NASA
Lyndon B. Johnson Space Center

Space News Roundup

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News Briefs

Station thrusters advance

Successful ground testing of a unique auxiliary propulsion system for the Space Station has encouraged researchers that a new type of thruster can operate for long periods of time with no hardware degradation. In tests conducted for the Lewis Research Center, thrusters used the electrolysis of water as the propellant source. In this process, water is broken down into hydrogen and oxygen and these gases are then burned as fuel. The thrusters ran for as long as 22,000 seconds. With a target of some ten years of life aboard the Station, the goal is a run of 40,000 to 60,000 seconds. The tests were conducted by Bell Aerospace Textron and Aerojet TechSystem Corp. under contract to Lewis.

Boeing signs agreement

NASA and the Boeing Aerospace Co. have entered into an agreement to fly a series of materials processing experiments aboard the Shuttle. The experiments are designed to prove that crystals of a size and quality impossible to create on Earth can be produced in the microgravity of space. The process involves operation of a chemical vapor transport crystal growth furnace which would be installed in the galley area of the Shuttle's middeck. Boeing expects to fly a total of three separate furnaces on each of the three flights covered by the agreement. Under the agreement, Boeing will provide the raw materials and most of the equipment and process some NASA samples. NASA has agreed to integrate the experiment packages, provide off-the-shelf equipment where applicable and provide room and crew support on missions.

Mea culpa, mea culpa

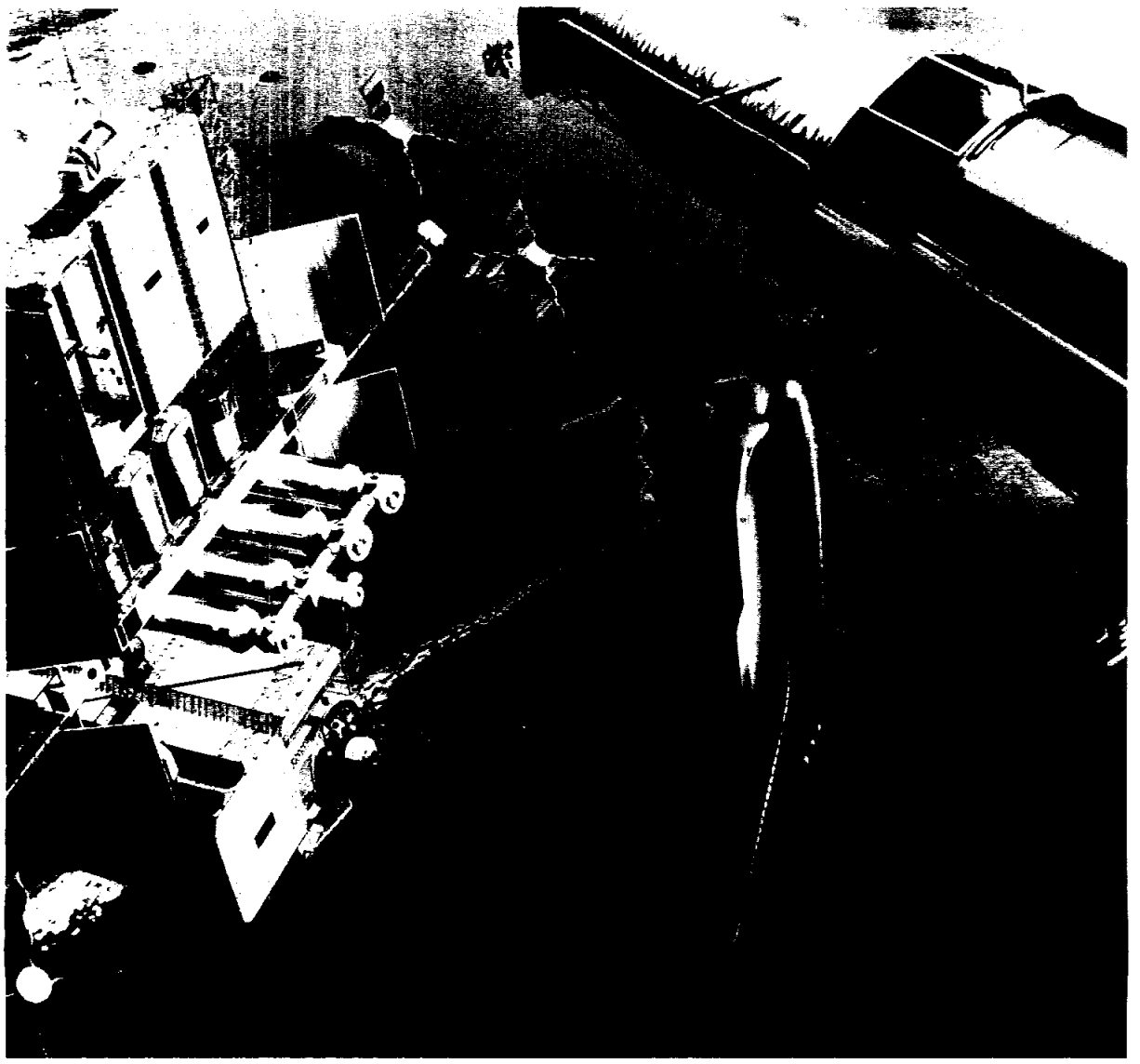
We goofed. In the May 16th issue of the Roundup, a story on the retirement of Pete Armitage said he is the "last of the Canadians at JSC." Not so. There are five employees in NASA — that we can confirm, at any rate — who came down from Canada to join the Space Task Group in 1961. Three of them are still associated with JSC. Burton Cour-Palais, who describes himself as "nowhere near retirement," works in the Space Sciences Branch, Solar System Exploration Division. Leslie St. Leger, another alumnus of the Avro Arrow engineers who came to NASA in 1961, now works in the Structural Mechanics Branch, Structures and Thermal Division. Dave Ewart, the third Canadian still associated with the Center, is Manager of JSC's Resident Office at Downey, California. At least two others are still with the Agency. John Shoosmith is Head of the Computer Applications Branch, Analysis and Computation Division, at Langley Research Center. John Hodge, a former flight director here, is now the Acting Associate Administrator for Space Station at NASA Headquarters.

NASA Update airs

The third edition of NASA Update, a new television program aimed at improving the flow of information to NASA employees, will air at noon June 4, 5 and 6 on JSC's closed circuit television system. The program features former NASA Administrator Tom Paine, who discusses the report of the National Commission on Space and how it affects NASA. The program examines recent Congressional action affecting civil service retirement plans. The program is broadcast every other week over NASA Select and then rerun on JSC's CCTV system. Program content suggestions are encouraged and may be submitted to NASA Mailbag, Code LF, Washington, DC 20546.

Charting the future

National Commission on Space proposes a bold program



A vision of one possible future in space comes from this Eagle Engineering artwork showing a second generation Shuttle as it prepares to dock with a growth version of the Space Station in the late 1990's. At right, astronauts service the Hubble Space Telescope. (Artwork by Pat Rawlings, courtesy Eagle Engineering)

The Presidentially-appointed National Commission on Space has called upon the Nation to establish a step-by-step effort to create a "Highway to Space" and a "Bridge between Worlds" which opens the inner Solar System for scientific inquiry, exploration and enterprise and leads to the first human outposts on the Moon by 2005 and Mars by 2015.

As stated in its report, the 15 members of the Commission want the United States ...

"To lead the exploration and development of the space frontier, advancing science, technology, and enterprise, and building institutions and systems that make accessible vast new resources and support human settlements beyond Earth orbit, from the highlands of the Moon to the plains of Mars."

As mandated by Congress, the Commission undertook a prospective look at U.S. space activities, projecting outward the next 50 years of the Space Age in order to formulate a bold agenda for America's civilian space enterprise. "I believe a basic theme which comes out of our study, and is the heart of the matter," stated Dr. Thomas O. Paine, Chairman of the Commission and a former Administrator of NASA, "is that the American space program will be what America decides to make it."

In issuing the report to both the President and the Congress, Paine explained that "the power of technology is so great, not only today, but as we see it advancing over the next 20 years, that it will be the

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Fletcher calls for new Orbiter

NASA Administrator Dr. James C. Fletcher, speaking before the Board of Governors of the Aerospace Industries Association of America May 22, called for construction of a replacement Orbiter and continued funding for the Space Station.

Fletcher said a failure to meet either objective would have "dire consequences" for U.S. science and technology and the national economy.

Fletcher also said he is worried that continuous criticism of NASA might eventually undermine public and congressional support of the space program and do great damage to the nation.

The text of his remarks follows:

Contrary to what you may have heard, I really was not dragged back to NASA kicking and screaming. It was a simple decision. The President called, reminded me of my duty, and I said: "All right. I'll come."

After less than two weeks as a member of the NASA team, I am very pleased to be back, and I'm confident that with your help we'll get the agency going again.

As NASA's partners in progress for more than a quarter of a century, I know you will agree that it is crucial that we do so, because NASA is more than another government agency. As a symbol of American aspiration and achievement, it is a vital national asset. Indeed, what NASA does deeply affects the way Americans look at ourselves and the way the world looks at us.

NASA's achievements are a natural outgrowth of that unique blend of vision and pragmatism that is the essence of the American pioneer spirit. We go into space to probe its mysteries for the benefit of mankind and to expand our understanding of the forces that created the solar system, the galaxies and the universe.

That is a worthy goal, most appropriate for this great country. And we must never lose our national resolve to strive to attain it.

In coming back to NASA, my top priority is to help ensure that we continue. We cannot afford to lose our momentum. We must continue with Shuttle flights, but only when we are absolutely sure that it is safe to fly. Currently, we believe that we will be able to resume flights in July 1987. Equally important, we must assure adequate capability in our Shuttle fleet and go forward to build a fourth orbiter. And we must keep the Space Station program on track - that is, bring it to initial operational capability by 1994. For the Space Station is the cornerstone of all our future progress in space. Failure to meet these goals clearly would be a blow to our national and international prestige. But even more important, the repercussions of such a blow could set the nation's space program on a very unpredictable and unsteady course. The consequences of that could be very dire, indeed, for the future of American science and technology and the American economy.

In the wake of the Challenger and the expendable launch vehicle accidents, we are making progress in correcting our mistakes. And let

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Lunar soil yields cement

Scientists experimenting with 40 grams (1/3 cup) of NASA supplied lunar soil samples, recently created a concrete product that is stronger than concrete made with Earth bound materials.

Researchers at the Construction Technology Laboratory, Skokie, Ill., studied the strength and characteristics of the lunar sample, to determine its suitability as an ingredient of construction grade cement. Preliminary results reveal that concrete material made from lunar samples achieved a rating of 10,800 pounds per square inch (psi). This figure is greater than the 10,260 psi highest rating of concrete made with Earth materials.

According to Dr. T.D. Linn, Construction Technology Lab's principal research engineer, tests performed on a 1-inch cube and three slabs of lunar concrete provide evidence that lunar material will be useful for building concrete structures on the moon. "We are quite pleased that early results show the lunar concrete is of a higher quality than any developed using Earth materials. In previous tests, over a one and a half year period, using quartz sand, the highest rating attained was 10,260 psi," said Linn. Current ACI (American Concrete Institute) standards require a rating of 4,000 psi for slab and 5,000 psi for column, the most critical requirement in constructing buildings.

Linn said prior to the tests, the lunar soil was examined under an electronic scanning microscope to determine its physical properties and appears to make good concrete material. He added that lunar concrete contained no organic substance as is found in concrete made with Earth materials, which is generally considered an impurity. It was also noted that lunar soil granules are coated with fine dust particles on the surface that creates a vacuum seal when heated. This process further increases the strength of the lunar concrete material.

The lunar soil sample was allocated to the Linn research team by JSC, where the lunar rock collection is housed. The repository contains nearly 850 pounds of lunar material returned to Earth by Apollo astronauts from six manned missions to the moon. According to Curator Dr. Doug Blanchard, "In supplying Dr. Linn and his associates with the lunar sample, we had hoped to study how we might use some of these materials to make a lunar base a viable opportunity.

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Bulletin Board

Blood pressure screening planned

The JSC Clinic will offer free blood pressure screenings for employees during the week of June 9 to 13. The screening clinics will be located in the lobbies of several buildings around the site during the week. Employees from Bldgs. 1, 2, 3 and 100 can be checked from 8:30 a.m. to noon June 9 in Bldg. 1. Employees from Bldgs. 4, 5, 7, 7A, 29 and 35 should report to Bldg. 7A from 1 to 3 p.m. June 9. Employees from Bldgs. 13, 14, 15, 16, 17 and 18 will be screened from 1 to 3 p.m. June 10 in Bldg. 16. Employees from Bldgs. 12 and 30 will be screened from 8:30 a.m. to noon June 10 in Bldg. 30. Employees from Bldgs. 24, 25, 32, 32A, 33, 36, 41 and 49 will be checked from 8:30 to 10 a.m. June 11 in the lobby of Bldg. 32. Employees from Bldgs. 9, 31 and 37 should report to the lobby of Bldg. 37 from 10:30 a.m. to noon June 11. Bldg. 44 employees will be checked in the lobby of their building from 1 to 2 p.m. June 12. Employees from Bldgs. 221, 222, 225, 226, 227, 261, 262, 265 and 266 will be screened in Bldg. 227 from 2:30 to 3:30 p.m. June 12. Employees from Bldgs. 45 and 48 will be checked in Bldg. 45 from 8:30 a.m. to noon June 12. Employees from Bldgs. 416, 417, 419, 420, 422, 423 and 424 will be screened from 8:30 to 10 a.m. June 13 in Bldg. 419. Employees from Bldgs. 321, 323, 325, 326, 327, 328, 329, 350, 351, 352, 353, 354 and 356 will be checked in Bldg. 325 from 10:30 to noon June 13. All Ellington Field employees will be screened from 1 to 3 p.m. June 11 in Bldg. 276 at Ellington. Employees from Bldgs. 8, 10 and 11 can be screened from 10 a.m. to noon and from 2 to 4 p.m. each day of the week in the Bldg. 8 Clinic.

Free health screenings set for June

The Speech and Hearing Institute of the University of Texas, in conjunction with the Bay Area United Way Service Center, will offer free screenings of speech, language and hearing in June. The screenings will be held from 9 a.m. to noon on June 9, 11 and 20 at the Bay Area United Way Service Center. The center is located at 18301-A Egret Bay Blvd. For more information, call 333-9700.

Bicycle Club to meet June 3

The JSC Bicycle Club will hold its next meeting at 7 p.m. June 3 at the Freeman Memorial Library. The meeting will feature a showing of the film "American Flyers." The group is open to all persons with an interest in bicycling. For more information, call Kitty Barnes at 480-9100.

EAA offers Astros tickets

The JSC Employees Activities Association has purchased tickets for two Astros games this summer at the Dome. Tickets for the June 27 Dodger game will be $5 and will go on sale June 9. Tickets for the July 18 game with the Mets will be $7.50, including refreshments, and will go on sale June 30. The seats are on the field level, adjacent to first base for one game and third base for another. The tickets will be on sale at the Bldg. 11 Exchange Store.

Apple user's group to meet

The Bay Area Apple User's Group (BAAUG) will meet at 7 p.m. June 9 at the Clear Lake Park Bldg. on NASA Road 1. The group will discuss organization of the club, and the meeting will include a demonstration of APPLEWORK's Spreadsheet. For more information, call 538-1854.

BAPCO to meet June 17

BAPCO, the Bay Area PC Organization, will meet June 17 at 7:30 p.m. at the Holiday Inn on NASA Road 1. The group is open to all persons with an interest in microcomputers. BAPCO meets regularly on the third Tuesday of each month. For more information, call Earl Rubenstein at x3501 or Jack Calvin at 326-2983.

Viking 10th anniversary planned

Ten years after Project Viking sent two probes to Mars, members of that effort are planning a reunion at the Langley Research Center. The reunion will be held Saturday, July 19. For information or reservations, contact Jesse Timmons, Mail Stop 433, NASA Langley Research Center, Hampton, VA 23665, or call (804) 865-4621.

Juneteenth Picnic planned at Rec Center

A picnic to celebrate Juneteenth Day will be held beginning at 11 a.m. June 19 at the Gilruth Recreation Center Pavillion. Juneteenth is a celebration of the day in 1863 when word of the Emancipation Proclamation reached Texas. The agenda includes continuous music by Flash Productions, a short program, food, games and prizes. Tickets are $5 until noon on June 12, and $6 thereafter. No tickets will be sold after June 17 or at the picnic. For tickets or more information, call Carolyn May at x4441, Vic Holloman at x3533, Jackie Wilson at x3221, Joeva Ross at x2811, Vergis Bourgeois at 280-2400 or Louto Braquet at 333-6484.

EAA plans rafting trip on Guadalupe

The Employee Activities Association will sponsor a rafting trip down the Guadalupe River on Saturday, June 28. Tickets are on sale in the Bldg. 11 Exchange Store. The price includes the bus transportation, the raft trip itself, BBQ beef dinner, and a country and western dance. Rafters may also choose all of the above but skip the dance. Tickets are $31 per person, or $26 without the dancing. About 45 tickets are available in either category. For more information, call x4814.

Two die in aircraft crash

The many friends of Payloads Officer James R. Simons and Astronaut Stephen D. Thorne were saddened during the Memorial Day weekend to learn of their deaths in an aircraft accident

Simons, 39, and Thorne, 33, were flying in a Pitts S-2A biplane over north Galveston County May 24 when the accident occured. The aircraft owned, and piloted by Simons, suffered a mechanical failure during an aerobatic maneuver and crashed approximately 50 feet from a house near Runge Park, in Alta Loma, according to Sandy Dougherty, field investigator for the National Transportation Safety Board's Dallas Office.

Thorne, a Lt. Commander in the U.S. Navy, was a member of the Astronaut Class of 1985.

He came to JSC from the Naval Air Station at Cecil Field, Florida, where he was Squadron Aviation Safety Officer with Strike Fighter Squadron 132. Thorne was graduated from the U.S. Naval Acadamy in 1975 with a B.S. in engineering. He is survived by his wife, Sue, and his parents, Mr. and Mrs. James H. Thorne of Anderson, South Carolina.

At Roundup press time, funeral services for Thorne were scheduled to take place May 30 at Arlington National Cemetary.

Simons flew jet aircraft for the U.S. Air Force, the U.S. Navy and, most recently, U.S. Marine Corps Fighter Attack Squadron 112 in Dallas. He was a member of the USAF Thunderbirds aerobatic team from 1974 to 1976 and flew in more than 200 aerial demonstrations. He came to JSC from the Langley Research Center in late 1981.

Simons is survived by his mother, Mrs. Agnes Simons Abbott, and his stepfather, Mr. Rulon Abbott, of Lewiston, Montana. Burial was May 29 in Lewiston. A memorial service was held the same day at Clover Field, outside of Friendswood, where Simons kept his aircraft. His family asks that contributions in his name be made either to the Wings of Hope, Inc., 2319 Hampton, Suite 105, St. Louis, MO 63139 or to Boy Scout Troop 956, 16438 Millpoint Drive, Houston, TX 77059.

Charting the future

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decision of America, and the leadership that we provide to the rest of the world, that will determine what the world of the 21st century will be like. We're not predicting it, we are simply trying to say what we can make happen."

To develop a new long-range civilian space program, the Commission proposed a future-oriented civilian space agenda with three mutually-supportive thrusts:

- Advancing understanding of our planet, our Solar System, and the Universe;
- Exploring, prospecting, and settling the Solar System; and
- Stimulating space enterprises for the "direct benefit of the people on Earth."

These thrusts were judged by the Commission to be of comparable importance. To accomplish them economically, the Commission said America must make a long-range commitment to two additional thrusts:

- Advancing technology across a broad spectrum to assure timely availability of critical capabilities; and
- Creating and operating systems and institutions to provide low-cost access to the space frontier.

The Commission said new economical cargo and passenger transport vehicles would be needed for trips to low Earth orbit, augmented by the addition of a transfer vehicle for destinations beyond. These three systems would be available in conjunction with an "Earth Spaceport" — a transportation point in space for passengers and cargo — within 15 years. By the year 2000, robotic lunar surveys would have begun, with one objective to look for hidden caches of water, frozen at the lunar poles. Following these unpiloted investigations, lunar outposts to support astronauts would be established by about 2005, leading eventually to permanent bases on the Moon. The stretch to the planet Mars and its moons by astronauts would begin a decade later, the report said.

To accomplish these milestones, the Commission envisioned an evolutionary network of spaceports near Earth, orbiting the Moon and Mars, and in a special location between the Earth and Moon, known as a Libration (L1) Point. Connecting the L1 Spaceport and the spaceport circling Mars would be "cycling spaceships," continually traveling between the orbits of Earth and Mars. The cycling spaceships, constructed similar to the spaceports, would allow routine access to the planet Mars. The Commission emphasized that a U.S. return to the Moon and expeditions to Mars should not merely constitute brief expeditions, but set the stage for longer, systematic explorations — "eventually we will come to stay."

The proposed evolutionary steps as envisioned by the Commission can be realized within reasonable budget levels in an expanding economy, the commissioners contend. They said that their proposed 21st century civilian space agenda is an investment which will remain below half of the highest percentages spent on the civilian space program during the peak Apollo years.

"In view of the increasing significance of space and the critical economic importance of U.S. scientific and technological preeminence in the next century, we believe that these estimated levels of expenditure are reasonable in relation to the expected benefits to our Nation and the world," the report said.

Three specific changes to improve the management of America's civilian space program are recommended in the Commission report. These are:

- Twenty-year civilian space program and 5-year budget planning to establish long-range goals and budgets for review and decision by the Administration and the Congress.
- Multi-year procurements to replace year-by-year funding, with firm decisions that eliminate annual changes which have proven very costly to NASA and its contractors.
- Two-year overall approval of civilian space budgets by the Office of Management and Budget and the appropriate Congressional committees to replace annual line-by-line auditing.

In addition, the Commission recommended reestablishment of a National Aeronautics and Space Council (as provided for by Congress in the NASA Act). This council would be part of the White House organization and would develop the strategies and subsequent plans for new national space goals, "ensuring prompt and effective cooperation and coordination among the Government agencies and departments responsible for the overall progress of America's space programs."

The Commission said that collaborative efforts can help America fulfill its goals in space sooner and less expensively.

Calling the Solar System "our extended home," the Commission said that "... space technology has freed humankind to move outward from the Earth as a species destined to expand to other worlds." As part of the rationale for exploring and settling the Solar system, the Commission asserted. "With America's pioneer heritage, technological preeminence, and economic strength, it is fitting that we should lead the people of this planet into space. Our leadership role should challenge the vision, talents, and energies of young and old alike, and inspire other nations to contribute their best talents to expand humanity's future."

The Commission said that the value of the report "rests upon the extent to which its recommended space goals for 21st century America are adopted and acted upon." If the decision is made to proceed on the civilian space strategy as outlined by the Commission, the detailed review, planning, and budget preparation should be carried out by NASA in consultation with other agencies, the Commission said. The Commission has recommended that the President and the Congress direct the Administrator of NASA to review the Commission's findings and proposed space agenda, and by December 31, 1986, to recommend a long-range implementation plan, including a specific agenda for the next 5 years.

"It is the view of the Commission that the immediate benefits from advances in science and technology and from new economic enterprises in space will be many and varied," the report said. "In removing terrestrial limits to human aspirations, the execution of the Commission's proposed space agenda for 21st century America will prove of incalculable value to planet Earth and to the future of our species."

Lunar concrete studied

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The results from Dr. Linn's investigations are very interesting. The fact that lunar cement behaves like high quality concrete made with Earth materials proves that it apparently works."

NASA planners anticipate a return to the moon after the turn of the century and the establishment of a permanent lunar base. Such a facility would require a variety of construction techniques designed for longterm life support in the harsh environment of the moon.

Emphasizing the results are preliminary, Dr. Wendell Mendell, JSC planetary scientist said, "these results, while they are preliminary in nature, are extremely interesting. We want to see what additional conclusions can be obtained from further examination of the data." Explaining the significance of the lunar soil tests, Dr. Mendell said, "Concrete is one of several materials being considered for building on the moon. If you can make a brick on the moon, you save a great deal of money. That's a tremendous incentive for learning to use lunar materials."

The proposal to study lunar soil as a possible source of building materials was made by the Construction Technology lab in 1984. The Lunar and Planetary Sample Team, a peer review panel which advises the lunar materials program at JSC, reviewed the proposal and approved providing the lunar sample for study in the fall of 1985.

The Construction Laboratory is a non-profit research facility sponsored by the Portland Cement Association. Results from the lunar soil tests will be made available to the general public.

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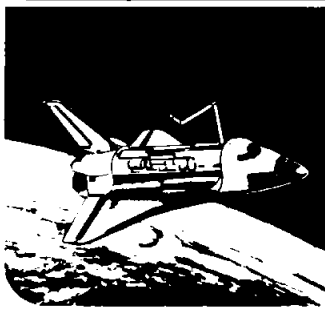

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Editor . . . . . Brian Welch
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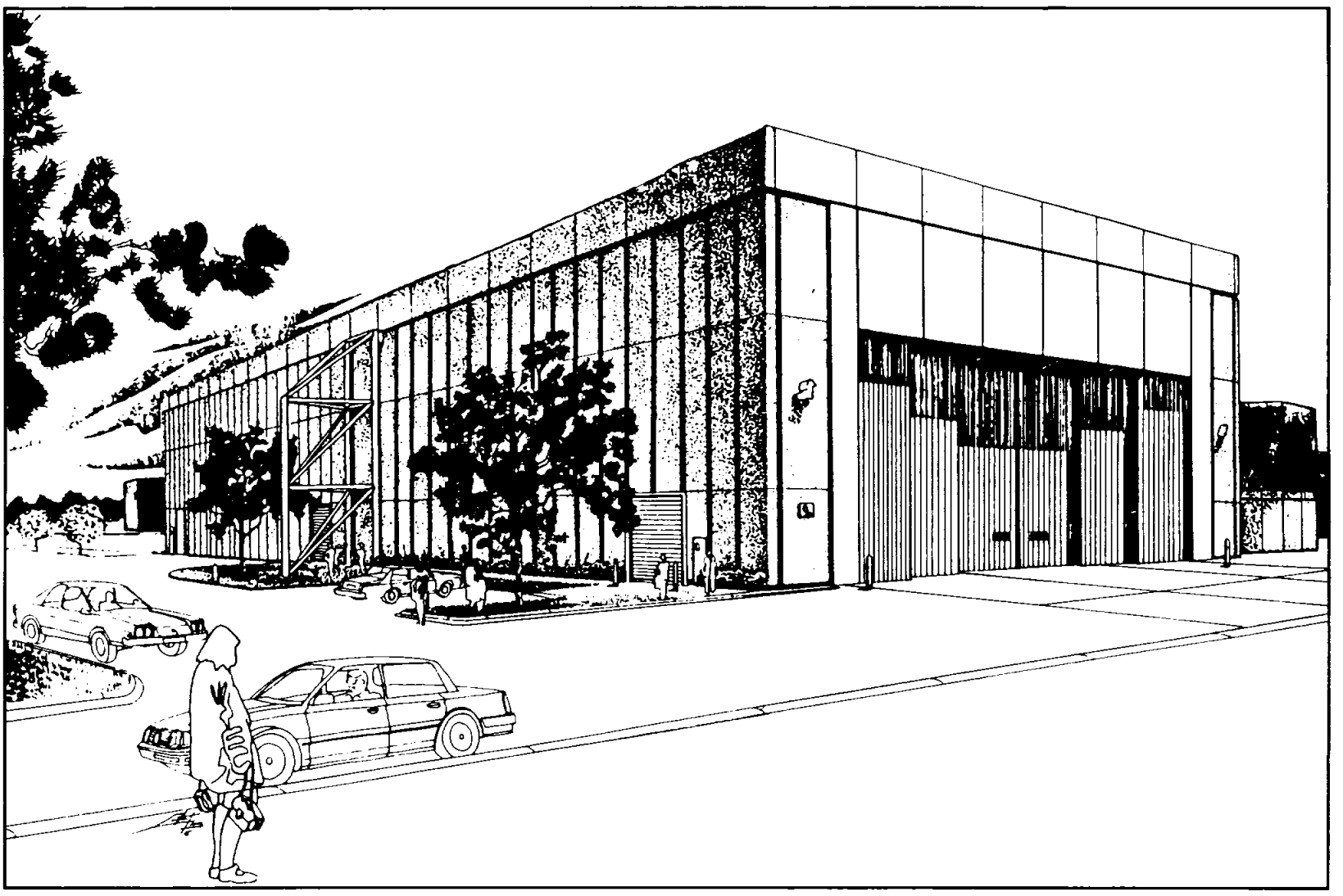
Work to commence on 9B

Bldg. 9A addition will house Space Station mockups and trainers

By Barbara Schwartz



As the world watched over their shoulders in December, Mission 61-B astronauts Woody Spring and Jerry Ross assembled truss-type structures in space and the feasibility of Space Station construction became a reality.

A major part of the training activities for the EASE/ACCESS experiments was done in facilities of the Mockup and Trainer Section of the Man-Systems Division.

Extensive training of multiple astronaut crews will be necessary for Space Station assembly and habitability, and now a final design contract has been let for a facility to house Space Station training articles and systems. The new building, designated 9B, will be an extension to the west end of Bldg. 9A, which houses the Shuttle Crew Compartment Trainer and Full Fuselage Trainer, the Manipulator Development Facility (MDF), and the air bearing floor, plus mockup payloads, sunshields, and other training equipment.

John Robert Smith, a senior mockup trainer engineer in the Mockup and Trainer Section, has the responsibility for coordinating the design and building of the new facility which he expects to be completed by December 1987.

Smith said an IOC (Initial Operational Configuration) Space Station trainer, consisting of several modules with connecting units, a mobile remote manipulator development facility (MRMDF), and single systems trainers will be in place and ready for training exercises at least two years before Space Station is planned to be assembled on orbit.

"Some things are already available to us (for Space Station training), like the twin module assembly in Bldg. 15. We have some WETF (Weightless Environment Test Facility) neutral bouyancy hardware being manufactured in Bldg. 10 by the Technical Services Division. We will be using the MDF, the air bearing floor, and the precision air bearing facility during the early stages of Space Station assembly training," Smith said.

Since Space Station is still in the design phase, the IOC trainer is likewise a representative design which will probably change with maturation of the Program. One module of the trainer will be for habitability operations, another will be a laboratory, and other modules will represent those planned by the European Space Agency or the Japanese space program.

There will be nodes that act as connecting units. A logistics module, which will store Space Station supplies, will be attached to the system. There will be some airlock capability for EVA ingress/egress activities. The modules may be rearranged into various vertical and/or horizontal configurations as training requirements necessitate.

Spar of Canada, the company that built the Shuttle's Remote Manipulator System (RMS), is designing a similar arm system, the Mobile Service Center (MSC), for use on Space Station. The MSC will be an RMS on a mobile platform that will be able to move along the Space Station truss. A similar training system, the MRMDF, will be designed and built for the new training facility.

Using light weight mockups (inflatable balloons), the MDF (in 9A), and the MRMDF (in 9B), astronauts will be able to practice assembly-type tasks, transferring a payload from the Shuttle payload bay to the Space Station truss and connecting modules. "It will be a scheduling headache for the people in MOD (Mission Operations Directorate) to put all that together, but I can see Shuttle crews working in conjunction with Space Station crews doing coordinated activities," Smith said.

An airlock and node trainer is also planned. A node may have an elevated cupola on top where a crew member would have 360 degree vision which would be beneficial for operating the MRMDF controls in that area. There will be other special systems trainers, or part-task trainers, to support health maintenance activities such as personal hygiene or food preparation or to run through procedures development without disturbing large integrated exercises in the other trainers.

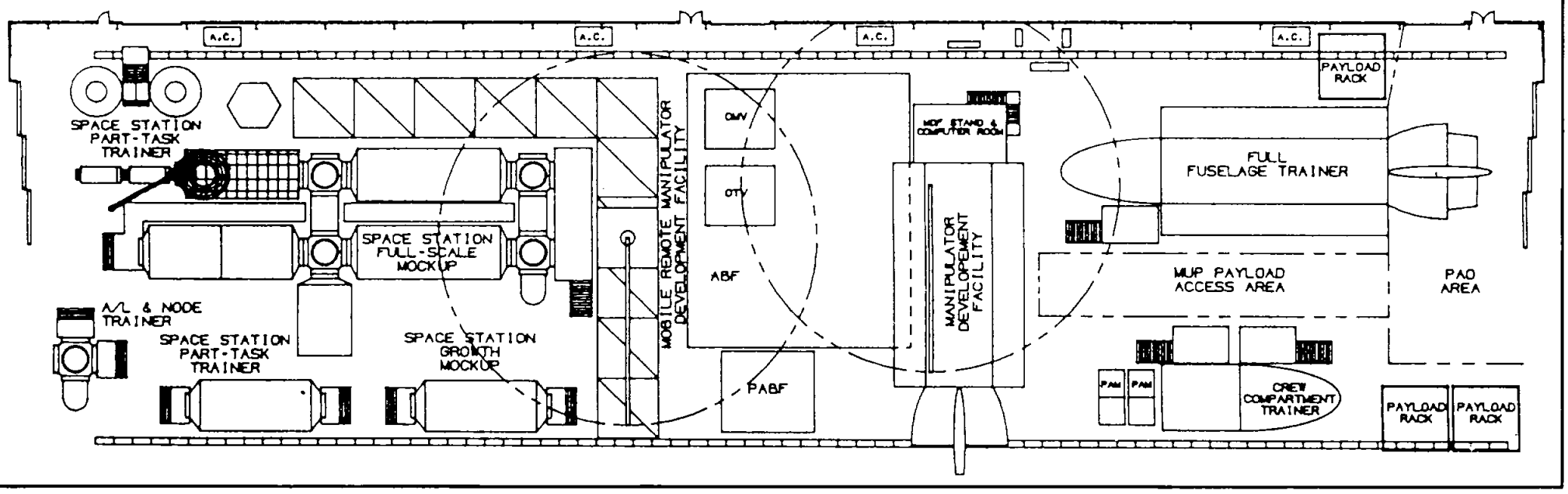
John Trebes, Manager, Space Station Mockup and Trainer Facility, will be responsible for developing the IOC mockups and trainers.

There are several ways to have the mockups and trainers designed and built, he said. Early in the development stages of the Program, low fidelity mockups are designed and constructed. As the Program matures, low fidelity mockups may evolve into high fidelity trainers. In some cases, a trainer is purchased outright from the prime contractor. Johnson Engineering Coorporation, one of the Section's support contractors, may make drawings from narrative descriptions, sketches, or data provided by Trebes and may build the hardware in their shop. Other options are having the Technical Services Division fabricate the trainer, or the total design and fabrication may be subcontracted out.

Most training activities in Bldg. 9A are scheduled during normal duty hours. Occasionally, a flight crew will practice a night run on the MDF after 5:00 p.m. with the lights out. Mission Specialist Mary Cleave trained that way for STS 61-B. A small crew works second shift to do configuration changes for the following day's activities, removing the galley or bunks or adding television equipment. The same type of operation is planned for Space Station training in the additional facilities. Unfortunately, the WETF will not have the convenience of growing their facilities to accommodate the addition of Space Station training. WETF will probably work second or third shifts on a routine basis in the future.

Trebes in the Space Station habitable module mockup in Bldg. 13.

The floor plan below illustrates how the Shuttle mockups in Bldg. 9A and the Station mockup in 9B can work together. The dotted-line circles in the center of the drawing represent the limit of reach of the present Shuttle Manipulator Development Facility and the future Station Mobile Manipulator Facility. A mock payload from one can be handed off to the other. Bldg. 9B will also include a mockup of the Station trusswork, and the mobile RMS will be able to move about on that truss.



Interview

Dr. Kathryn D. Sullivan

A candid discussion of our present and future on the way to space

"The debate has matured," she says, and that is why the National Commission on Space had the luxury of being able to provide America with a credible plan for the next 50 years of space exploration. The Commission did not, Kathy Sullivan notes, have to first convince Americans that we should do anything at all. Sullivan, an astronaut since 1978, was the only current NASA employee on the Commission. She was the first American woman to perform an EVA and is Adjunct Professor of Geology at Rice University. In the following wide ranging interview, she discusses the Commission's work and just some of the issues that were dealt with in the last year.

Roundup: How would you describe this whole process of charting the next several decades of space exploration?

Sullivan: I think the process has been a very interesting one. For the people actually doing the exercise, it has been a matter of determining how bold to be. You agonize a lot over whether you should be very bold about what could happen in 25 years, even given that you can't foresee any major breakthroughs. You are being bold on extrapolating trends you already know of. You realize you are always blind to the thing that may come in out of left field and totally change the outlook. And on the other hand, you can't be involved in something like the NASA program in the 1980s and not be aware of the political situations and the budgetary situations that are probably going to mean that all that could happen technically will not in fact happen. The only real legitimate constraint we had was that we better not violate the known laws of physics. Our leader, Tom Paine, reminded us frequently that historically, the only people who have come anywhere near doing a reasonable job guessing what would happen in something like 30 or 50 years away from their own time have been those who would go to scientists and engineers and not ask what will happen, but would ask what is physically possible. What does physics permit? And then it's just a question of the rate at which you approach those developments.

Roundup: It looks as if one of the yardsticks used was gross national product and extrapolations of that, as kind of a governor of where you think these developments could take place.

Sullivan: Yes we did. And there are a lot of people who will probably criticize that. It came around fairly late in the game, actually. What we finally came down to was that if you go off and talk to the space science community, the would-be commercial space community, the planetary probe folks — not just the hardware people, but the more diverse user groups — it's clear that there is a lot that everybody can see out there in their own areas. Things that are important to do, important to know, important aspects of the frontier. Virtually everybody in each of those fields also sees as part of the reason for continuing the economic impetus that their fields of development would give to the country. They told us how those stimuli would affect America's competitive posture in the world economy on into the 21st Century. Everybody is distressed and worried at how we seem to have created industries like automotive and steel and then totally lost our edge. A lot of people currently active in the space field are flat out worried that we are in the process of doing the same thing in space through either lack of leadership or guidance or perseverance or commitment or whatever it may be. So everybody has a big agenda of really exciting and challenging things, and everybody can show important economic and technological stimuli for the country, and many believe the pattern of educational stimulus that the post-Sputnik startup of the space program represented could happen again. They believe it must happen again, because we are in a crisis in scientific and engineering education in the country today. That is well recognized by, you name it, the National Science Foundation, the National Research Council, all of the Academy of Science boards, and everybody is lamenting about this terrible situation that we are in from an educational point of view. Everybody wants to find some set of stimuli that can begin to change that problem. Space was the source of one great surge in the past, and many people believe it is the one we ought to look to for another great stimulus now. So the synopsis of all of this is, after you list all of these different groups and see all of the items on the agenda, unless you are just a staunch critic and naysayer to space activities, you become convinced that there is great potential to make really important things happen in the country through space expenditures, and that it ought to be an investment we accept as a needful and important one for our future and therefore ought to have some sort of standing other than arbitrary/discretionary. We came to believe that strongly that these thrusts are important enough for the country that we ought to stand behind them to the degree that we would argue they are worth a fixed and yet modest percent of GNP, and not just an annual, whimsical level. NASA's budget right now, of course, is handled under a committee that deals with HUD and other independent agencies. It is in the discretionary portion of the budget. It is not an entitled agency. And we are basically saying we think the work the Agency supports and underwrites and leads and fosters is important enough that it ought to receive a more consistent budgetary treatment. The country's future, and its ability to compete in world markets, is increasingly tied to science and technology, both for good and bad. And that means, in my opinion, that you need not only an adequate number of specialists in the field, but you need a public — governing officials, businessmen, lawyers, school teachers, community leaders — a whole country of people who are more up to speed about how science works, how scientists come to conclusions, how they take an abstract idea and turn it into a machine, how statistics come out looking like thus or so. And I think right now, if you look at minimum exit requirements for U.S. high school students, it's clear that the problem we have really begins in the very earliest grades. We are content, evidently, with really a very low standard of general public science literacy. I think that is going to hurt us in the long run. There is a fairly distressing study that came out recently from the American Association for the Advancement of Science that surveyed comparative test results and school curricula content of U.S. students and other countries. And they concluded that we are settling for much less in the way of basic familiarity with mathematics, with how science does its business. The more distressing part of the study was a poll of parents. They, by and large, were satisfied. They thought their children's schooling was rigorous enough and was giving them enough. And yet, looking statistically at how the U.S. system is performing, I can't accept that position, I don't believe we are performing adequately, and it is therefore very distressing that the people who ought to be asking for more, the children's parents, are quite content.

Roundup: And some of the same futurists the commission may have dealt with are saying that a fundamental change is on the way, that the entire nature of the U.S. economy is shifting from providing consumer services to providing information services.

Sullivan: Yes, we got some very interesting presentations from the Department of the Census, which are recapped only very briefly in the report, about those demographic trends. Numbers of people, sectors of activity, amounts of discretionary income available, and so forth, and if their data is anything like correct, it is clear that the country is heading that way. We are still producing vast amounts of food but the acreage under cultivation and the number of people directly involved in that sort of work are diminishing. Factory jobs, medium and low skill type of jobs are all predicted, essentially, to decrease in the next several decades. That says our populations skill mix must change or we will have an incredible unemployment problem. I don't believe that we should or can disenfranchise a whole bunch of Americans just because one sector of the economy is going to move ahead of others. We need to be forward looking, we need to identify problems, we need to come up with solutions and stick to them. And probably the biggest problem, if I were to identify some one factor that was a big American problem in facing these issues, is that our track record on sticking with things past the point that they are flashy and fun, and on into the point where they are basically drudgy but still important, is really poor. We just love to pick up a toy and play with it for awhile, realize it has a few flaws, and then drop it completely and jump to the next neat toy. On paper, the next neat toy always looks wonderful at the point in time that you are getting disillusioned with the current toy. The Shuttle looked glowing on paper in the early 70's, much better than any Apollo hardware could be, a tremendous thing to do, all things to all people. And of course it is not all things to all people. It's not as bad, I don't think, as many people are saying today. It is an important step in a family of research vehicles and we need to recognize that it is one learning step on what has to be regarded as a progression. There will be fits and starts, there will be errors occasionally, sometimes policy errors and sometimes really bad technical errors, but we have got to understand that staying power is required.

Roundup: A hypothetical JSC employee might say to you, 'Kathy, I've been reading the papers and watching the news since January, and it really looks grim for the Agency right now. I'm concerned. Where are we going? After your experience, is there anything you can say that can convince me the Agency still has a future?'

Sullivan: I don't have an ironclad answer. We grappled with the issue of whether NASA was an element of the equation that we needed to write for the future. And we thought that a legitimate question when we started this exercise in March of 1985, long before the Shuttle accident. Current policy seems to have a clear role for military space activities and commercial space activities, but it's not clear what the proper role for a government civilian space activity is. It has been a matter of great debate, and every opinion you can imagine has been expressed. But we felt that the substance of the Space Act of 1958 is still valid. That was the consensus of the members of the Commission. In the current climate, I would agree with that hypothetical JSC employee. There is a very strong threat at this point in time to the continuity of NASA as an Agency. There probably are a number of people who see an easy answer to be to give the military what they need and to give the private sector the rest of it. I disagree with that for a couple of reasons. One is that a whole bunch of the objectives and goals and possibilities we outline in this report are far beyond the scope of anything a commercial enterprise would undertake, and they are well out of the realm of what the military would undertake. There are important things to do that are proper for a civilian, government R&D agency. The second thing that is important to me, as an American, is my belief that it has always been significant that we have had a strong civilian manned program. It seems to me an important statement, an aspect of our national character. There is a meaning there to NASA that is very important, and now we see that there are many important things to do. I would hope that this document might, if nothing else, serve to demonstrate that there are too many reasons, too many good things to do, to lightly dismiss what we have in the way of talent and expertise in the Agency. What NASA's proper — or allowed — mix of activities from here on will be is another subject. We need to be open to, and to a degree expect, that there will be considerable change in what we have seen as our charter and what we have seen as our reason for existing. The only way to deal with that is the way the Agency has always prided itself on dealing with things: to look at this time of drastic flux as a set of great new opportunities if we are alert and flexible and willing to capitalize on them, rather than as a great defeat and a giant setback and a slap on the hand.

Roundup: What are some of the things you remember from the public sessions? The commission held, what, 15 all over the country, didn't it?

Sullivan: That's right. A couple of things struck me. One of them was that I remember back in the 70's when the debate about space was whether we should be doing any of this stuff or not. It was a yes, no, stop or start debate. I didn't hear any of that as we went around the country. I heard a lot of suggestions about what we should do, when we should do it, who should do it, but I heard no questioning of whether we should be doing these things. Now, I won't claim that we did a scientific poll or sampling of all U.S. public opinion by any means. All I will say is we went to 15 cities, we advertised equally in all of them, we basically said, 'Anybody is welcome to come say anything they would like about space and the country's future.' That is an equal option for somebody who would be strongly opposed as it would be for someone who would favor it. So it has to be significant that we got no negatives, we got no demands that space exploration stop. Another consistent theme from the public was the educational motivation. The debate has matured. The generation that is now in its mid-career, and everybody behind that generation, has never known a time when there was not civilian manned activity in the United States. The generation that is in its late 20's to late 40's grew up in the Apollo crescendo, and by and large, liked it and was proud of it and saw all of the things that it was doing for the country. At least the people we heard from wanted to know that was going to continue. If they were sad or distressed about anything, it was that we peaked that one time and it didn't seem like anything was ever like that again. And if they had kids, they often said they wanted to know their kids were going to have as challenging and exciting a set of events in the country as they had had. There was a farmer in Iowa who took off from a day of plowing and drove all the way across the state to tell us that space has nothing to do with his daily life, except for bringing a weather satellite picture to his evening news, but that he was interested in what was happening, he'd like to stay informed about what was

(Continued on page 5)

(Continued from page 4)

happening, he believed in its importance to the country, and he wanted us to know that even the 'outsiders' understood and cared and wanted it to go on. We got that kind of message from many, many people. That is a significant point, although it is not a scientific opinion survey. There is another aspect of that, which I think is significant to the Agency and how we try to deal with the public. There is a decent segment of the public out there that is quite informed. And a large number of them are distressed that they can only get quickie little cheap bits of information about what NASA is doing. They would like to get more substance. They would like to know where to really find out things that are happening. They think NASA should be telling them better things, and the 15-second shot of the Shuttle lifting off every now and then, if the news guys deem it worthy of carrying, bothers them. And it was hard to sit there and listen to that. I know how much this Agency does in outreach programs and media programs and PAO programs and it was hard to sit and listen to that resounding criticism, many, many times, and not feel defensive. I know there are a lot of people in this Agency that really work hard and yet I don't think I ever heard people coming in and talking about materials or information they had gotten from NASA. It was always this lament that 'You guys are sitting off in a corner and you don't even tell us what is going on.' And if I would counter and say well, there are films and there are books and there is this or you could write here, they would say. 'Well how come I had to wait until you came to find out that NASA does this or that? How come I can't find that out?' I'm not trying to assign blame to either NASA Public Affairs or to the media, but the net effect has been that very cursory, very shallow information has been all that's been getting through. I don't underestimate — I know — the challenge that lies behind the simple statement of 'Communicate more substantively with the public.' It's a loaded sentence and I know that. But if we don't accept it as a challenge and really work on it as a challenge in our PAO and outreach programs, we will never solve that problem. We will not solve that problem by, and here I go getting fired, but we won't solve that problem by visiting celebrity astronauts. It won't happen. This links up with the educational issues we discussed earlier. We need to keep a close watch on our efforts to work with the youngest levels of children, the youngest grades. Space is not a panacea, it is not by any means the only thing kids should be studying. It can be a motivational tool, but it ought to make them appreciate how many amazing things they can do if they get good at science and math, not a motivational tool to maybe win a ticket on the Space Shuttle. We need to really work on that foundation. We need to motivate parents to understand how it is important for their children to have that foundation. Not because it entitles them to a quick and easy fun ride, or because it entitles them to wear a blue suit, but because it will open more options to them than they can imagine. It will given them possibilities for a rewarding and satisfying professional life.

Roundup: One woman in the public sessions said, 'I don't care if I get a better microwave out of this, or if my teflon works better. The fact is we should just do it to do it.' The Commission seems to be saying that in a lot of places.

Sullivan: In a lot of places. That is one of the fundamental underpinnings of our conclusion and it is sort of implicit in our report, that there should continue to be a NASA. There are things we should do just because we ought to do them. We ought to continue to quest, to know, to understand. We will undoubtedly stumble on to new discoveries and new technologies that we can't predict today. They will radically change some of the equations of our daily lives. That is an article of faith for almost any scientist or technologist. It is a very difficult thing to defend, because nobody can tell you what it is or when it is coming. Nobody can even tell you what program has a higher probability than another of finding that breakthrough. That's what makes the politics and budgets so hard. But I believe that core of science and exploration can work very happily with commercial enterprises.

Roundup: In the present climate, some might say we could have saved ourselves a lot of problems, perhaps lowered the political expectations, if we had given the Shuttle an X number, the X-25 for instance, rather than calling it the Space Shuttle, and that indeed is what is happening with the Aerospace Plane today.

Sullivan: It is foolish to believe that the current Shuttle vehicle could, with a magic snap of the fingers, be turned into a fleet aircraft. If you have an X-15 at one end of the scale and a 727 at the other end of the scale, the Shuttle will always be somewhere towards the X-15 end of dead center. It will never be, and shouldn't be viewed or operated as, a fleet vehicle. It's a good thing to strive to, it's a good thing to critique the current program and operations to see where we are falling short. And in the next generation of the Shuttle, we can then think about how we might move ahead to make it more like a 727. The Aerospace Plane is a very exciting potential future vehicle. I have one real concern about it. It gets back to our American tendency to like the fancy new thing and get kind of bored with the old thing. I am skeptical about all of the various highly advanced new technologies that an Aerospace Plane embodies. Properly proving and analyzing them, in the timeframe that would allow it to become the very next generation vehicle after the current Shuttle, will be difficult. And on paper, the Aerospace Plane looks glowing. It can easily take a couple of hundred pounds of cargo at $20 per pound to orbit. And if you stop and look at that, you could probably imagine a very successful SCRAM-JET air-breathing engine development program that goes miles and miles towards advancing that technology. But unfortunately, it might also happen to reveal that the way things all scale out, a reasonable vehicle weight and size and so forth, when you add the engine factors in, is only going to attain Mach 12. Now that may yet be a very useful vehicle technology, but it ain't no longer an orbital vehicle. And if we have hung our entire space future on that vehicle, coming right after Shuttle, we can leave ourselves exposed to another very significant gap in orbital capabilities. We wrestled with that a lot in the report, and I argued very strongly, and ultimately wrote in the day the manuscript went to the publisher, that the most important government policy for civilian space activity should be that there never be a hiatus in access to space for civilian purposes. Everything other than that is wishes. We would like there to be a commercial enterprise, we would like there to be fleet-type operations, we would like the cost to come down. But the cost coming down is a technology program, it is not policy, to my knowledge. We really need to see that. There is a hue and cry now about how terrible and disastrous it is to be incapable of confidently getting into space. We need to keep that in mind as we move toward future vehicle developments, and be sure that we don't short shrift the current beat up pickup truck just because it is kind of old and we are tired of it. I'm very concerned about that issue. I think it is one of the most significant policy and program management issues for the next 15 or 20 years.

A supply ship takes off from a Mars base in this Robert McCall artwork which accompanied the report of the National Commission on Space. (Copyright 1986, Bantam Books, Inc.)

Roundup: When one listens to all of the talk, it does seem amazing that this country, after the almost violent SST debate of the early 70's, and with the benefit of having watched the Concorde operate at a deficit for most of the last decade, is now starting to see the Aerospace Plane as fact. After one Shuttle accident, people seem to be saying that the Aerospace Plane will be flying by 1995 and therefore all we have to do is keep the present three orbiters flying until then and not build any replacements.

Sullivan: It's two separate things. The Aerospace Plane is going to happen, probably should happen, but it should be an X vehicle. And the X-vehicle ought to fly to see what all we can learn by the early 90's. And only then will we be able to determine what improvements or how many years or how much additional effort is needed to make it some kind of follow on space vehicle. The answer might be no, it won't work. I believe we must be prepared to invest whatever resources humanly and economically are required in all of those intervening years to keep an appropriate fleet of vehicles active. That will undoubtedly be a mixed fleet. We have got to have continuous access to space. We are falling further and further behind just in understanding what questions to ask in space by virtue of not being able to be there routinely.

Roundup: And by historical analogy, run a grave risk of being the Portugal of spaceflight.

Sullivan: Or the China. We had a lot of debates about the Space Station too, and I'll lay this on you as another way to get myself fired. There are a lot of people asking a lot of critical questions about the Space Station right now. I think it is appropriate to be very cautious, to be questioning very strongly what we are trying to do and how we are trying to do it. We need platform in space that provides, at a minimum, periodic manned visits. We need that desperately. There are 18 ways from Sunday to get there. There have been proposals for extended stay time packages for the Orbiters, there is the present Phase B Station baseline and there are other ways to do it. Critics of the Station say we are trying to go gold-plated Cadillac, all things for all people. Our charter on the Commission was to accept the current Shuttle and Space Station as givens. So we purposely did not indulge in any Station criticisms. But I do think it is important to remain open and keep questioning what we are doing and how we are doing it. We must not lose sight of the ultimate objective. Don't let how you think you want the program to be cloud your judgment. Now the report identifies a number of scientific priorities that we consider important, and for them all, some sort of long duration station capability is critical. An example would be that we are in no position to commit humans to extended stay times in zero g given our current state of knowledge of zero-g physiology and long term effects, and in our understanding of how we would provide health care. It could be the answer to the zero-g question for the Mars mission, for example, is that there is a wonder drug we are just about to find, or that we don't have to provide full Earth gravity. It could be that the bad side effects of prolonged zero-g are leveled off or reversed at some fractional g level, or at some percentage of time at that level. If we only start to ask those questions when we think we want to be six months away from launching a mission to Mars, we won't get there. We won't know. That is a precursor question. You need proper data and studies in hand early. Again, there is not a particular space station that is magically the only one that can meet those needs. But some capability for extended duration experimentation in space is clearly needed, and soon. And that should be our objective.

Roundup: There must have been some real firefights within the Commission over issues such as this.

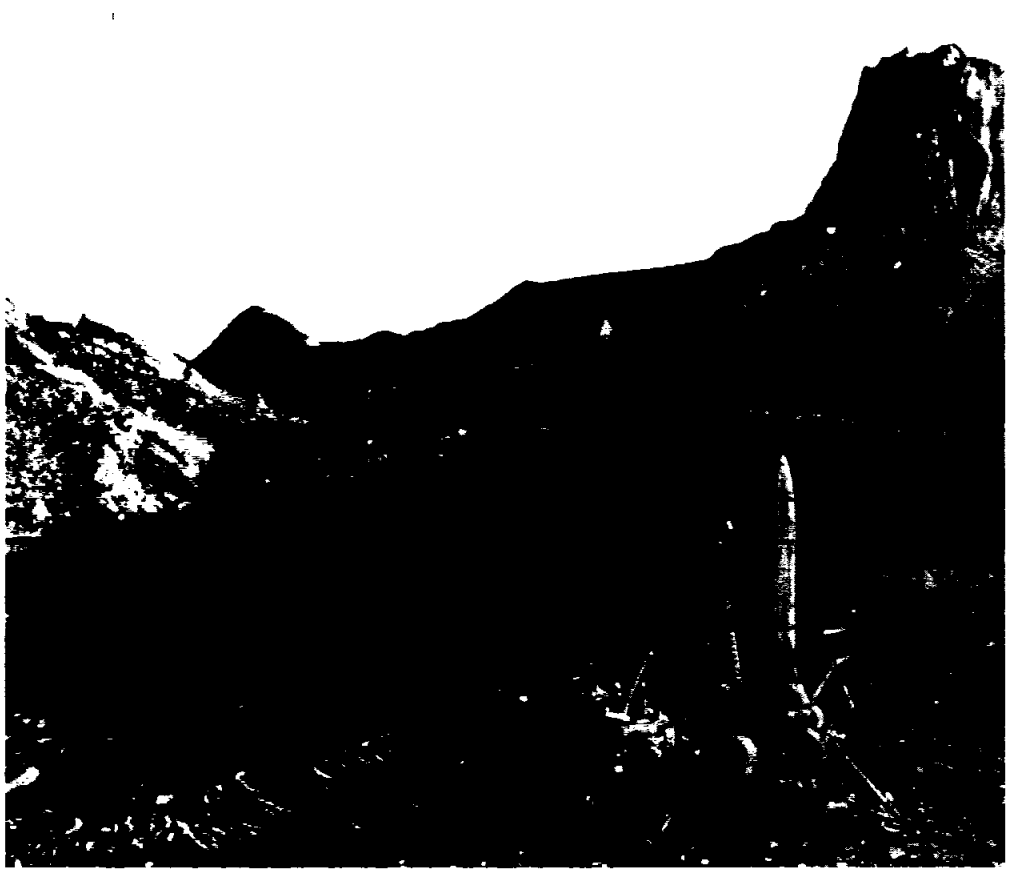
Sullivan: This was not a unanimous body. We had great differences of opinion and debates and arguments. The one thing that I would say for it that struck me as very unique was that as the debates proceeded, and as the text came together, it became clear that everybody placed the potential significance of the report as far above any of their own immediate personal objectives. I don't know if that was because of the particular mix of scientists and engineers we had, or because of the long time scale of the study. But we all noticed it and commented on it. We were very pleased with the spirit of debate. It was very lively, very intense, but the willingness to compromise and the desire to get a good statement was just unspokenly always there.

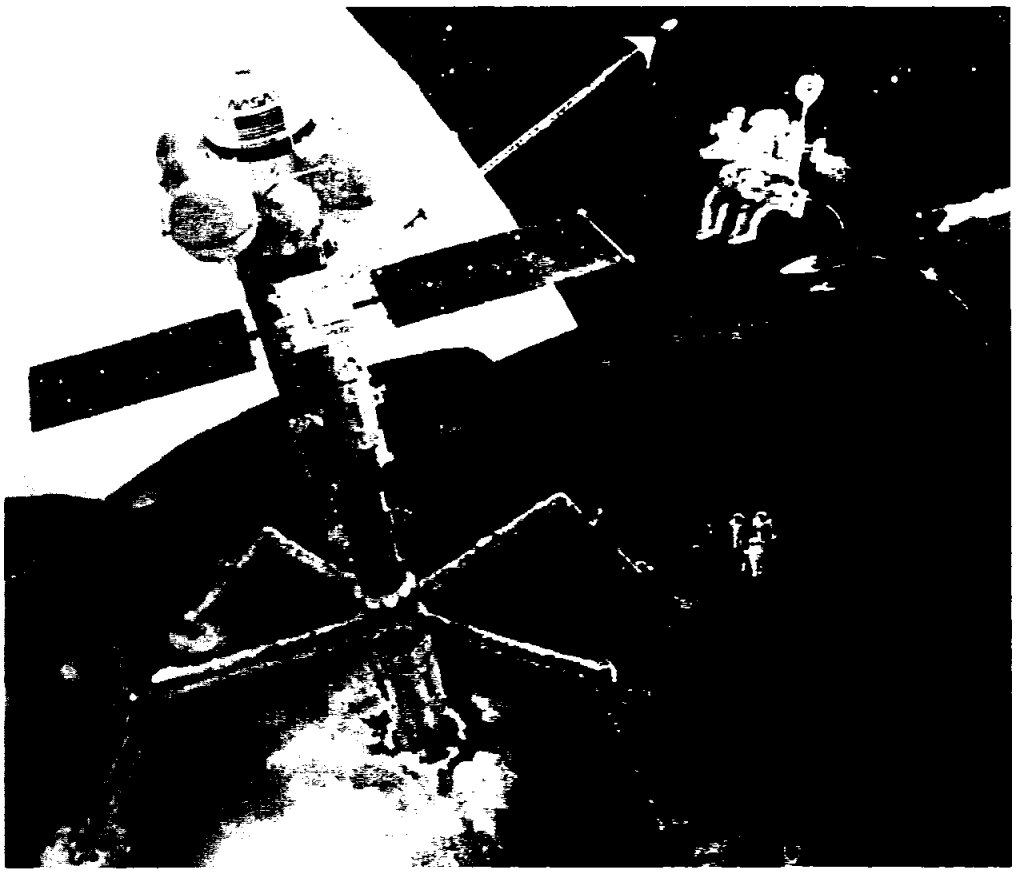
Roundup: This has to have been, for someone interested in the space program, a year full of one of the great intellectual debates in recent memory.

Sullivan: Well we sure covered a lot of ground. It really was a pretty daunting task. I walked in with a fairly jaundiced view of the whole thing. You can walk around any number of offices at this Center alone and see shelf feet of paper that intelligent people have written in years past about where we ought to be going and why and how. And evidently, that was either the wrong color ink or the wrong piece of paper or the wrong people or too far in the past or whatever, because none of that sufficed, you now have been given the wonderful job of doing it again. And the skeptical side of your brain will say, well, lots of luck. You'll have five hours on somebody's desk, six hours on the shelf, and than you'll end up in a closet or a trash can. And the optimistic side of your brain will say, well, but they wouldn't ask if it wasn't time to give the wheel another spin, and you are being given a unique opportunity to help do that. We all confessed to one another later that we were in about the same point in how we approached this thing, hoping to be able to give the wheel another spin but also aware of how politics and government and budgets work. So we decided to write the book, tie a brick to it, and heave it into the window and see what happens.

Visions of tomorrow

These views of space activities in the 21st Century accompanied the report of the National Commission on Space. Above, artwork by Robert McCall depicts a mature lunar base where scientific endeavors exist alongside mining and manufacturing efforts. In the foreground, a mass-driver is propelling baseball-size pieces of lunar material into space. At left, McCall depicts an astronaut departing an orbital transfer vehicle for a close up look at an asteroid. Below left, artist Ron Miller provides a view of a possible U.S./U.S.S.R. Mars sample return mission. In this concept, the U.S. would provide the rover, while the Soviets would provide the spacecraft to return the samples to Earth. Below right, McCall shows what the mining of propellants on Phobos, a moon of Mars, might look like in 20 or 30 years. (All artwork Copyright 1986, Bantam Books, Inc.)





Employee aids in release of ridley turtles

On the morning of Tuesday, May 6, the Coast Guard and the National Marine Fisheries Service (NMFS) in Galveston returned 989 Kemp's ridley turtles to the ocean. Invited to take part in this release was Karen Smith, an on-site Omniplan employee who is also the president of the Houston/Galveston Chapter of the Oceanic Society, an organization that helps raise money for the turtles.

Two other members of the Oceanic Society who are Clear Lake residents, Steve and Judy Davis, arrived at the Turtle House at midnight to begin boxing up the turtles for their long trip. This group was only allowed to help get the boxes ready, as you must have a special permit from Texas Parks and Wildlife in order to "handle" these animals and only the NMFS people have these permits.

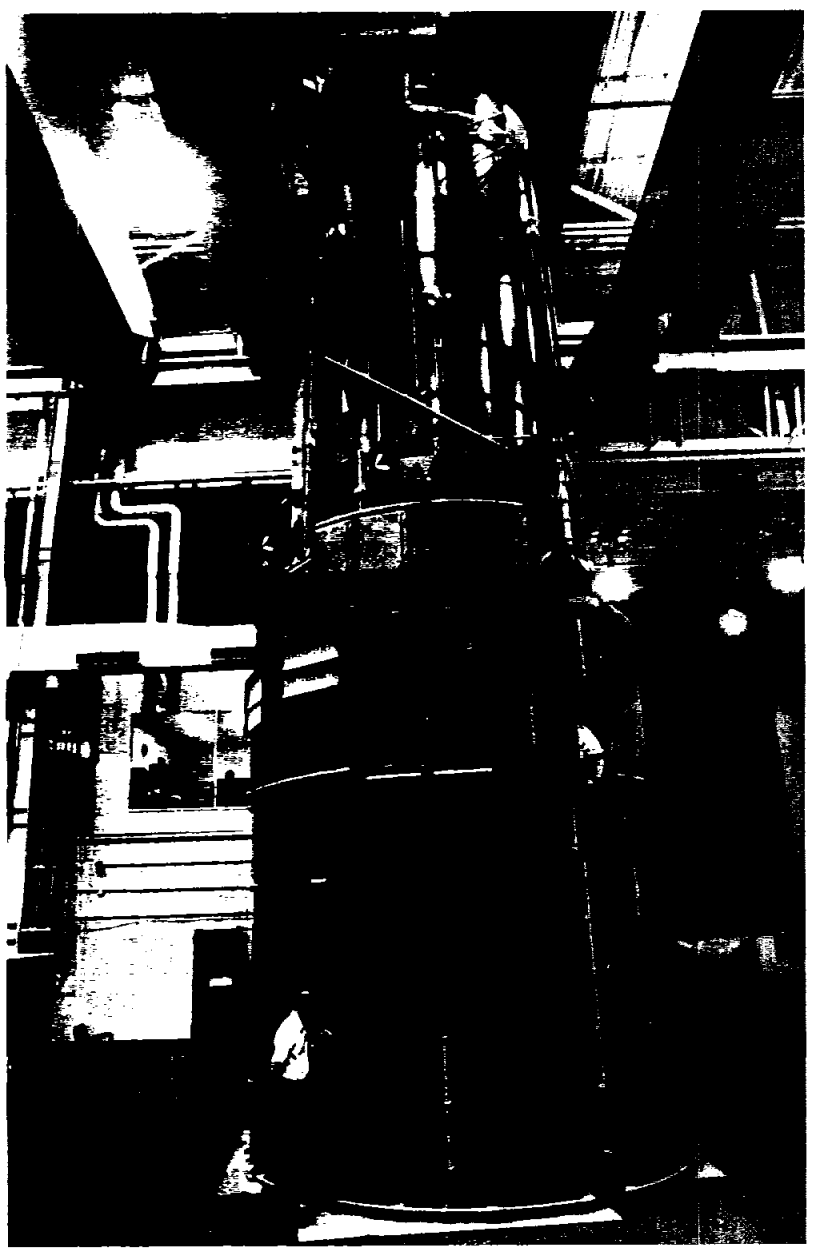
The Kemp's ridley turtle is an endangered species that lays its eggs on an isolated strip of shoreline near the village of Rancho Nuevo in Mexico — the only known nesting place. The eggs are collected in early summer and moved to Padre Island National Seashore for about a two-month incubation period. Hatchlings are imprinted — programmed to remember — in the sand and at the water's edge. It is hoped the turtles will remember where they hatched and return there to nest. Last year, 60 of them "remembered" and nested at Padre Island. They then became Sesquicentennial Turtles (one of which was called Lone Star).

After imprinting, the NMFS Southeast Fisheries Center Laboratory at Galveston takes over and raises the turtles until they can be released back into the Gulf of Mexico. They are raised to at least two pounds so that they are better able to defend themselves against enemies. They are released at Corpus Christi because the NMFS believes the release there is part of the imprinting process.

At about 2 a.m., the entire group was ready (16 people) and the turtles (in two rented trucks) began their long drive to Port Aransas. Once there, they boarded the Coast Guard cutter, *Point Baker*, for an eight-mile trip out into the Gulf. When they arrived at the drop site, the NMFS people began dropping the turtles one by one overboard. A diver with underwater video equipment documented the "drops" to make sure none of the turtles died.

The HEART (Help Endangered Animals — Ridley Turtles) group, a major fund-raising organization, sponsors the head-start program for the endangered sea turtles. Tax deductible contributions help buy food and equipment for the NMFS. To help, contribute, or obtain more information, call Karen Smith at x5341.

One of the many Kemps ridley sea turtles is returned to the Gulf of Mexico from the *Point Baker*.



A full-scale mockup of the Hubble Space Telescope is now in Bldg. 9A. The mockup will be used in simulations to prepare for the telescope deploy mission. Bruce Sprague, a Johnson Engineering technician, is shown examining the mockup.

Mars experiments chosen

As a first step towards returning to Mars exploration, NASA has announced selection of 33 possible investigations for the Mars Observer mission scheduled for launch in 1990. The mission will place an unmanned U.S. spacecraft in orbit around the Red Planet in 1991 to conduct a 2-year study.

During the next 6 months (instrument accommodation phase), each proposed investigation will be evaluated for compatibility with the Mars Observer spacecraft and mission. Final selection then will take place and the investigations will be developed for the mission itself.

The Mars Observer mission, first in a new series of planetary observer missions to the inner solar system, will carry seven or eight instruments. Power for the spacecraft will be supplied by solar panels.

Carried into low-Earth orbit by the Space Shuttle, the spacecraft will be launched toward Mars by a solid fuel upper stage and placed into a near-polar orbit of 224 miles. The sun-synchronous, 117-minute orbit will allow the spacecraft instruments to make a complete global survey of the planet's surface and atmosphere about every 56 days. During the 2-year study, the spacecraft will track the planet's seasons and watch seasonal changes on the martian surface and in the atmosphere.

"This return to Mars is especially exciting because Mars is probably the only other planet in the solar system on which humans might reasonably expect to live some day," said Dr. William Quaide, Chief Scientist of NASA's Solar System Exploration Program. "It's also an exciting planet because in the past it may have been very Earthlike, whereas today it is a cold desert. We want to know how that came about."

Three experiments are expected to provide detailed information about the nature of Martian surface material. They are the gamma ray spectrometer (GRS), the visual infrared mapping spectrometer (VIMS) and the thermal emission spectrometer (TES).

The trio of instruments will determine the chemical and mineral composition of the surface by measuring the gamma rays, visible light and infrared (heat) radiation emitted by the surface. The data will provide invaluable information on volatile materials (water ice and carbon dioxide), lava flows, rock types and surface weathering.

The Martian atmosphere also is a major target for investigation. A pressure modulated infrared radiometer (PMIRR) will detect infrared radiation from the atmosphere to measure its chemical composition, pressure, temperature, water content and the presence of atmospheric dust. Other atmospheric measurements will be carried out by the GRS, VIMS and TES as well.

The spacecraft telecommunications system, along with the GRS and the VIMS, are primary instruments called facility instruments and are a special feature of the spacecraft's experiment package. Developed by NASA, the instruments can be modified to fly on future planetary missions. A team of scientists has been selected to operate each instrument and analyze the scientific results.

A second special feature is the selection of five scientists who will carry out wide-ranging interdisciplinary studies using data from several different instruments and experiments.

Three other experiments will focus on determining the shape of Mars and learning as much as possible about the interior of the planet. A magnetometer will be aboard to determine whether or not Mars has a weak magnetic field or perhaps, none at all.

The shape of the planet will be accurately measured by a radar altimeter to help determine details of the planet's surface, slopes of ancient river channels, exact depths of great canyons and the shapes of the huge Martian volcanos.

It is uncertain if the mission will include a camera. NASA has selected an imaging experiment for evaluation during the instrument accommodation phase on the chance that the limited spacecraft resources and budget will accommodate it.

"We want very much to include an imaging system on the mission," said Quaide, "but the Mars Observer has been planned as a mission with limited resources — power, data rate and dollars — and we are not certain we can squeeze the camera in with all the other instruments which are considered more critical to the mission."

The camera, if selected, would provide synoptic images of global weather systems important for monitoring global dust storms on Mars. It also would give scientists the highest resolution images ever obtained from orbit of selected surface features.

Astronomers address asteroid impact hazard

New studies of the hazards posed by asteroids or comet nuclei colliding with the Earth, based on analyzing old craters on the Earth and Moon, have been announced by astronomers performing research for NASA.

In two papers delivered May 20 at the annual meeting of the American Geophysical Union in Baltimore, Md., the scientists estimate that a collision by a large asteroid could be catastrophic. The chances of such an event occurring in the next century, however, are extremely remote.

A scenario of greater concern, they said, would be a far more probable encounter with a smaller object, a large meteoroid. Objects of that size explode when they enter the atmosphere. Such an explosion could be mistaken by some of the world's less technically advanced nations for a nuclear attack, prompting undesirable political consequences.

The papers were authored by Dr. Alan Harris, a Jet Propulsion Laboratory planetary scientist, and Dr. Eugene Shoemaker, a U.S. Geological Survey scientist who serves in NASA's Planet-Crossing Asteroid Program.

In one paper, Harris and Shoemaker estimated that the odds of an asteroid or comet nucleus one-third mile in diameter or larger hitting the Earth in the next 100 years are only 1 in 1,000.

In the other paper, Shoemaker calculated the effects of collisions by asteroids of various sizes. An asteroid one-third mile in diameter would release energy equivalent to 10,000 megatons of TNT and leave a crater six miles in diameter.

Despite the low probability of such a collision, the astronomers said, systematic sky searches for near-Earth asteroids, combined with advance emergency planning, are prudent steps to reduce further the possibility of an unexpected disaster.

"Increase in the discovery rate of these objects from an average of 3 to about 30 per year can be achieved with a moderate level of research support," Harris said.

Over 30 to 50 years, he said, most Earth-crossing asteroids down to about one-third diameter can probably be discovered.

If a collision was foreseen, it would be possible to predict the time and impact location with high accuracy, allowing the threatened area to be evacuated.

Some day, Harris noted, it may be possible to avoid a collision altogether, either by modifying the asteroid's orbit or breaking it up into a relatively harmless swarm of smaller pieces. The energies required for either strategy would require thermonuclear energy.

Comets are more difficult to predict than asteroids. Asteroids usually occupy orbits similar to the Earth's, making the object visible longer in advance if it were to approach the Earth. Comet orbits, on the other hand, are highly elliptical, bringing them in from the outer solar system with less advance warning.

Nevertheless, tracking of the comet and evacuation of the impact area would be practical means of avoiding a major disaster.

The scientists emphasized that such large events are extremely improbable, placing more concern on the effects of a meteoroid up to about 330 feet in diameter entering Earth's atmosphere. Events of that size are estimated to occur once every few decades. One such event was probably responsible for a nuclear-device-like explosion over Tunguska, Siberia in 1908.

The world's most technically advanced nations would be able to identify such a meteoric fireball for what it is. Nations lacking that technical ability, however, could mistake the fireball for the air burst of a nuclear weapon and attempt retaliation against hostile neighbors. That issue, they recommended, should be addressed at the international level.

Harris and Shoemaker arrived at their statistical probabilities by analyzing and dating craters around the Earth and on its Moon.

CAD/CAM has many applications at JSC

In this continuation of our two-part series, we look at other areas around the Center where computer aided design, engineering and manufacturing techniques are being used.

By Barbara Schwartz

Personnel in the Electronic Systems Test Laboratory (ESTL), Tracking and Communication Division, along with many others at JSC, have discovered the benefits of using a CAD system. Intricate, multilayered, two- and three-dimensional drawings and diagrams are intrinsic to the systems testing done in the Lab.

Test configuration diagrams, documentation and scheduling, test equipment diagrams, and detailed "blueline" drawings which include minute details of information to set up the configuration have all been automated. ESTL also has developed floorplan layouts in the CAD system including various layers showing the space itself, electrical circuitry, telephone circuitry, and furniture and equipment, all in order to make future planned laboratory reconfigurations simpler by trying various arrangements in the computer before an actual change takes place.

Linda Bromley, software manager and a test director for ESTL, has played a key role in automating the Lab's tasks. Bromley said the CAD system has noticeably increased productivity. A drawing that took 68.5 hours to draw manually now takes 25 hours using the CAD system, resulting in a 174% time savings. Additionally, editing drawings proves to be an even greater time saver. Considering the quantity required and number of revisions made per drawing, Bromley estimates time saved to be more than 250%.

As in other areas, designers in the ESTL have created a "library" of parts that can be assembled into detailed schematic drawings. Rose Marie Micocci, a Lockheed employee doing design layouts for ESTL, is considered by Bromley to be an expert on the Applicon (CAD) system. Micocci uses either a step-through menu process or a digitizing tablet with electronic stylus to input drawings in geometric form. She has developed a symbol library of various frequently used shapes, and by applying the stylus to the digitizing tablet the forms are automatically added to the drawing.

Micocci said the editing features of the CAD system have greatly improved productivity because she can easily change a simple flow diagram or an intricate printed circuit board design in minutes, whereas, the manual method required "whiting out" the old and redrawing the new or often redrawing the whole design.

The Systems Analysis Office, another area in the Tracking and Communications Division, uses a sophisticated CAD system for planning, analysis, and design work. Antenna systems for Space Station are one of the projects being evaluated in that area. With the systems analysis capability of the CAD system, analysts can determine the best location, how many will be needed, what kind, and can produce plots showing strengths of signals being generated in various configurations.

Bromley said the work in both areas dovetails together. "The systems analysts get an idea of what the equipment will be, for example on the Space Station, and they do analysis on how the equipment should react. We (ESTL) may get the same equipment in and measure how it reacts. We compare then on the same graph a prediction of how it should work ideally and how it actually does work. If those are too far apart, then there are obviously some problems," she said. CAD systems have simplified this process.

Brett Parrish, Flight Telecommunications Branch, designs printed circuit boards using FUTURENET, an inexpensive personal computer-based CAD system that was specifically designed to do electrical schematic layouts. Parrish said the algorithms used for designing printed circuit boards are similar to ones used to create chess programs — circuitry routing is done automatically. The circuit board schematic can be sent directly to a photo plotter in Technical Services where it is transferred to film. The printed circuit boards are then manufactured in that area and returned to the designer.

James C. Clarke, Chief of the Electronics and Computer Systems Branch, has been given the responsibility of managing Technical Services Division's CAD/CAM systems. "Tech Services provides unique manufacturing capabilities." Clarke said. In addition to printed circuit boards and airfoil models, the stinger used on mission 51-A to retrieve the Palapa/Westar satellites, the beam on which getaway special canisters are mounted in the Orbiter's payload bay, and experimental equipment are some of the other items manufactured in the Division.

As in other areas that use CAD systems, Clarke says that one of the major benefits is in making changes. "It is so much easier to do a repeat job when we have the program saved. We can call it back up, modify it, do what you want, and send it back out again. Operators modify the database, as required," Clarke said, referring to the computer-aided manufacturing (CAM) process.

Joyce Davis, a Mechanical Engineering Technician in the Machine Branch, will vouch for the benefits of using the system to do a repeat job. She did the programming and machining of the three mechanical fingers that snapped open on the end of the stinger to hold the Palapa and Westar satellites on mission 51-A. The fingers were originally made of aluminum but were found to require more strength. Davis used the system to remake them out of stainless steel.

Clarke works closely with the other Branches in Tech Services in developing CAD/CAM capability. He said that soon the MAZAK, a large piece of machining equipment, will be connected directly to the CAD system, so that instead of using paper tapes to operate the machine, it will be computer driven. Also, Clarke said, a computerized drilling machine is being ordered to drill holes in printed curcuit boards, a process which is now done manually.

The computer-driven photo plotter is a recently added improvement. The photo plotter transfers printed circuit artwork directly to film without having to produce a drawing, plotting each level separateiy. One of the other uses for the photo plotter is plotting silk screening designs and lettering. From the plotter, the film goes to the appropriate manufacturing areas where the designs are fabricated.

William A. Parkan, Chief of the Mechanical Equipment Branch, Facilities Design Division, manages the Facilities CAD system. Pan Am has the contract for Facilities work done on the CADS. Their system uses two-dimensional graphics that are inexpensive and well-suited to their needs.

"We are in a major construction program because of requirements to add facilities for Space Station. We are just getting started on the Central Computing Center and Bldg. 9B and a proposal for Bldg. 9C. We're also looking at an addition to Bldg. 5 to provide more simulator space for Space Station training," Parkan said.

Design specifications now given to architectural design firms require them to provide drawings generated on a compatible CAD system, so they can be easily incorporated into Facilities' database. Drawings can then be updated when future repairs and modifications are made.

"The cheapest part of transferring to a CAD system is buying the equipment. Creating the database is the most time consuming and expensive part," Parkan said. A lot of Facilities' work has been repair and modifications to buildings. Parkan said the CAD system would be ideal for changing the drawings or designing modifications, but there are over 10,000 existing drawings that need to be put into the database in order for it to be totally efficient.

Pan Am's CAD system is used by two different functional areas — a drafting group that does mostly facilities-related work and an equipment design group. William Shelton, supervisor of the drafting group, said another central processing unit (CPU) and ten more terminals will be added to the 14 terminals run from one CPU that both groups are sharing.

"When we get done, we will have by far the largest CAD drafting system onsite, and we'll come close to having one of the largest in the country. This is excluding educational institutions where they have a multitude of terminals, and they have people coming in for an hour a day. We'll be one of the largest facility groups," Shelton said.

In order to enhance productivity, Shelton plans to have people dedicated to inputting the 10,000 facilities drawings. Input will be standardized and divided into disciplines — architectural, electrical, and mechanical specialties. Drafters in the specialized areas will know what components have been drawn into the system and can use them when inputting successive drawings.

Additionally, the drafting group maintains the Facilities Housing Plan, an outline of each floor in every building, that is used to identify organizational areas. Regular updates are required when moves take place or space is reallocated. The Operations and Maintenance Manuals, which are made up of engineering drawings of JSC facilities, are in the system and are continually updated. Backgrounds for the telephone system providing information on location of all outlets and security drawings of control zone areas are also maintained in the CAD system.

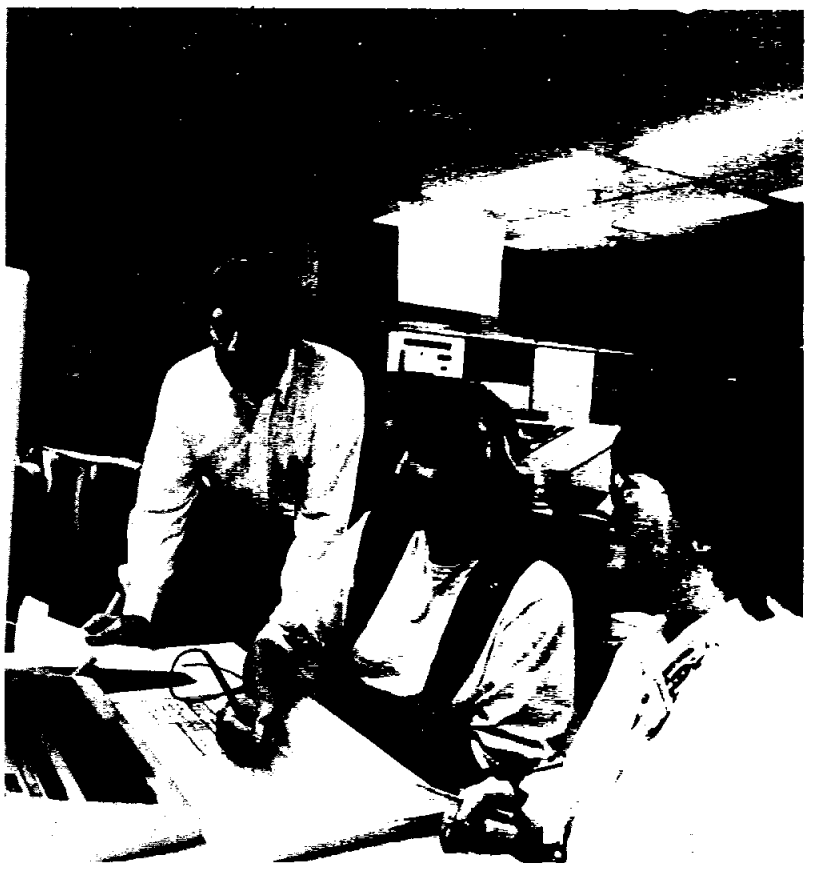
Most of the design work done by the Equipment Design Group, headed by Sonne L. Hooper, requires new drawings with the exception being a set of "Velcro drawings" that are used to track the location of all the Velcro strips in the Shuttle.

"In the last three years," Hooper said, "we have done a lot of the drawings for equipment flown on the Shuttle, a lot of custom equipment designed for it like medical kits, blood collection kits, "best setup" layouts for tile installation, packpacks, and the rotating chair in the physiological lab used to test motion sickness."

To protect Facilities' costly database, a daily tape is made of the information recorded on the CPU's hard disk. Every second week, another independent tape is recorded and stored in a fireproof vault in another location.

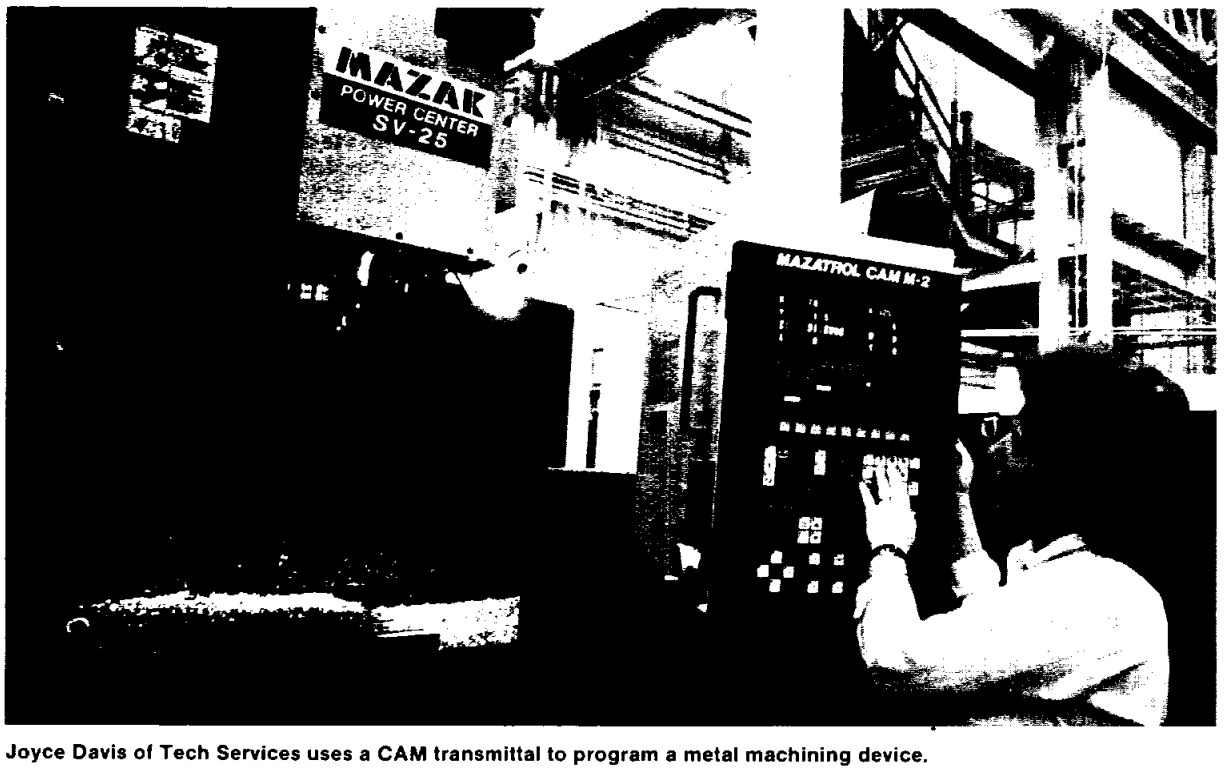
Considering the repetitive nature of drafting, Shelton credits the computer with being "a great deterrent to job burnout" because of the ability to easily duplicate and change drawings. Hooper said, "Drafters are learning a new skill for applying their trade by becoming familiar with the CAD system — and one that is the coming thing."

People working with the CAD/CAE/CAM systems are universally enthusiastic about their jobs. They are discovering new methods, using new tools, to accomplish more work in less time and to do things that couldn't be done before.



Tom Walker, and Linda Bromley look on as Rose Marie Micocci uses a digitizer pen to select from a library of parts images for a technical drawing on the ESTL CAD system. ESTL uses the system for floor plans and testing diagrams.

Ruth Cole of Tech Services is shown electroplating a copper printed circuit board. The board will be used in the Tracking and Communications Division.



Joyce Davis of Tech Services uses a CAM transmittal to program a metal machining device.

Fletcher says Agency will be stronger

(Continued from page 1)

there be no doubt: I am the first to admit that we made mistakes.

The Delta investigation is proceeding well and I am confident we will find the root of the problem and correct it.

We are testing new potential designs for the Shuttle solid rocket motor joints and will consult with a panel of national experts - the best minds in the nation - on the final design. We also intend to make other changes in the Shuttle main engine, steering system and brakes before permitting the orbiter to fly again.

And I have appointed General Sam Phillips, who, as you know, headed the Apollo program, to do a thorough review of how we manage our programs and to recommend to me how they can be strengthened. Sam is widely respected at NASA, and I know he will do a fine job.

So we are slowly, but surely, getting back on track. And I have no doubt that NASA will come back, stronger and better than before.

The NASA you and I know made mistakes in the past, corrected them and moved on. We all know NASA is a dedicated and motivated team of professional men and women who opened space for the benefit of mankind, and is continuing to explore the solar system and the universe to benefit life on earth. We have surmounted great challenges in the past and proved we know how to do our job right.

But sometimes I wonder if the NASA you and I know is the same organization that some in the media portray since the Challenger accident.

I have given a lot of thought to media coverage of NASA since January 28. Let me say that given the magnitude of the story, for the most part, the news media has striven to be accurate, thorough and fair in its coverage.

Having said that does not mean that I think the media has been without fault. I believe that a small number of reporters have acquired a deep and unwarranted suspicion of NASA, its organization, its motives and its people. They have sought to question its every action, and to uncover its every perceived blemish and wart.

This really bothers me. It is almost as if these few are talking about a different agency - not a NASA that has done magnificent and creative things - but a NASA that has always been poorly managed, a NASA that has always made mistakes and a NASA that never got its act together. I am very disappointed at the way a small segment of the press has treated NASA recently, because I believe it creates a distorted image of who we are and what we are about.

More importantly, if this kind of coverage continues, I worry about whether it could do irreparable damage, not only to the agency, its people and its program, but also to the nation as a whole.

For example, could such continued coverage cause public support, and thus, Congressional support of the NASA program to diminish to the point where the program itself could be in jeopardy?

By the same token, could it cause widespread morale problems and resignations among the dedicated, talented and motivated members of the NASA team - individuals who believe in the agency's mission and see their work not only as a job, but as a contribution to our country? I wonder how much disruption NASA could take without causing serious delay and damage to our ongoing projects and the future momentum of the national space program?

Finally, and most important, could continued criticism of NASA in this small segment of the media cause the agency to lose its vitality?

If this should happen, the result could be serious damage to the United States' technological, scientific and economic leadership in the world. For, as we all know, the NASA program spurs innovation and productivity, creates new jobs, new products and new industries and, for more than a quarter of a century, has been a major factor in United States' technical and economic leadership in the world.

Dr. James C. Fletcher is sworn in as NASA Administrator May 12 by Vice President Bush while President Reagan looks on.

I believe all of us in this room, indeed, all Americans, should think about these questions very seriously, because they bear directly not only on the future of the space program, but on America's future as well.

America's civil space program has helped us achieve the highest standard of living ever known and provided the economic base for the scientific and technological achievements which are fueling rapid and beneficial change in the world. The program not only has helped to shape our vision of the future, but has made and will continue to make that vision real.

Moreover, our investment in the program has fueled economic growth and progress. I need hardly remind this group that the Apollo program not only expanded our knowledge base, but spawned such new industries as medical electronics and cybernetics, and gave tremendous boosts to the computer and aerospace industries. As a result, the United States took the lead in those areas and maintained it for years.

Now others are catching up, and the United States must develop new areas of technology to ensure our economic leadership for the forseeable future. We can expand our scientific and technological base and create a new era of economic growth and progress for America by continuing to move forward in space. The Space Station, the Aerospace Plane, and future, more ambitious missions to the moon, the asteroids, and Mars, will be the building blocks of this new era.

Like Apollo, these projects will spawn new products, new processes and new industries. We can expect developments in robotics, teleoperations, intelligent computers, exotic metals, medicines and other materials that can be made only in space - in hypersonic flight, optical communications, pollution-free vehicles and a host of other areas.

Modest, but steady investment in our space program will insure these developments; but more important, will insure a bright economic future for our children and our country in this increasingly competitive world.

Indeed, I can't imagine America without its space program. It has become so much a part of our national culture that we seemed to take it for granted - that is, until the Challenger accident. And now that program, with all that it has done and can continue to do for America, could be irreparably damaged, if we do not maintain and strengthen the national consensus to move forward.

If you share my concern at this critical period in the agency's history, I believe you can help the NASA team and the nation. As leaders of one of our greatest national industries, I hope you will use your influence to keep the NASA program working for America.

Each of you and the company you represent can play a very important role and assume a very heavy personal responsibility in this effort. You are all top decision-makers in companies using state-of-the-art technology to explore new frontiers. As such, you have a unique opportunity to promote public discourse and awareness of the importance of NASA to America and its future - at the grass roots, where it counts the most. For, as you all know, that is where the momentum for major governmental decisions is generated.

I urge you to continue to lead - to continue to help shape and secure the United States future in space. We must all continue to strengthen public awareness of the vital role space plays in our lives and will continue to play in the future.

In his 1984 State of the Union address, President Reagan said: "The American dream isn't one of making government bigger; it's keeping faith with the mighty spirit of a free people under God."

I believe that spirit is alive and well today. It is reflected in the more than 350,000 letters of support NASA has received since the Challenger accident from Americans of all ages and from all parts of the country. Recently I read a sampling of those letters. One was from an eighth-grader named Susie. She expressed her sympathy to NASA, the seven astronauts and their families. "I hope that this terrible tragedy will not stop the space program," Susie wrote. "I am sure that the astronauts would want the program to continue, because it was their dream to go to space. I doubt that they would want to take that dream away from anyone else. I hope some day to go to space to explore the solar system. All I can do is to pray that the program will continue."

Susie and others like her have faith in the future of their space program. They represent its great reservoir of support in this country. You and your key subordinates can help us tap that reservoir in your communities and in the nation and make its force felt in Washington. It is vital that we continue to emphasize the potential of space and the positive changes and opportunities it holds for our nation's future.

Twenty-nine years ago, the United States was shocked into action, when the Soviets beat us into space with Sputnik. We geared up to meet the Soviet challenge and then pursued an all-out effort to go to the moon. We got there, not once, but six times - three times, incidentally, on my watch. In the process, we reaped a new understanding of ourselves and our world and incalculable benefits for mankind.

But we lost that momentum after the Apollo-Soyuz flight in 1975. The Shuttle schedule slipped from 1978 to 1981, and there was a six-year hiatus before the Space Transportation System once again allowed us to resume manned space flight. We did so successfully with 24 Shuttle missions that expanded our knowledge of the microgravity environment and its potential for scientific and industrial experimentation.

Today the space program is at a critical turning point. If there is no national commitment to build another orbiter, the nation could lose interest in space, including the forthcoming Space Station and the exciting next steps suggested by the Paine Commission.

As you know from your corporate experience, it's the steady program that prevails. The on-again, off-again program is counter-productive and should be avoided at all costs.

Can we afford another gap in progress in space, perhaps a gap of several decades of progress? I think not. The Shuttle is not an end to itself - but a means to an end. It will carry into orbit the people and materials necessary to construct the Space Station. And once we have done that, the Space Station itself will become a means to other ends as we continue to explore and use space for the benefit of mankind. So the Space Station is our next logical step.

The space program must continue to be a succession of logical steps. It must continue to be predictable. It must continue to be consistently and adequately funded. And in the face of growing international competition, we must maintain its momentum, lest others pass us by.

President Reagan once said: "There are no constraints on the human mind, no walls around the human spirit, no barriers to progress except those that we ourselves erect."

I agree with that. The truth is that our relatively small national investment in space exploration - eight-tenths of one per cent of the Federal budget - continues to insure that America's potential for growth and progress is as limitless as space itself.

That investment is also buying the opportunity to answer questions as old as humankind. How did the universe begin? How big is it? What is its destiny? And that most intriguing of all such questions: are we alone in it?

I believe that with your help, this great nation will continue to search for the answers. We will continue to expand our vision and our reach, for it is the hallmark of a great nation to seek to know the unknown.

And in doing so, we will reap many benefits, not only in science and in technology, but in building the framework for a more peaceful, more prosperous, more cooperative home for the human family, right here on earth.

Thank you very much.

OSC to build upper stage

The Jet Propulsion Laboratory has selected the RCA Corp., Princeton, N.J., and Orbital Sciences Corp. (OSC), Vienna, Va., for negotiations leading to the award of contracts to build a spacecraft and upper stage booster, respectively, for the Mars Observer Mission scheduled for launch in August 1990.

Negotiations with RCA for the spacecraft will be conducted by JPL. Negotiations with OSC for the upper stage will be conducted by the Marshall Space Flight Center, Huntsville, Ala.

In view of a bid protest filed with the General Accounting Office, contracts will not be awarded nor will proposed contract values be announced until the protest is resolved.

The basic contracts would extend through February 1991 for the upper stage booster, and through September 1993 for the spacecraft development and flight operations.

The spacecraft contract will include an option provision for three additional spacecraft buses, and the upper stage contract will include options for three additional stages.

The Mars Observer will study the climate of Mars, its atmosphere and surface using eight science instruments while in orbit around the planet during a full Martian year (687 Earth days).

The Mars Observer is the first in a series of proposed planetary observer programs using existing technology and spacecraft designs to provide economical scientific investigations of Venus, Mars, the moon and near-Earth asteroids.

Fixed-price contracts with incentive provisions are planned for both the spacecraft and upper stage development.

Cookin' in the Cafeteria

Week of June 2 — 6, 1986

Monday — French Onion Soup; BBQ Sliced Beef, Parmesan Steak, Spare Rib w/Kraut, Chili & Macaroni (Special); Ranch Style Beans, English Peas, Mustard Greens. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin. Selection of Salads, Sandwiches and Pies.

Tuesday — Split Pea Soup; Meatballs & Spaghetti, Liver & Onions, Baked Ham w/Sauce, Corned Beef Hash (Special); Buttered Cabbage, Cream Style Corn, Whipped Potatoes.

Wednesday — Seafood Gumbo; Cheese Enchiladas, Roast Pork w/Dressing, BBQ Link (Special); Pinto Beans, Spanish Rice, Turnip Greens.

Thursday — Beef & Barley Soup; Roast Beef w/Dressing, Fried Perch, Chopped Sirloin, Chicken Fried Steak (Special); Whipped Potatoes, Peas & Carrots, Buttered Squash.

Friday — Seafood Gumbo; Fried Shrimp, Baked Fish, Beef Stroganoff, Fried Chicken (Special); Okra & Tomatoes, Buttered Broccoli, Carrots in Cream Sauce.

Week of June 9 — 13, 1986

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; Baked Turbot, Liver & Onions, 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.

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

Sale: 1 BR Pebblebrook condo, fan, new paint, priv. entrance, new carpet, must sell, $29,900. (409) 925-8593.

Sale/lease: Austin 1-1 condo, near stadium, assume loan, no equity, by pool. B. Crain, x4031 or 420-2936.

Sale: Friendswood/Forest Bend 3-2.5 townhouse, LR, den, storage, $49,500. 333-2322.

Lease: Walnut Hill condo, Fairmont Pkwy., 1 BR, appliances, W/D conn., 15 min. to JSC. Diane, x3057 or 484-5256.

Sale: League City 5-3-2, 3,000+ sq. ft., formals, den, study, pantry, fans, fenced, above ground pool, deck, no equity, assumable VA, $98,000. Joyce, 282-3314 or 332-1774.

Sale: Modified A frame, 2 BR, loft, beautiful lot, $45,000. M. Lillpop, 864-8679.

Sale: Modern 3-2 rustic, 2-story, FPL, deck, very nice, $69,900. 864-8679.

Sale: New Univ. Green townhouse, 3-2-2, FPL, whirlpool tub, alarm, loft, private courtyd., near pool, $81,000. Dennis, x2868 or 480-5076.

Lease: Tranquility Lake 1 BR condo, W/D, FPL, microwave, cable hookup, security gate, icemaker, covered parking. 554-6892.

Rent: A-frame on Clear Lake, 2 BR + loft, 3 story, rough cedar, FPL, boat slip optional, panoramic view, $800/mo. negot. Larry, collect, (415) 527-9587.

Lease: Heritage Park 3-2-2, formal dining, fenced, new paint, FPL, lge. kitchen, custom drapes, $575/mo. 482-6609.

Lease: Friendswood/Forest Bend 3-2-2, fenced, patio, good locale, new paint, refrig., $525/mo. 482-6609.

Sale: College Station 3 BR home, 3 blks. to campus, built-ins, deck, fenced yd., $39,500. 326-1278.

Lease: Galveston Gulf front condo, fully furnished, sleeps 6, weekend and wkly. rates. Glen, 280-8644.

Sale: 3-2-2 with spectac. view of Trinity Lake, FPL, 100' redwood deck, sandy beach, 3/4 acre, 7 mi. south of Baytown, $112,500. 573-1296.

Sale: 8 acres w/frontage on Hwy. 35, south of Alvin 6 mi., $500/mo., nothing down. Barr, 485-6074.

Sale: Timeshare week, Freeport, member RCI, transferable, $6500. 485-4995.

Sale: 14' x 80' Champion mobile home, 3-2, fan, garden tub, miniblinds, appliances, assumable VA. Sharyl, x5224 or 595-2230.

Lease: Egret Bay 1-1-2, FPL, lots of closets, W/D, $350/mo. Actkinson, 482-7061, x3781.

Sale: 2 residential lots in Green Acres off NASA 1, each 114' x 185', $12,000 ea. 324-4946.

Sale: Lake Palestine timeshare, the Villages, RCI exchange, below market value, pool, marina, fishing, etc. Fred Nau, x4726 or 333-2582.

Sale: Pearland 3-2-2, miniblinds, near park/school/library, assume 10.5% FHA, no equity asked, you pay closing. 485-0076.

Lease: CLC Camino South 3-2-2, brick, FPL, fenced, fans, cathedral ceiling, $550/mo. + first, last & deposit. Lyn, 333-2359.

Rent: Baywind 1 condo, 1 BR, appliances, $350/mo. + deposit. 532-4766.

Rent: Fairmont Park W. 3-2-2, carpeted, fans, new paint, avail. June 1, appliances, W/D, spa in fenced yd., $625/mo. 532-1126.

Sale: Friendswood/Forest Bend townhouse, 3-2.5, LR, den, lots of storage, near park and pool, $49,500. 333-2322.

Sale: Pipers Meadow 3-2-2, dining, FPL, mini-blinds, 403 Capehill, $64,900. 488-0500 or 480-6516.

Sale: Friendswood/Regency Estates 4-2-2, 2,000 sq. ft. ranch, large kitchen, dining, great room w/FOL, nearly new, all gas, hi-eff. AC, 90 x 130 lot. Steve, x4794 or 482-3696.

Lease: 1 BR condo, W/D, FPL, 2 wks. free. Jim Briley, x2546 or 488-7901.

Lease: Deer Park 3-2-2, brick, corner, lg. fenced yd., boat access, storage bldg., FPL, bar, garage/shop area, $650/mo. 479-6100.

Lease: Baybrook condo, 1-1, all appliances, W/D, walk-in, up, $300/mo. + dep. 474-3839.

Rent: Pipers Meadow 3-2-2, fenced, Genie, miniblinds, fans, low util, $600/mo. Glen, x5629 or 480-3015.

Lease: Barringer Knoll condo, 2 BR, appliances, W/D conn., fan, new paint/carpets. 326-4395.

Sale: Leona's weekend hideaway between Livingston and Woodville, phone for details. Leona Germany, 643-4456.

Sale: Lake Livingston lakeview and lakefront lots, many trees. (409) 855-2063.

Lease: Newport/League City 3-2-2, cathedral ceiling, central AC. Dick S., x4086 or 554-6290.

Cars & Trucks

'79 Ford Fiesta hatchback, sunroof, AM/FM stereo, 30 MPG, $1,190. 487-4325.

'74 Ford Maverick, AC, PB, PS, 4 dr., good work car, $490 OBO. 532-4766.

'78 VW van, AC, AM/FM/cassette, rear defog., maintained, ex. mech. cond., orig. engine, $2,750. Greg Williams, x3421 or 482-6763.

'72 MGB GT, 90% restored, many new parts. 481-4612.

'81 Camaro, 4.4L, V-8, auto, AC, PB, PS, gold, clean. $3,295. 482-6730.

'84 Chevy Sherrod custom van, immaculate. 481-1382.

'67 Mustang Classic, 3 spd., AM/FM/cassette, nice, clean, $3,000. 538-4327 or 333-9565.

'77 Ford LTD, low miles, good engine, clean in and out, $995. Richard Hill, x5541 or 534-3389.

'79 Mustang, clean, AC, PS, PB, auto, 6 cyl., new tires, 5,000 mi. on rebuilt engine and trans., $1,900. 474-2660.

'78 Ford wagon, V-8, 70K mi., clean, one owner, $1,850. 488-0426.

'79 Pontiac Firebird, new air, good ~~cond.,~~ $2,300. Ray, x6327 or 554-5434.

'71 Jeep DJ5B (Post Office Jeep), 58K mi., RH drive, good mech. cond., $800 OBO. Chris, 941-0138.

~~'81 P~~Pontiac Firebird, very clean, V-6, AT, PS, PB, AM/FM, AC, $2,750. McNeely, x6347 or 482-5838.

'78 Camaro, 305 V-8, auto, PS, PB, ~~AM/FM~~ stereo, $2,500. 480-4757 or 333-0939.

'70 Mustang convertible, 302 V-8, 137K mi., PS, power top, split glass window, passes inspection, great potential, best offer over $3,000. 480-0374.

'72 Pontiac Ventura II, 117K mi., good cond., one owner, $400. 481-8107.

'79 Toyota Corolla, 4 spd., AC, new tires/paint/brakes/carb./alt. and more, AM/FM/cassette, $2,250 Neg. Mike, x3532 or 486-8569.

'81 Ford Mustang Cobra, hatchback, auto, PS, PB, AC, radio, new trans., new brakes, $3,500. 480-8061.

'76 Olds Regency 98, leather, new paint/tires/shocks/front end. Kesterson, x2870 or 996-9103.

'80 Malibu Classic, ex. running cond., auto, radio, new tires, super AC, $1,400 firm. Kesterson, x2870 or 996-9103.

'70 Plymouth, 2 dr. Gold Duster, V-8, auto, PS, AC, orig. owner, radio, low mileage. 944-4581.

'75 Cadillac, Sedan de Ville, ex. cond., $1,200. Dean, x3241 or 488-7032.

'64 Chevy Impala SS, 2 dr., auto, AC, bucket seats, $2,500. 649-2465.

'85 Chevy Blazer, loaded, low miles, ex. cond., $9,000. Ben, x4971 or 488-1326.

'82 Honda Civic, 1500 DX, ex. cond., 26K mi., 5 spd., AC, ultra-seal, cassette, $4,200. Tanna, x4323.

'75 Mercury Marquis, 460, runs good, $800 neg. Stutesman, x4933.

'84 Dodge custom van, fully loaded, CB, TV, mini blinds, 12K mi., $13,900. Cindi, 488-9005, x219 or 488-0288.

'84 Chrysler Laser, metallic blue, 5 spd., 15K mi., $7,950. Kevin, x2307 or 280-0813.

'75 Triumph TR6, runs great, new tires, new suspension, AM/FM/cassette, 71K mi., $3,500. Steve, x3486 or 996-0823.

'80 Cadillac Coupe de Ville d'elegance, 350 V-8, AM/FM/8-trk., CB, wire wheel covers, loaded. 333-3187.

'78 Camaro, 305 V-8, auto, PS, PB, AM/FM, $2,500. 490-4757 or 333-0939.

'76 Buick Electra 4 dr., needs work; '79 Buick Lesabre; '80 Buick Electra, good condition. Joanne Fink, 333-4494.

'77 Ford Super Cab, 440 V-8, RV equipped, AM/FM/CB, Jayco pop-up camper, sleeps 3, self contained, great condition, will sell seperately, best offer. 532-3658.

Ford F250, extended over cab, self contained camper, clean, 62K mi., smooth running, $3,195. Hill, x5541.

'76 VW Beetle convertible, bright orange, ex. investment, $3,895. 334-3896.

'78 Buick LeSabre, auto, AC, 65K mi., $1,395. 334-3896.

'80 Datsun 280ZX, auto, AC, like new paint, AM/FM, $5,900. 486-5364.

'85 Nissan Sentra, 5 spd., loaded, 16K mi., $6,800. 486-6876.

'84 Chevy S-10 pickup, AM/FM, 5 spd., GEM top, 40K mi., $4,400 or $1,200 equity and 21 payments of $167.26. 479-7437.

'82 Ford F150 XLS truck, 1/2 ton stepside, AC, PS, PB, AM/FM, cruise, cassette, tilt, sliding rear window, orig. owner, $6450. Larry, x2723 or 481-9058.

'78 Buick Regal, ex. running cond., $1,200 OBO. Stewart, 488-9005, x233 or 335-1416.

'73 Porsche 914, AC, AM/FM, rear defog., 2.0 liter, 5 spd., alloy wheels, fender flares, new bearings and head job, rings and paint needed, $3,250. Greg Williams, x3421 or 482-6763.

'23 T-Bucket, 350, turbo 400, '57 rear-end, lots of chrome, nice top, new tags and inspect., $5,500 OBO. Casey, 538-1928.

'82 Z-28, 350 4-bolt block, small valve 882 castings, turbo 400, new factory V-8 pan and pump and more. Casey, 538-1928.

'78 Ford Bronco, 4WD, 3" lift kit, 36" mag tires, PS, PB, white rims, AM/FM/cassette, $2,600. Bill Greenwood, x3738 or 554-5426.

'81 Dodge Omni "Miser" 4 dr. hatchback, std. trans., AC, good condition. 486-9343.

Boats & Planes

Catalina 30, ex. cond., fully rigged, roller furling, bimini, ready to cruise or race, $28,500. 326-1278.

Bayliner 22.5, Skagit cuddy camper, 160 HP Volvo I/O, low hours, dual batt., head, stove, icebox, sink, swim platform, CB, compass, depth finder, full canvas, more, $5,000. Ron, 488-0131 or 488-3452.

16' Hobie Cat, w/galv. trailer, fully rigged w/Harken gear, vest, manuals, like new, stored inside, $2,400. Charlie, x3421 or 480-3260.

Mercruiser exhaust elbows, will fit small block Chevy V-8, 4" x 5" flange, exhaust down, approx. 1 yr. old, $150. 473-2709.

Alcort Sunfish, w/galv. trailer, very good condition, $625. 333-2444.

'56 Dillman Pamquin, 30 HP, barely runs, no equipment, will consider trade. Malinda, x3188.

Recreational

Venture Brogham tent camper trailer, AC and extras, sleeps 5, ex. cond., $1,050. 473-2709.

Motor home for rent, ex. cond., 23' mini, sleeps 5 adults and 2 children, $325/wk., $50/day, 10¢/mi. 996-0734.

Cycles

'79 Vespa Grande moped, optional signal lights, seat for 2, carrier rack, good cond., 755 mi., $450. Dahms, x3601 or 488-0156.

'82 Suzuki GSL 850, w/fairing, good cond., needs some work, must sell. Clint, 473-5626 or 488-8919.

20" Super mongoose BMX bike, all chrome, like new, was over $300, sell for $150 OBO. McNeely, x6347 or 482-5837.

Audiovisual & Computers

Two TI-994a computers, peripheral expansion box, RS232 card, memory, disk controller, modem, Gemini 10X printer, BUI monitor, plus software and more. Mill, 471-6482.

Coleco Adam computer, hi speed cassette drive, daisy wheel printer, word processor, games, software, etc. Kilbourn, x4545 or 482-7879.

TRS 80-4 computer system, 128K, 5 meg. hard disk, DMT 400 printer, stand, software, $1,500 OBO. 331-1600.

Sale: Commodore 64 software, productivity and games. Steve, x2755.

Heathkit 25" color TV, working condition, tambour door cabinet, all manuals plus another set for spare parts, $100. 482-2369.

RCA basic table model VCR, $125 OBO; 25" color console TV, cable ready, remote, $300 OBO; assorted switchers, etc. Allen Wylie, x3268 or 486-6681.

10" color TV w/remote, $250; 10" color TV w/video jacks, $175; GE portable VCR and camera, $700; 19" RGB/composite monitor, $300. Allen Wylie, x3268 or 486-6681.

TEAC A-4070, 8" reel-to-reel tape deck, w/splicing access, spare parts, and 28 new and used BASF tapes, $200. Ken, 488-4035.

Household

Queen size waterbed with headboard and mattress, only 7 mo. old, $200. Randy, 480-5194.

King size motionless waterbed, mattress, heater, liner, frame and rail pads, $200. Stan, 488-6822.

Ward's deluxe 15.1 cu. ft. deep freezer, $150; 2 bedsits, upholstered twin-size mattresses that fold into lounge chairs, nearly new, $25 ea.; mahogany upright piano, former player, good harp and works but needs refinishing, $200. Ken, 488-4035.

11 × 16 carpet and pad, dark brown, good condition, great for dorm room, $35 OBO. Barbara, x3466.

Small all-wood desk, fair cond., new surface, $25; homemade sofa/storage bin and table, $40. Ann, x3466 or 996-1287.

Simmons Beautyrest kingsize mattress, very good cond., $95. Dahms, x3601 or 488-0156.

Bunk beds, very good cond., hardwood, railing and ladder, $150. Linda, x7428 or 486-6873.

Birds eye maple vanity and dresser, $125 each. Kelly, 280-0533.

Queen size waterbed, full motion, padded headboard, large storage area, heater, used 4 mo., ready to carry out, $100. Bill Keeton, x2254.

Refrigerator compressor, rigged to produce vacuum or pressure, $10. Bauch, 333-3382.

Handmade twin bed, orthopedic type mattress, very firm, 3 underbed drawers, $100 OBO; 10 piece pit group, rust, $200 or trade; double porcelain sink, $10. Stefanye, x4794 or 331-7360.

Queen size waterbed, queen size hide-a-bed, best offer. Howard, x3697 or 480-1123.

Tappan gas range, used 1 yr., ex. cond., $175; decorative horns, 6 ft. Joan, x3057 or 486-1058.

Sofa bed, great cond., $90; chair, good cond., $25; practice piano, beautiful, $300. 480-7581.

1953 "Beauty" gas stove; 1982 gas dryer, ex. cond.; 2 double beds; record collection from 50s-70s. 482-6686.

Two dressers, 1 double bed, 2 night stands, 1 coffee table, 2 end tables, queen size sleeper sofa and matching loveseat. Jon, 332-8363.

New loveseat and chair, $275; 2 Oxford files, $50/pair; TV table, $20; typing table, $20; footstool, $35; 2 kitchen chairs, $25; antique dining room table and chairs; $350. 488-5564.

2 one drawer metal filing cabinets, $35; office table, $22.50; cypress clock, $25; antique school desk, $35. 488-5564.

Sears 17 cu. ft. upright freezer, frost-free, coppertone, ex. cond., best offer over $100. 488-4487.

Loveseat and sofa, end tables, coffee table, 2 arm chairs, dining table & 2 chairs, from $50 to $250. 974-8834 or 326-2380.

Wanted

Want female to rent master BR, kitchen and W/D privileges, $200/mo. + 1/2 util., $100 deposit. Bekki, x2141.

Roommate, female preferred, to share 3 BR house in League City, 554-2405.

Need ride from Baytown to JSC, 7:30 a.m. to 4:30 p.m., starting July 1. Richard, x6186 or 488-2205.

Want Casio MT 310 keyboard, working or not, others considered. Alison, x5827.

Want roommate to share furnished 2-2 house, $225/mo. + $50 deposit. Rick, x5341 or 480-3017.

Interested in carpool from Alvin. Wanda, x4751.

Want shop manual for 1973 Mercury Comet, will pay reasonable price. Chuck, x4241 or 487-2978.

Want ping pong table. 334-3896.

Pets

Red female Doberman, 6 mos., AKC reg., all shots, show cut ears, used to children, $300. 554-5253.

AKC German shorthaired pointer pups, ex. field, how and hunting lines, whelped 4-11-86. Ben, x2091 or 944-1506.

Found: Black manx cat, young female, yellow eyes, in Univ., Green, claim or free to good home. Faith, x2956 or 486-0269.

Poodles, AKC, white female, Minni Champs, shots and wormed, 10 wks., $250. 326-2380 or 974-8834.

Doberman puppies, AKC, 9 wks. old, tail and dewclaws removed, wormed and first shots, come back for 2nd set, $175. Horton, x4084.

Female Beagle, 2 yrs. old, needs good home, $50. 488-4915.

Musical Instruments

1961 Hammond Organ, drawbars, dual keyboards, 1 octave footpedals, and bench, cheap. Laura York, 488-9005.

Studio piano in ex. cond., will consider reasonable offers, asking $400. Kesterson, x2870, x5480 or 996-9103.

Martin alto sax, case and accessories, very good cond., $225. 333-2444.

Miscellaneous

New 1986 World Book Encyclopedia, aristocrat binding, $549; new 1985 World Book set, aristocrat binding, $399. Kilbourn, x4545 or 482-7879.

Canon AE1 program camera, 50mm F1.8 lens, case, $160; 135 mm f2.5, $80; 70-210 f4, $150; Rokinon power winder, $35. 488-3941.

Brand new Nikon FG w/50mm lens and 75-200mm lens, needs shutter and button repaired. Randy, 480-5194.

Sears weedeater, $200. 488-6822.

'81 Chevette engine, complete, running, ready to rebuild, $50. Alison, x5827.

VW Beetle car top carrier, ex. cond., $10. 532-3342.

Five CJ7 wheels, orig. equip., 15 × 6 × 5.5, need paint, $10 OBO. Dave F., x6186 or 488-8111.

VW fiberglass kit car body, ex. cond., almost complete, $700. Bruce Smith, x2740 or 486-1966.

Pair of jacks for pickup camper, $85. 554-2470.

Sz. 9 wedding dress, from Foley's, worn once, $175. Beverly, x5094 or 559-1053.

3.5 HP lawnmower, 20" cut, $30. Tim, x3268 or 280-9774.

Crib, playpen, changing table, high-chair, very good condition, $75. Gary, x5595 or 538-2110.

Fertilizer spreader, drop type, good as new, $10. 333-3071.

Spalding skis, his and hers, $150/pr.; boys bikes: Kent, $30; Schwinn sting ray, $40; 6 HP Johnson outboard, $400. 326-2187.

Weight bench and weight set, used 2 wks., pully system, slant board, squat rack, plus, was $175, sell for $100. Trish, x2241 or 486-7009.

3.5 HP lawnmower, 22" cut, $65; Garrett AM2 metal detector, $125. 482-8827.

Sears cruise control kit, for U.S. cars and trucks, new, never used, $50. 538-2474.

Pflueger trolling motor, 3-speed, 12 lb. thrust, good cond., $65. 486-4378.

Sunbeam electric mower, 18", ex. cond., $60. 997-2034.

Charter Arms .38 special, 2" barrel, $155; Charter Arms stainless .22 long rifle, 3" barrel, $205; Interarms auto .22 pistol, $135; two Rugers: stainless .357 mag, $245; and "Speed Six," $235. Charlie, x3591 or 333-4681.

3M copier, with paper, makes view graphs, $200 OBO. Richard, x2141 or 482-1156.

Gilruth Center News

Call x3594 for more information

Ladies weight training — This popular course begins July 14 and runs 4 weeks. The class meets Mondays and Wednesdays from 7 to 8 p.m. The cost is $20 per person.

Defensive driving — Learn to drive safely and qualify for a 10% reduction in your auto insurance for the next three years. This all day Saturday class meets from 8 a.m. to 5 p.m. June 14. Space is limited.

Belly dancing — That's right. Belly dancing. Tone muscles while learning this ancient art form. Students are requested to wear leotards and tights and bring a scarf to class. This 6-week course begins June 11 and meets Wednesdays from 5:30 to 6:30 p.m. The cost is $35.

SCUBA lessons — This NAUI-certified SCUBA course begins June 16 and meets from 6:30 to 9:30 p.m. The cost is $45 per person. No equipment is necessary prior to the first meeting. Enrollment is limited.

Jazzercise — Designed to develop total fitness, this class meets Mondays and Wednesdays from 4:30 to 5:20 p.m. beginning June 2. The cost is $25 per person.

Tennis lessons — Beginning tennis classes will be offered starting June 16. The class, which runs for 8 weeks, will meet from 5:15 to 6:45 p.m. Tuesdays. The cost is $30 per person.