534-3932.

'86 Honda 250 Rebel, windscreen, 250 mi., like new, $1,100. Richard, 282-3493, x31663.

Audiovisual & Computers

Okidata printer, 120 CPS, like new, $100; Mixer/Pre-Amp PMX 9000 and 12-band graphic equalizer, $400 for both. Sherry, x39181 or 486-1414.

MacIntosh 400K,external disk drive, $75 OBO. Brad, x35336 or 480-7215.

Tandy color computer, 2 disk drives w/DOS, Amdek monitor, modem, printer, graphics x-pad, software, BO. Tim, x39105 or 333-1313.

Commodore 64 w/monitor, 1541 disk drive, modem, many programs (games, word processor, etc.), $650. 471-3165.

Apple IIe computer, 128K enhanced, 2 drives, modem, much software, $800. Gordon, 486-4403 or x30518.

Sine/Square wave generator, Heath model IG18.70. Syd, 280-1579.

Commodore 64/128, 64K "Serial Box" serial port print buffer, ex. cond., was $100, now $30. 487-3799.

PC Jr. w/color monitor and Quadram Expansion Chassis, 512K, 2 disk drives, printer port, PC compatible, 300 baud internal modem, 83 key keyboard, joystick, complete docs, word processing, database, comm. software, $950. Robert, 480-6797 or x30780.

Computer, dual 8" disk drives, monitor, keyboard, $400. 334-4894.

Apple IIc, 2 disk drives, 13" monitor, clock, joystick, software, 512K ZRAM CPM card, $950; Atari 2600 w/12 game cartridges, $120. Tony, 280-1564 or 482-4156.

King's Quest III, IBM version, original disks and documentation, $15. George, x37005 or 488-8761.

Z80-based computer, keyboard, 2 disk drives, monochrome monitor, Wordstar, Multiplan, DRGraph, BASIC, $350. Jim, x34608.

HP digital cassette drive for HP-41C w/HP-IL interface module, ex. cond., $450. Carlos, x38879 or 554-7727.

Apple IIe, 128K, monitor, 2 disk drives, Systemsaver, Grappler, Micromodem IIe, software. Alan, x38313.

Household

Whirlpool upright freezer, 16.1 cu. ft., like new, $150. Cindy, x34165.

Bar and 2 bar stools, light tan w/chrome, foot railings, $150 OBO; small Amana chest freezer, $100 OBO. Jack, x35629.

Rattan loveseat, walnut finish, pink floral slipcovers, ex. cond., $95. Cookie, x30328 or 474-5610.

4-drawer chest, $50; platform swivel rocker, $25; maple coffee table, $25; 12" B&W TV, $10; 4-drawer student desk, $35. 488-2953.

Washer, dryer, side-by-side refrigerator, dishwasher, used 18 mos., $150/ea. Rae, x33648 or 458-9342.

Antique French bench, rose, ex. cond., $250; antique fruit picture, large, $75; 2 matching hand-carved chairs, Spanish, new upholstery, $500/both. 488-5564.

Child's table and 4 chairs, wooden, $25; School desk, small, antique, $30; pot-bellied stove, small, $30; typing table, metal, $22; 2 matching kitchen chairs, $20/both; heavy duty computer desk or microwave stand, $30. 488-5564.

Bunk beds, o[illegible] w/mattresses, ex. cond., $325 firm. Billie, x38334 or 482-4365.

Sofa and loveseat, burgundy, fair cond., $100 OBO; 2 vinyl chairs, brown, never used, $50/pair; indoor antenna, $20. Loan Le, x36186 or 488-7646.

Freezer, Sears Signature series, 20 cu. ft., frostless, never used, $300. Tony, 280-1564 or 482-4156.

Full-sized mattress and box springs, $30 for both. Roger, x36802 or 334-6866.

G.E. gas dryer, 6 yrs. old, ex. cond., heavy duty, $150. Beth Ann, 333-6191.

Household furnishings, appliances, etc. Joe, 282-3255.

Remote-controlled color TV's, Quasar 19" and Montgomery Ward 13", non-working, ex. appearance, BO. Sharyl, x35342.

Photographic

Canon G3, f1.7 40 mm. lens, auto/manual exposure, Canonlite flash, case, $60 OBO. Dennis, x34405 or 480-5076.

Omega B&W enlarger, Chromaga color enlarger, many extras, $300. 471-3165.

Pets

5 yr. old poodle, mixed, free to good home. 480-7413.

Small, mixed-breed dog, part beagle, 2 yrs. old, mismatched eyes, all shots, free to good home. 332-3287.

4 puppies, 6 wks. old, part Pekingese and Chihuahua, 2 brown females, 2 black males, free. Terri, x31368 or 480-6389.

2 kittens, male is black tabby and white, female is calico, ready 9/12. Linda, x35969 or 332-2469.

Miniature Italian greyhound, honey-brown female, 7 mos. old, AKC registered, all shots, Houston license, $350. Carl, x32563 or 439-0941.

Musical Instruments

Gibson 6-string acoustic guitar, $450; Ventura 5-string banjo, ex. cond., $250. Ernie, x36893 or 485-2287.

Violin, by Karl Meisel, W. Germany, full-sized, ex. cond., $1,000 OBO; Cello, by Karl Meisel, good cond., $750 OBO. Tom, 487-0307.

Trombone, ex. cond., w/case, $300. Carol, x38884.

Zildjian 20" med. ride cymbal, $100; 13" New Beat hi-hats, $120, brand new. Joe, x31597 or 996-1667.

Alto saxophone, Selmer Super Action 80, hard case w/soft outer shell, ex. cond., $1,600. Mary, x37766 or 482-7144.

Premier snare drum set, w/bells, ex. cond., $150. Marv, x38312 or 488-3647.

Lost & Found

Lost: 6-spd. Raleigh bike from Mission Control Center. Jon, x37671.

Found: Ladies' glasses, pink tinted, in Printing Office. Ethel, x36148.

Personals

"I wish to convey my appreciation to all of you in your support, cards, letters and prayers in the recent death of my husband, William E. "Bill" Perry. Friends like you help make my path easier, while my loved one lives forevermore in God's eternal light."—Donna Perry

Wanted

Want roommate to share 3 BR house in Tiki, female preferred, pets accepted, $285/mo., split utilities. Antonio, x30220.

CL area gamers invite interested game players to Freeman Library meeting room for an afternoon of gaming, noon 8/22, 9/19 and 10/17. 282-8776.

Want female non-smoker to share 2-2 condo, $200/mo. plus 1/2 utilities and $50 deposit. Linda, 282-4189 or 488-0766.

Want to buy electric trains. Don, x37832 or 996-1425.

The Texas Wildlife Rehab. Coalition, non-profit group, seeks aquariums, hamster cages, heating pads and desk lamps to rehabilitate wild birds and small animals. 480-6531 or 332-8319.

Want baby bassinet or crib, Madeline, x31091.

Want to buy stereo, AM/FM, turntable, dual cassette deck, $100. George, x37005 or 488-8761.

Want licensed antenna radio operator who can administer tests for licensing. Carlos, x38879 or 554-7727.

Want lead vocalist for new rock band, serious callers only. Joe, x31597 or 996-1667.

Miscellaneous

Auto parts: 400 CID GTO short block, $100; Original 389 GTO intake, 4BBL air cleaner, $150; 69 Judge 3:23 Posi rear end w/coils and complete rear brakes, $100. 488-8011.

Murray 21" self-propelled mower, 3.5 hp. B & S engine, runs, needs work, $30. Lee, 335-8527 or 480-4548.

"Commit To Be At" membership at The Waistbasket, expires 6/20/88, unlimited membership, sun tanning, aerobics, babysitting available, $19.25/mo., want to sell before 9/15/87. Karen, x38850 or 520-8348.

Sheepskin seat covers that fit 280 ZX, charcoal gray, $40; Gympac 1500, like new, $75. Cindy, x34165.

Upholstered reclining chair, good cond., $40; Leather golf shoes, worn once, womens' size 6-1/2 M, $20; ice skates, like new, women's size 8, $35. 488-8273.

10-spd. bike, girl's 24" from Sears, good cond., $25. George, x34108 or 554-6057.

Roadmaster Corp. exerciser, rowing machine, model 8212, $50 OBO. Joe, 944-4581.

Used, 4-ton central A/C unit, compressor replaced approx. 1 yr. ago, good cond., $200 firm. Bill, x37750.

Stove vent, $10. Madeline, x31091.

Pick-up topper, aluminum, for long bed, $75. Syd, 280-1579.

Rifle, .308 Winchester, Remington model 788 w/Weaver scope, $175; Shotgun, 12 gauge, Remington Wingmaster, model 870, $150. Stephen, x32530.

Colt Python .357 magnum, 6 BBL, new, BO. 280-4380.

Ladies' solitaire diamond ring, platinum body, .43 carats, appraised at $1,350, $700; Pearson compound crossbow, 250 lbs. pull, leather belt pouch, 12 specially-made arrows and pear-shaped hunting heads, will trade for Tamron 60-300 zoom lens, ex. cond. only. Harold, x38497.

Round-trip airline ticket to Detroit and/or Rochester, N.Y. over Labor Day weekend, $125 OBO. Sheri, x32243.

Gun collection, classic pistols and rifles. Terry, x37727 or 481-5659.

Chest waders w/suspenders, size 8, converse hip boots, size 7, clean and in good cond.; auto service and repair shop manuals: '58, '59/'60 Chevrolet, '66 Chevrolet, Chevy 2, Chevelle, Corvette, '57 Ford and T-Bird, '71 Ford, Maverick, T-Bird, Mercury, Mustang, Lincoln; all originals, ex. cond. John, 488-4487 or x30018.

Service manual for '72 Chevrolet, incl. Corvette, and overhaul manual for '72 cars and 10-30 series trucks, $25 for both; Toyota repair handbook (Clymer), for '70-'77 Corona, Mark II and Celica, 220 pp., $10. John, x31056.

Dayton riding mower, 34" cut, Briggs 8 hp. engine, runs and cuts well, $200. Bob, 554-5346.

Sofa and loveseat, $200; coffee table, 46" sq., end table, 26", $100; abstract painting, brown/rust, $25. Reese, 554-5346.

Bible, Old and New Testaments, King James version, on audio cassettes, new, was $150, now $50. 487-3799.

Marcy weight machine, plus sit-up bench, $25. 480-7550.

Built-in desk, Formica surface, 2 drawers, 47" wide x 21.5" deep, $12; Ladies' Samsonite make-up case, aqua, like new, $25. Suzette, x33606.

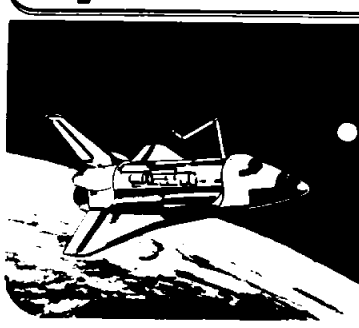
Pecan wood for cooking, 2 ricks (4'x8'x2'), seasoned, split, stacked, $100/rick, $200/cord. Fred, 486-9328 or x31902.

Car mask for Chrysler Laser, $60; Fuzzbuster Supernet radar detector, $150. 554-2645.

Boys' school clothes, ex. cond., Guess, OP, Polo, new Avia sneakers, some never worn, sizes 12s-14s; Butcher block dining table, round, ex. cond., $75; Ladies' silver bowling ball, 12 lbs., $15. 480-7194.

NASA Lyndon B. Johnson Space Center

Space News Roundup



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