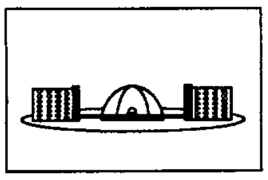
NASA
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas



Approaches

Several reference approaches to the Human Exploration Initiative are being explored. Story on Page 3.

Door jam

Bldg. 10's large overhead door partially collapsed last week when a cable broke. Photo on Page 4.

Space News Roundup

Vol. 29 February 16, 1990 No. 7

Contributes nearly $1 billion in '89

JSC boosts local economy

By Linda Copley

JSC contributed about $973 million to the Houston area economy in fiscal year 1989, an increase of $400 million over the previous year.

The center's expenditures locally included $157 million in federal salaries, $3 million in air travel, and $812 million in goods and services from more than 1,100 local businesses, averaging $3.7 million for each working day.

JSC received $1.9 billion, or about 17 percent of the $11 billion appropriated for NASA in fiscal '89. The major portion of JSC's budget, $1.6 billion, went for Research and Development (R&D) and Space Flight Control and Data Communications. Research and Program Management (R&PM), covering everything from salaries, gas and electric bills, and mowing the grass, took $301 million. Facility construction accounted for the remaining $14 million.

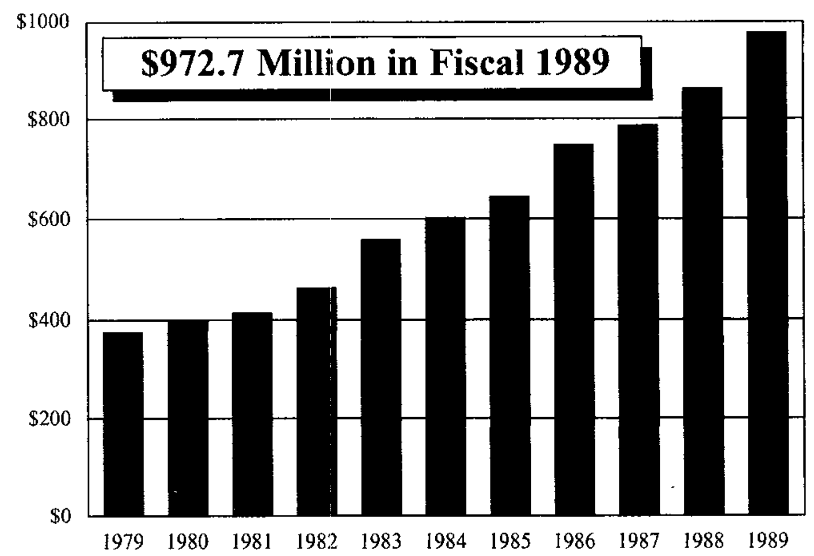
Utility costs for the center for fiscal '89 were $1.6 million for gas, $7.4 million for electricity, $6.8 million for (phone and electronic) communications, and $300,000 for the purchase of surface water and sewage treatment.

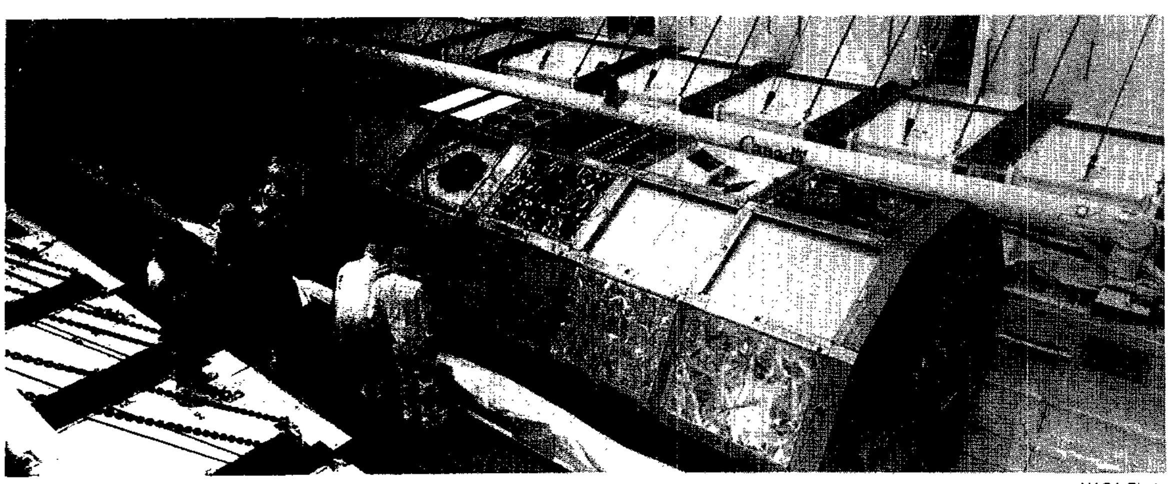
Since moving to Houston in 1962, total JSC funding from NASA equals $37.3 billion in actual dollars through Sept. 30, 1989. That total includes $3.9 billion for R&PM, $33 billion for R&D, and $351 million for construction of facilities overall in the past 28 years. JSC has paid out $2.6 billion in civil service salaries since 1962.

JSC spent $1.1 billion in fiscal '89 with both Texas firms and out-of-state companies that pay salaries to employees in their Texas operations. That places Texas

Please see **JSC,** Page 4

Millions Fed Into Local Economy





NASA Photo

The Long Duration Exposure Facility (LDEF) is viewed by scientists and technicians in Kennedy Space Center's Orbiter Processing Facility. LDEF has since been moved to the Spacecraft Assembly and Encapsulation Facility (SAEF-2), where its individual experiments will be removed for more detailed study.

No early surprises on LDEF

Framework ready to fly again, scientists say

The Long Duration Exposure Facility (LDEF) took thousands of hits from natural and man-made particles, but project scientists said Tuesday it could fly again with new, improved experiments.

Chief Scientist William Kinard of Langley Research Center said preliminary investigation shows LDEF's aluminum structure to be in excellent condition and ready for reflight, although NASA currently has no reflight plans. LDEF and its 57 experiments were designed to record encounters with atomic oxygen, radiation, micrometeoroids, man-made debris and other space hazards.

There was some unusual discoloration—a change of white and yellow paints to brown—on at least one experiment, said Dr. Ann Whitaker of Marshall Space Flight Center, co-principal investigator for solar array and structural materials, but overall the satellite looks as expected.

LDEF has been removed from *Columbia*'s payload bay, moved to the Spacecraft Assembly and Encapsulation Facility (SAEF-2) and placed on a "spit" in a rotational mode so that co-principal investigators can view it and begin removing their experiments next week. Investigators have been inspecting the satellite from 1 to 5 feet away.

"I think the materials people and the science people here have learned a great deal and they would dearly love to get a chance to make improvements, to put new generations of materials up and see how they work," Kinard said.

"We are approaching the point of making some final decisions on space station materials and I think it would be very effective to be able to put these materials up on a spacecraft like LDEF and get a little survival data prior to committing (materials) to the space station."

JSC's Don Kessler, representing the Micrometeoroids and Debris Special Investigation Group, said quick-look observations have revealed no surprises in terms of natural and man-made space debris.

"The orbital debris environment is not any more severe than we anticipated, but we need a lot more analysis to be sure of that," Kessler said.

Please see **LDEF,** Page 4

JSC establishes lunar and Mars program office

By Kari Fluegel

A new Lunar and Mars Exploration Program Office here at JSC will soon begin the technical definition and integration responsibilities for the agency's exploration initiative.

In response to the growing interest in and emphasis on continued space exploration, NASA Headquarters has delegated program level responsibilities to JSC. In turn, JSC Director Aaron Cohen has established the Lunar and Mars Exploration Program Office to be headed by Mark Craig, manager of the exploration office formerly housed within the New Initiatives Office.

'Johnson, with its history and experience, has a very real responsibility to help shape the initiative.'

—Mark Craig

"The program office is responsible for defining how an outpost on the Moon and manned missions to Mars will be undertaken, both technically and programmatically. In so doing, it is responsible for working with and integrating study results from all of the NASA centers," Craig said.

The office will be composed of an existing 22 JSC civil service positions plus about 50 contractors and civil servants from other NASA centers and NASA Headquarters.

Deputy manager of the program office is Douglas R. Cooke, currently deputy manager of the exploration office in the New Initiatives Office.

The program office, mail code XA, will be comprised of three offices: the System Engineering and Integration Office headed by Norm Chaffee, currently deputy division chief in the Propulsion and Power Division; the Mission Development and Operations Office headed by Ed Lineberry, previously manager of the Mission Development Office, New Initiatives Office; and Program Development and Support Office, co-assigned to the Administration Directorate, headed by Humboldt Mandell, now manager of the Space Station Project Control Office.

The Mission Development and Operation Office will define the top level concepts, or architecture, of the exploration initiative—what goes where, when and how—while the system engineering group will transform this architecture into vehicles and systems to be studied by NASA teams around the country, Craig said.

Program Development and Control will define the schedules and costs

Please see **LUNAR,** Page 4

Atlantis, crew ready to light up night sky

By Kyle Herring

Plans to launch *Atlantis* Wednesday night or Thursday morning were firmed up last weekend when shuttle managers cleared the STS-36 vehicle for its Department of Defense mission.

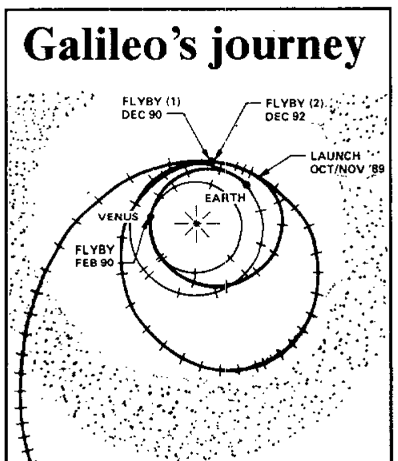
STS-36

Shuttle program managers conducted a bottoms-up review at the routine flight readiness review and concluded no major problems stand in the way of the launch. Liftoff could occur during a four-hour launch period beginning at 11 p.m. Wednesday. The 34th shuttle mission will be only the fourth night launch in the program.

The crew for the STS-36 mission—Commander J.O. Creighton, Pilot John Casper and Mission Specialists Mike Mullane, Dave Hilmers and Pierre Thuot—is scheduled to arrive at KSC aboard NASA T-38 trainers Sunday night or Monday morning for final training prior to launch.

All work at the launch site was proceeding smoothly as engineers conducted final close-out work before starting the countdown for *Atlantis*' sixth mission into space.

Galileo's journey



Galileo whips by Venus

Galileo was busy snapping photographs and recording other information about Venus this week after making a gravity-assist flyby and being whipped back toward Earth.

The nearly perfect Feb. 9 flyby was not without incident, however, as a software incompatibility caused Galileo's on-board computer to click off a number of unplanned exposures.

Galileo, launched from the Space Shuttle *Atlantis* in October, gained 4,990 miles an hour as it shot around Venus. As of today, it is 34.3 million miles from Earth and 452 million miles from its ultimate destination, Jupiter, traveling at 89,558 miles an hour. The spacecraft remains in excellent health.

The flight team at NASA's Jet Propulsion Laboratory was able to track down the computer problem that caused the camera to misfire and has taken precautions to prevent it from happening again.

The photos and infrared and ultraviolet spectral observations taken during and after the flyby will allow scientists to search for deep cloud patterns and lightning storms in the torrid Venusian atmosphere. Data will not be transmitted back to Earth until December, when the spacecraft makes the first of two Earth flybys that will give it the remaining velocity boosts needed to reach Jupiter by 1995.

Meanwhile, the Magellan spacecraft that has Venus as its destination is 112.4 million miles from Earth and 80.3 million miles from Venus, cruising at 60,317 miles an hour. The spacecraft, launched from *Atlantis* in May, is on schedule for arrival at Venus Aug. 10.

JSC

Ticket Window

The following discount tickets are available for purchase in the Bldg. 11 Exchange Gift Store from 10 a.m. to 2 p.m. weekdays.

General Cinema (valid for one year): $3.75 each.

AMC Theater (valid until May 1990): $3.50 each.

Sea World (San Antonio, year long): adults, $17.25; children $14.75.

Barefoot in the Park (8:15 p.m., Feb. 16; League City Civic Center): adults, $6; students, $4.

Sesame Street Live (10:30 a.m., Feb. 24, Summit): $7 each.

Rodeo tickets (Rodney Crowell & Restless Heart—11 a.m., Feb. 24, mezzanine, $9; Patti LaBelle and James Ingram—7:45 p.m., Feb. 28, mezzanine, $8; Anne Murray—11 a.m., March 3, mezzanine, $9; Alabama—4 p.m., upper level, $7.50).

JSC

Gilruth Center News

EAA badges—Dependents and spouses may apply for a photo I.D. 6:30-9:30 p.m. Monday-Friday.

Defensive driving—Course is offered from 8 a.m.-5 p.m., March 17 and April 21; cost is $15.

Weight Safety—Required course for those wishing to use the Rec Center weight room. The next class will be from 8-9:30 Feb. 22.

Ballroom dance—Professional instruction in beginning, intermediate, and advanced ballroom dancing. Classes begin March 1, and meet every Thursday for eight weeks. Beginning and advanced classes meet 7-8:15 p.m., intermediate class meets 8:15-9:30 p.m. Cost is $60 per couple.

Taekwondo/hapkido—Classes in the Korean art of self-defense, and mental and physical discipline are held Tuesday and Wednesday nights; cost is $40 monthly.

Low-impact aerobics and exercise—Each eight-week session runs twice a week from 5:15-6:15 p.m. Cost is $24.

Softball sign-ups—Summer softball sign-ups will be held the week of Feb. 20 at the Rec Center.

Country and Western dance—Six-week session begins March 12. Lessons are held each Monday night. Cost is $20 per couple.

JSC

Dates & Data

Today

Houston Space Society—"Political Activism for Space" will be discussed by Bill Agosto, president of Lunar Industries, Inc., at the Houston Space Society meeting at 7:30 p.m., Feb. 16, in the Atlantic room at the University of Houston. Call 639-4221 for information.

Gem and Mineral Show—The Clear Lake Gem and Mineral Show, to be held Feb. 16-18 at the Pasadena Convention Center, 7902 Fairmont Parkway, Pasadena, will include a tour of Bldg. 31's Lunar Laboratory with Lunar Sample Curator John Dietrich briefing the group. The tour will leave the convention center at 5:30 p.m. Friday; those interested in attending must register at the show. Show hours are 9 a.m to 8 p.m. Friday-Saturday, and 10 a.m. to 5 p.m. Sunday. Contact: Mack Robinson at x30803 or 534-4696.

Cafeteria menu—Special: tuna and salmon croquette. Entrees: pork chop with yam rosette, Creole baked cod. Soup: seafood gumbo. Vegetables: Brussels sprouts, green beans, buttered corn, whipped potatoes.

Monday

Presidents Day—Most JSC offices will be closed in honor of the Presidents Day holiday.

Tuesday

Cafeteria menu—Special: stuffed cabbage. Entrees: turkey and dressing, round steak with hash browns. Soup: beef and barley. Vegetables: corn cobbette, okra and tomatoes, French beans.

Wednesday

Houston Space Business—The monthly luncheon meeting of the Houston Space Business Roundtable will begin at 11:30 a.m., Feb. 21, at the American Host Hotel. The speaker is Viet Hanssen of Hanssen International; call 486-5068 for reservations.

Cafeteria menu—Special: pepper steak. Entrees: catfish with hush puppies, roast pork with dressing. Soup: seafood gumbo. Vegetables: broccoli, macaroni and cheese, stewed tomatoes.

Thursday

AIAA dinner meeting—The American Institute of Aeronatics and Astronautics will present Dr. Alan Binder, a planetary scientist for Lockheed Engineering, speaking on "The Lunar Prospector Mission: A Private Initiative for Lunar Exploration" at its monthly dinner meeting at 5:30 p.m., Feb. 22, at the Gilruth Rec Center. Dinner begins at 6:30 and the program at 7:30. Dinner reservations are $7 for members, $8 for non-members, and $6 for students. Call Sarah Leggio, 282-3160, by Feb. 16, for reservations and information.

Solar System seminar—The Solar System Exploration Division seminar series will present Dr. Colin Keay, University of Newcastle, speaking on "Electrophonic Meteor Atmospheric Entry Research" at 3:15 p.m., Feb. 22, in Bldg. 31, Rm. 129. Call Nadine Barlow, x35044, for more information.

EAA Noontime Seminar—The JSC Employee Assistance Program will present Barbara Howard, from Women's Hospital of Texas, discussing "Are You A Victim of Premenstrual Syndrome (PMS)?" from 11:30-12:30 p.m., Feb. 22, in Building 30.

Cafeteria menu—Special: chicken fried steak. Entrees: beef tacos, barbecue ham steak, Hungarian goulash. Soup: turkey and vegetable. Vegetables: spinach, pinto beans, beets.

Feb. 23

Cafeteria menu—Special: tuna and noodle casserole. Entrees: liver and onions, deviled crabs, roast beef with dressing. Soup: seafood gumbo. Vegetables: whipped potatoes, peas, cauliflower.

JSC

Swap Shop

Swap Shop ads are accepted from current and retired NASA civil service employees and on-site contractor employees. Each ad must be submitted on a separate full-sized, revised JSC Form 1452. Deadline is 5 p.m. every Friday, two weeks before the desired date of publication. Send ads to Roundup Swap Shop, Code AP3, or deliver them to the deposit box outside Rm. 147 in Bldg. 2.

Property

Sale: Egret Bay Villas, 1 BR/bay window, FPL, appl., balc., pool, boat ramp, FHA appr., $38,000. 332-7788.

Trade Houses: Custom canyon view 4-3 off 360 West of Austin, prefer 5 yr old, open plan w/in 20 min. of JSC. 471-8795 or 333-6083.

Sale: Seabrook, 3-2-2, formals, lg den w/FPL, 1800 sq. ft., remod. w/new A/CH, roof, interior, deck w/spa, trees, never flooded, $67,500, $4K total move-in. Rickard, x30271 or 474-9334.

Sale: Nassau Bay colonial, 4-2-2, many upgrades, home warranty, never flooded, landscaped, $125,000. 333-3547.

Sale: Sycamore Valley, 3-2-2, assume FHA, $848 mo., no qual, $8500 equity neg., owner fin., many extras. Steve, 484-7877.

Rent: Ski Heavenly Valley at Lake Tahoe, NV, 2 BR condo, $350/wk, 3/26 to 4/2. Tom, x38298 or 488-4089.

Sale: League City, 2.06 acres, $35,000, near schools, city water and sewer, 15 min. from NASA. 554-6695.

Waterview condo, 3-2-2 covered, split master, new paint, carpet, appl., fans, pool, sec. gates, boat slips avail., $39,500. 333-2524.

Lease: Pipers Meadow, 3-2, FPL, new carpet, new tile, 1 yr lease, $800/mo, avail April 1. Susan, x37424 or 480-8259.

Rent: Baycliff mobile home lot, $85/mo., $50 dep. 488-1758.

Sale: League City, 3-2-2, approx 1500 sq. ft., lg yard, $55,000, OBO. Jim, x32167 or 334-3069.

Sale: Dickinson, custom one story, 2000 sq. ft., 4-2-2.5 det., wooded lot, formals, C/AH, FPL, sec. sys. 337-4168.

Lease: El Dorado Trace, lg 1-BR condo, 2 balc., all appl., W/D, alarm sys., CP, ceiling fan, mini-blinds, no pets, $425 + dep. Mark, x30131 or 332-2416.

Lease: Webster, El Dorado Trace, lg 2-2.5 townhome, FPL, W/D, ceiling fan, no pets, $575/mo., + dep. Joe, x30255 or 480-5470.

Webster/Ellington, nice 2-1 apt., many extras, $450/mo. Dave, x38156 or 486-5181 or Eric, x38420.

Sale/Lease: Nassau Bay townhouse, 4-2-2, over 2000 sq. ft. w/2-story den, deck, atrium, oversize gar, $109,900 or $1,095/mo. Jerry, x38922 or 488-5307.

Sale: lg. lots, excl. subdiv. near NASA, mid $30's, can finance. Don, x38039 or 333-3313.

Sale: Kirkwood South, custom 2-story, 2300 sq. ft., 4-2.5-2, formals, FP, study, walk-in closets, near Dobie H.S., $78,500. 488-5210.

Cars & Trucks

'79 Chevy Caprice, V-8, 70K mi., AC, 4-dr, PS, PB, good cond., $2500, OBO. 280-2028 or 488-8919.

'82 VW Rabbit conver. 55K mi., AC, cass./stereo, good cond., $6000, OBO. 280-2028 or 488-8919.

'78 Honda Accord hback., 5-spd, AC, AM/FM, needs exhaust work, $300. Eddie, 326-2106 or 333-7029.

'81 Ford Bronco (full sz w/remov. top), 4x4 w/mudders, reb. 351, auto., AM/FM, new carpet, seat covers and gas tank, $2800, OBO. Richard, x30271 or 474-9334.

'79 Pontiac Grand Am, blue and silver, 2-dr., PS, PB, AM/FM/cass., good tires, new tags and inspection, $1700. Eric, 554-6170.

'78 Ford T-Bird, full pwr access. w/maint. rec., shop manuals, ex. cond., $1250. 488-6326.

'79 Fleetwood mobile home 14x70, 2-2, comp. furn., new energy eff. A/C, WD, carpet, water-heater. $9500. Cherri, 280-2039.

'81 Olds Toronado, V-8, all options, showroom cond. in and out, $3300. x36158 or 409 945-8787.

'89 Toyota Celica, red, sunroof, A/C, AM/FM/tape, auto., loaded, $12,200, neg. 554-5002.

'87 Toyota Tercell hback, champagne, 2900 mi., A/C, AM/FM/cass., 3 new tires, new muffler, new battery, new license and inspection, 4-spd. Pat, 337-4548.

'83 Buick Regal, ex. cond., AC, tilt, cruise, AM/FM/cass., 1 owner, $3000. Mariann, x39238 or 332-7574.

'65 Olds Starfire, sport coupe, 106K mi. one owner, good cond., $3300, OBO. Tom, x38298 or 488-4089.

'84 Corvette coupe, auto., Bose sound, custom wheels, 62K mi., $10,350. Wally, 280-1118 or 532-1953.

'79 Pontiac Phoenix, 62K, clean int., reasonable. Wally, 280-1118 or 532-1953.

'71 Volvo, runs great, good cond., A/C, $950. 474-6977 or 326-2180.

'89 Olds Calais, med. metallic grey, loaded, w/5-spd., quad 4 and FE3 suspension pkg., 20K mi., $11,500. James, x37548 or 470-8759.

'83 RX-7 GSL, gray w/red int., sunroof, 5-spd., 60K mi. on new eng., runs and looks great, $4,500. Dwane, 943-2773.

'86 Mazda B2000 Cab Plus SE-5 pkg., one owner, 27K mi., ex. cond., $4900. John, 335-6129 or 480-8733.

'84 Ford Ranger, V-6, 55K mi., $3300, Shayla, X30167.

'81 Chevy Caprice, one owner, 25K mi. on GM reman. diesel eng., $1250. Hammack, 326-2986 or 280-5159.

'88 Hyundai Excel SE, blk and silver, clean, 5-spd, 4-dr, 22K mi., $1200, OBO. Kimberly, 283-6150.

'89 Nissan Sentra, 10K mi., 337-6090.

'85 Toyota MR2, silver, tail fin, loaded, 5-spd., ex. cond., 54K mi., $6500, OBO. Cindy, 779-4515 or Drawin, x32142.

'79 Cutlass Supreme Brougham, V-8, 2-dr, A/C, PS, auto., tilt, delux uphol., stereo cass., ex. cond., $1895. 280-8796.

'89 Ford Probe LX, blk w/tinted wdws, AC, AM/FM stereo cass., 5-spd, low mi., ex. cond., $1000 and pick up payments, OBO. 333-6497.

'83 Porsche 944, guards rep, A/C. 5-spd std, brn int., factory alarm, sunroof, ex. cond., 100K mi., $9500, neg. 464-8694.

'86 GMC Safari mini van, very clean, $8200. 326-6392.

'79 Cadillac Seville, 51K mi., moonroof, leather, $3500. Don, x38039 or 333-3313.

'84 Nissan Sentra, white, 2-dr, CP, 84K mi., A/C, 5-spd, AM/FM/cass., good tires, $2500, OBO. Walt, x35939.

'81 Datsun 280ZX Turbo, T-tops, 2-tone brown, auto., A/C, AM/FM/cass., sport tires, ex. cond., $3400, OBO., 283-4171 or 486-8574.

'77 Porsche 924, approx. 79K mi., good cond., $4000, OBO. 333-7345 or 474-2339.

'84 Cadillac Sedan Deville, choc. brown metallic, brown velour, one owner, low mi., $5600. Mike, 333-2335.

'86 Chevy S10 PU, blue, AC, AM/FM/cass., rack, Bl Bk price. 479-3934.

'75 AMC Matador, 2-dr, auto., very clean, runs great, $800 OBO. 480-3344.

'86 Toyota Celica GTS, pwr wdws, locks, seat, mirrors, sunroof, steering and brakes. 2.0L, 5-spd, tinted wdws, blue, 70K mi., ex. cond., $8950. x31188 or 428-1310.

63 Classic VW Beetle, new tires, short block. Jonhe, x30291 or 332-9976.

'85 35' Mallard motor home, loaded, low mi., $32,000. 337-4051.

Cycles

'82 Honda Magna V45, 2200 mi., ex. cond., $1199. 532-1206.

'83 Honda CM 250, 7500 mi., $375. Kevin, 280-1500 ex. 3647 or 532-2181.

Women's Raliegh 10-spd bicycle, w/access., $65. Gail, x39838.

'78 Kawasaki KZ650, less than 7K mi., w/helmet. Steve, x35806 or 333-4222.

'81 Suzuki 850cc, Vetter fairing/windscreen, foot rests/eng. protectors, padded bk rest, shaft drive, low mi., ex. cond., $1400. Patrick, x32635 or 488-1079.

'86 Kawasaki Ninja 900, red/white/blue, 10K mi., ex. cond., $2500; '84 Kawasaki 440 jet ski, $2000; '83 Kawasaki 550 jet ski, $2000. Andy, 333-6671 or 332-9105.

Boats & Planes

14' Glassmagic skiboat, 80 HP Mercury, galv. trlr., skis, fresh water use, ex. cond., 38 mph, $1595. x35180 or 326-3706.

'78 Chrysler 22' sailboat, swing keel, 3 sails, well equip., $4000. Walt, x35939.

Audiovisual & Computer

Satellite sys., brand name DX, 2 receivers, antenna positioner, dish, hardware, some cable, $1300. 438-2951.

Commodore 1541 disk drive, 1702 color monitor, modem, Koala pad, software incl. Word Writer, Flight Simulator, Print Shop, $400, OBO. Bob, 554-5346.

Atari 800XL, 64K RAM, $50; Commodore 64, $40; software/books, $20. Floyd, x34709.

TI-994A computer w/assorted software cartridges and access., $150. Ed, x36969 or 332-0442.

Household

Dining rm/dinette set, Chromecraft modern walnut table, 4 tufted black vinyl swivel chairs, $215, OBO. Boyd, 488-8806 or 482-5274.

G.E. 14.8 cu.ft. upright freezer, white, ex. cond., $150; solid oak bunk beds w/mattresses, box springs, matching 6-drwr dresser, $150. 480-8461.

Wards Signature 20 refrig., 3-dr, 20 cu.ft., frostless, side-by-side, almond, ex. cond., $200. 480-8461.

Super Single water bed w/heater and bkcase, $150. 280-8546.

Scandinavian style entertainment center, $250; rust La-Z-Boy rocker/recliner, $150; ex. cond. 282-3985 or 488-0151.

Contemp. solid oak king sz waterbed, w/six drwrs under and mirrored hdbd w/matching highboy dresser and nightstand, like new, $850. 282-3985 or 488-0151.

Dbl bed frame (adjust.), hdbd, box springs, matt., $100, OBO. Elaine, 333-3992.

25" Fisher color console TV, stereo, remote control, cable ready, works great, $500. Bob, 554-5346.

Magnavox compact audio system w/db cass., CD player, AM/FM/ turntable, $250, OBO. x35046.

150 watt/chan. Carver receiver, 1 yr on warr., $450; TEAC ZD-700 CD player, $150. David, 554-2992.

White oval kitchen table w/4 cush. chairs and leaf, $100. 282-3788 or 480-2188.

Solid blonde oak BR suite; twin beds, bedding, night stand, 5-drwr chest, $395. 333-3547.

Two-piece sect. sofa, ottoman, rust, $80. 480-9545.

Super single waterbed, 6 drwrs under., ex. shape, compl., $65. Marlene, 280-1500 ext. 3654.

Soild walnut BR set, two twin beds w/matt., night stand, dresser w/mirror, $350. Beth, x37081.

19" color TV w/remote, $225. Dave, x32592 or 482-6673.

3 yr old king sz BR set, ex. cond., hdbd, base w/drwr, split semi-motionless matt. w/dual heaters, dresser w/hutch, two end tables, $600 firm. 471-4100.

One bedframe, adjusts to fit twin, full or queen sz matt.; computer desk, ex. cond. w/chair. 488-2822.

Two Ethan Allen small sofas, salmon, blue, cream floral pattern, $250 ea., 488-4576.

Roll-top desk, all wood, 4 yrs old, $115. Karen, x37623.

Love seat, light beige, pastel floral print, $100; leather Scandinavian recliner, like new, $400. 996-8410.

Musical Instruments

Fender concert amp, tube type, like new, $295; Gibson-Epiphone Emperor Jazz Guitar, ex. cond., $795. Ed, 896-1035.

Two band/PA column spkrs., Ovation 6119 Div. of Kaman, four 12" spkr. per case, $300. Jessie, x35981.

Upright piano, good cond., $400. 338-2754.

5'10" Grand piano, polished ebony, 4 mos. old, $6,500, 10 yr. full warr. transf. Joe, x32099 or 946-8198.

Lost & Found

Lost: bi-focal sunglasses. 333-6083.

Found: Set of keys, Bldg. 24 sidewalk. OCC, x33061.

Pets & Livestock

Silky terrier pups, ex. pedigree, AKC Ch. sired, 2 M, 3 mos. old, $400/ea. Cindy, 488-6324.

Yorkie, AKC Reg. male, 10 mos., comes w/4x4 playpen, carrying cage, other access. Kimberly, 283-6150.

Free 6 mos. old kitten, very affectionate, beautiful coat. 333-6662 or 280-8425.

Cocker Spaniel, M, AKC, looking to breed w/cocker w/AKC paper, want pick of litter. Tamela, x36159 or 472-6323.

Wanted

Want prop. in Bacliff, raw land, util., housing in any form. 333-6558 or 339-1337.

5-string banjo player would like to meet bluegrass guitar, bass and fiddle players. Tom, 480-9668.

Want Beta VCR in good cond., age, no problem. Michael, x38169 or 482-8496.

Want babysitter to care for 6 mo. old in your nonsmoking home, Seabrook/Nassau Bay, M-F, 7:30-5:30 p.m. x36616 or 474-7496.

Want cars or trucks, running or not, any cond. 333-6558 or 339-1337.

Want appli., refrig., AC's, W/D, freezers, dishwashers, stoves, elec. or gas, working or not. 333-6558 or 339-1337.

Want to trade concert/church elec. organ for 30' plus cabin cruiser. 337-4051.

Want someone to cut grass in Friendswood. 483-6080.

Want cheap work car or truck. 482-4156.

Want TI 99/4A computer game cartridges and access. Irv, x36461.

Miscellaneous

Compl. shop manual for '79 Ford truck, van econoline (E-100 thru E-310, F-100 thru F-300) and F-, B-, C-, L-600 thru 9000 series except CL-9000, $25. Rudy, x33836.

White satin wedding dress w/lace, sweetheart neckline, med. lgth., scalloped train, sz. 9, was $950, now $400. Rob, 282-3098 or Yvonne, 996-7622.

Western tan suede cowhide fringe coat, sz. 40, like new, U.S.-made, $85; Avon collector steins, $25-30, OBO. Boyd, 488-8806 or 482-5274.

Cross country ski exersizer, adjust., folds flat to store, $25. Gail, x39838.

Work bench, weights, pull down bar, made by DP, $75. 280-8546.

Sewing mach., 24 util. and decorative stitches, one step auto. button holer and free arm, 2 yrs. old, just cleaned and oiled, $175. x38102.

Dual-action exer. bike, Vitamaster, $60; DP-multi-gym 300, $75. x38102.

Smith Corona typewriter model #250 SD, like new, built-in spell-write, dictionary and expand. memory, $150. Richard, x30415 or 480-0524.

Mike Myers 5'8" twinfin surfboard, ex. cond., $150. Richard, x30415 or 480-0524.

Car stereo, Sherwood, FM/AM cass., Dolby B&C, logic control tape, auto. rev. search, etc., DIN mount, new, $275. Jim Gibbons, x31224.

Red Shoei motorcycle helmet RF-108V, $125; Hein Gericke street/racing boots, 11 1/2, $75; lg. rain suit, $25. David, 554-2992.

New-style Vette bra, $60; '85 Vette manual, new, $10. David, 554-2992.

Sony turntable, $5; 300 lbs. weights and bench, $45; ladies 3-spd., $15; ladies 10-spd., $65; 2 men's 10-spd., $20, $65. 333-6558 or 339-1337.

Lawn mower, $40; rower, $20; custom wardrobe closet, $150. 282-3788 or 480-2188.

Crib, matt., $40; Graco Bear high chair, $17.50; wooden dog house, $10; dog kennel pet carrier, $10; 4-pc. stand sz. gar. door glass, $5.00, OBO. 480-3157.

Rowing machine, $60, OBO; queen sz. box spring and matt., $100, OBO. x38918 or 482-9447.

Juke box, Wurlitzer, $1,995. 472-4360.

2 long-torso shortie scuba diving suits, 1 man's (41), 1 woman's (12), $45/ea. 482-0275.

Console stereo w/2 spkrs; super single waterbed, no matt., 6 drwrs., wooden Early American LR set, sofa, rocker, chair, coffee table, $100/ea., OBO. Laurie, 334-4628.

Recharg. Ni-Cad batt., various szs., $1.50/ea.; Sears exer. bike, $35. 334-1934.

Phonemate answering mach.; std. cass.; Vox, $35; first alert home sec. sys., wireless w/siren, $50. 334-1934.

Aquarium w/all access. for saltwater or fresh; 300 Watt MCS stereo with CD player; autographed baseball cards, others from 1969-1989. Brian, 280-4137 or 482-9195.

Books on cass., Day of the Cheetah by Dale Brown, The First Deadly Sin by Lawrence Sanders, Tracks by Louise Erdrich, $7/ea. Ronnie, x32539.

Cover for '89 and '90 Chrysler Le Baron, almost new w/carrying bag and cable, $60. Vicki, x36043.

PSE Pulsar adjust. wgt. draw, compound bow w/extras, $100. 944-5624.

Scuba Dacor mask, 3-view, silicon skirt, used once w/case, $47, OBO. Darwin or Youm, x32142.

Gravely riding lawn mower w/floating blades, ex. cond., $800, OBO. 333-6497.

Wm. Rogers Silverplate set for 8, 7 extra serv. pcs.; Wonder Woman telephone, modular; antiques: wooden wheel chair, record player, sewing mach., iron bed, walking plow and iron vice. 783-9164.

Queen sz. bed w/pine frame, $180; dining table and 4 chairs, $100; Corelle dish set, 6 cups and saucers, 8 bowls, 8 lg. plates, $15. x36091 or 333-5326.

Office desk, $50; barbecue grill, $40. x36091 or 333-5326.

Diamond dinner ring, rainfall design, total wt. 2 1/4 carats, $1,500. x30692 or 664-5579.

Ping pong table, full reg. sz., $50. Mike, 333-2335.

Pool cue w/2 head pcs. and case, $20; Kodak 110 Instamatic camera, $7; blue carpet runner, 2'x6', $5. Stacey, x32649 or 480-9793.

Dishwasher, ex. cond., ener. saving, almond door, $75. Jon, x30011 or 488-8466.

Stereo tape cass./recorders, Pioneer model CTF550 and CTF650, $100/ea., OBO. 538-3434.

PU truck tool box, $45; gold cart, $25, OBO. 944-9152.

Dilly galv. boat trlr., up to 19', $425; 2 swivel boat seats, $40/both; S.S. 23 gal. gas tank, 14"x8",48", $35; boat anchor and glove box, $10/ea.; S.S. propeller for Johnson, $100. Andy, 333-6671 or 332-9105.

Reference approaches juggle cost, schedule, performance

The Human Exploration Initiative

To enable people such as those in this illustration to live in the hostile environments of the Moon and Mars, sophisticated technologies, systems and strategies are needed. Cost, schedule, complexity and program risk must be fully analyzed and the various approaches must be compared against one another. This analysis will help establish the scope, scale, schedule and strategy needed to implement President Bush's program of expanding human presence in the solar system.

(Editor's note: This is the sixth installment in a series of articles summarizing the Report of the 90-Day Study on Human Exploration of the Moon and Mars. The final excerpt will be published next week.)

The mission described in the previous section was developed to provide a framework within which various approaches to and elements of the Human Exploration Initiative could be examined. Once the mission itself had been defined, the next step in the study process was to examine a number of reference models to determine which parameters most significantly affect feasibility and cost. For instance, the program could be driven by schedule, as Apollo was, or phased so that a major technology and system development program precedes the actual development of the mission elements. Various elements could be more heavily emphasized; for example, the lunar outpost could focus more on achieving self-sufficiency than on serving as a proving ground for human exploration of Mars. The program could be budget-constrained, or the decision on final dates and associated funding could be varied to meet other policy objectives.

In order to provide the data necessary to make these types of assessments, several reference approaches were selected to determine which parameters drive such things as cost, schedule, complexity, and program risk. In all, five reference approaches were analyzed; these approaches can be used by the agency and the National Space Council in determining the appropriate scope, scale, schedule, and strategy to be used in implementing the President's program.

REFERENCE APPROACH A

The strategy around which this approach is formulated is to establish human presence on the Moon in 2001, using the lunar outpost as a learning center to develop the capabilities to move on to Mars. Key features include an aggressive schedule leading to permanent human occupancy of the Moon in 2002, with lunar development leveling off in 2012 to provide the funding flexibility to begin Mars exploration. An initial expedition to Mars allows a 30-day stay on the surface, with the first 600-day visit beginning in 2018.

An unmanned test flight of the lunar transfer and excursion vehicles in 1999 is the first lunar activity supported by Space Station *Freedom*. The first unmanned cargo flight in 2000 emplaces the initial habitation module, airlock, and power system for four crew members who arrive in 2001 for a 30-day mission.

Two more flights emplace additional surface habitation, science equipment, laboratory, and power facilities. A lunar excursion vehicle servicer is provided to maintain a reusable vehicle on the lunar surface. In early 2002, the second crew begins permanent occupancy of the lunar outpost with a 6-month stay. Beginning in mid-2002, when the third crew arrives, reusable lunar excursion vehicle operations are initiated, and the excursion vehicle is maintained at the outpost. Twelve-month crew tours of duty begin at this time. The initial nuclear power unit and the lunar oxygen production demonstration hardware are added in 2003.

Human exploration focuses on local geologic and geophysical exploration, with regional exploration accomplished telerobotically. The first elements of astronomy telescope arrays are deployed, and a network of geophysical and particle physics stations is started. Lunar laboratory activities include human biomedical research and geochemical sample analysis.

Outpost capabilities increase as the constructible habitation module is erected, outfitted, and occupied in 2005. Two lunar excursion vehicles, one cargo and one piloted, are simultaneously maintained on the lunar surface.

In 2006, the number of crew members expands to eight, consisting of two groups of four who serve rotating 12-month tours of duty. At this point, the outpost is capable of conducting a long-duration partial-gravity test in support of Mars mission planning. In 2008, the surface nuclear power capability is augmented substantially to 550 kilowatts. A complete 1,000-day Mars mission is simulated using the outpost and *Freedom* to develop countermeasures.

In 2010, the lunar oxygen plant is emplaced and operated to produce 60 metric tons of oxygen per year, which saves transporting this oxygen from Earth. The lunar outpost continues to operate with a crew of eight until 2012, when the outpost enters a sustained steady-state period with one lunar flight per year and four crew members serving 12-month tours.

The human exploration of Mars begins with an initial expeditionary piloted flight, a dedicated cargo flight, and a second piloted flight to begin extended-duration operations. The Mars transfer and excursion vehicles are assembled at *Freedom*. Full propellant tanks are launched separately and assembled to the vehicles at *Freedom*. The first piloted Mars expedition departs Space Station *Freedom* in 2015. Four crew members arrive at Mars in 2016, aerobrake into Mars orbit, and descend to the surface for a 30-day stay. Part of the payload delivered to the surface is a habitat module with an airlock and utility systems to support the crew during their stay. The crew members conduct local science and exploration within a 10-kilometer range of the outpost using unpressurized rovers. Teleoperated rovers explore and sample to distances of 50 kilometers, and provide regional geologic information and resource locations. Exploration focuses on studying past and present geologic and climatic environments, including the search for past and present life and water environments. The human explorers are studied to understand the effects of living and working on Mars. The crew returns to the vicinity of Earth in the transfer vehicle (without aerobrake) transferring to a separately carried Earth crew capture vehicle just prior to arrival at Earth orbit in 2016.

The permanent habitation facility and its associated airlock and utility subsystems and the necessary emplacement and construction equipment to deploy it are delivered to Mars on the second flight, a cargo flight that departs Earth in 2017 and arrives at Mars in 2018. Other payload delivered includes an additional rover and a vehicle launch and landing facility capable of supporting the excursion vehicle for up to 600 days.

The second piloted flight leaves Earth and arrives at Mars in 2018. The four crew members live in the initial habitat module while they construct and activate the permanent habitation facility. When the permanent habitat has been activated and occupied, the crew can remain on the surface for 600 days. An early task is the demonstration of a Mars water extraction process.

The crew from the second manned flight leaves Mars and arrives at Earth in 2020. The next manned flight departs Earth and arrives at Mars in 2020. During their 600-day stay, the four crew members continue the water extraction demonstration, the oxygen production experiments and more detailed geologic and geophysical exploration and evaluation of resources.

In 2022, a one-way cargo flight departs Earth, arriving at Mars in 2023. This flight transports additional consumables, spares, and science equipment to support the next piloted flight, which departs in 2024 and arrives at Mars in 2025. Steady-state operations then commence.

To support this schedule, the *Freedom* "assembly complete" date must be accelerated to 1997, which will require a heavy-lift launch vehicle. Shuttle-C is the only concept being considered in this time frame. *Freedom* must support two expendable lunar missions per year through 2002, at which time it must be capable of supporting reusable vehicle operations at the same rate. Beginning in 2004, *Freedom* must support up to three lunar missions per year.

Beginning in 2011, the smaller heavy-lift vehicle configuration will be used to augment the *Freedom* lunar mission configuration to support a test flight of the Mars aerobrake in 2013, and again to support the initiation of human Mars missions in 2015. The Mars transportation vehicle elements will be launched to *Freedom* beginning in 2014 for the Mars vehicle piloted flight in 2015, using a larger heavy-lift launch vehicle with a 12.5 meter diameter by 30 meter long payload shroud, which is capable of lifting 140 metric tons to *Freedom*. This vehicle will launch all subsequent Mars transportation vehicles.

REFERENCE APPROACH B

This approach is a variation of reference approach A, which advances the date of the first human Mars landing to 2011. In order to preserve funding flexibility to initiate activities at Mars, it is also necessary to accelerate development of the capability for lunar oxygen production, leading to the need for very early emplacement of a nuclear power system on the Moon. This approach limits the degree to which lunar outpost operational experience can influence the design of the Mars transportation and surface systems.

The need to conduct the Mars outpost development activities in parallel with heavy lunar activity also results in a higher resource requirement in the first decade of the next century. In order to support the parallel set of lunar and Mars activities with minimum resources, other lunar infrastructure, such as the constructible habitat, is somewhat delayed, and lunar operations level off much earlier to a steady-state mode involving four crew members and one lunar flight per year.

REFERENCE APPROACH C

This approach is also a variation of reference approach A. The key emphasis is that this approach advances to 2005 the date by which lunar oxygen production is available to reduce lunar outpost logistics requirements, creating an earlier opportunity for Mars outpost development. As with reference approach B, early lunar oxygen production requires very early emplacement on the Moon of surface nuclear dynamic power system capability.

The early emplacement of the lunar oxygen plant delays the emplacement of other infrastructure, such as the constructible habitat, and also postpones the date for the transition to a crew of eight. The transition of the lunar outpost to a steady-state mode of four crew members and one lunar flight per year can be slightly accelerated, but a significant period is preserved in which the eight crew members are available for performing lunar science activities.

The relationship between lunar and Mars outpost hardware development remains a serial one, in which designs of Mars outpost transportation vehicles and surface elements are significantly influenced by lunar outpost operational experience.

REFERENCE APPROACH D

The scale and content of this approach are identical to those of reference approach A. The sequencing and phasing relationships between key program milestones remain approximately the same, but the milestones are all delayed by 2 to 3 years, with a return to the Moon in 2004. This approach does not accelerate the "assembly complete" date of *Freedom*, and generally allows more time to complete and incorporate beneficial technology developments.

REFERENCE APPROACH E

This appropach reduces the scale of lunar outpost activity by using only a human-tended mode of operation and limiting the flight rate to the Moon to one mission per year. It also increases the number of expeditionary flights to Mars prior to establishing a permanent outpost there. Initial lunar operations are consistent with the currently planned Space Station *Freedom* "assembly complete" date of 1999. In 2004, the first humans return to the Moon. Occupation of the lunar outpost facilities is on a continuing man-tended operations basis involving one lunar flight per year, with crew tours of duty ranging from 30 days to 6 months, and with the outpost unmanned for periods up to 12 months. (One exception would be one or more 600-day stays to simulate stays on Mars.) In 2011, lunar oxygen production is accomplished, but only in small demonstration quantities. The first humans land on Mars in 2016. Three Mars expeditionary missions of increasing surface stay time up to 90 days precede the establishment in 2027 of a permanent Mars outpost with 600-day occupancy.

	Dates				
Milestone	**Reference Approach A**	**Reference Approach B**	**Reference Approach C**	**Reference Approach D**	**Reference Approach E**
Lunar Emplacement	1999-2004	1999-2004	1999-2004	2002-2007	2002-2007
Lunar Consolidation	2004-2009	2004-2007	2004-2008	2007-2012	2008-2013
Lunar Operation	2010→	2005→	2005→	2013→	2014→
Humans on the Moon	2001	2001	2001	2004	2004
Permanent Habitation	2002	2002	2002	2005	—
Constructible Habitat	2005	2006	2007	2008	2011
Eight Crew	2006	2007	2007	2009	—
Lunar Oxygen Use	2010	2005	2005	2013	—
Lunar Farside Sortie	2012	2008	2008	2015	2022
Lunar Steady State Mode	2012	2008	2012	2015	—
Mars Emplacement	2015-2019	2010-2015	2015-2019	2017-2022	2024→
Mars Consolidation	2020-2022	2015-2018	2020-2022	2022→	—
Mars Operation	2022→	2018→	2022→	—	—
Humans on Mars	2016	2011	2016	2018	2016
Extended Mars Stay	2018	2014	2018	2023	2027

NASA scientist says pollution can cool Earth's climate

A scientist at NASA's Goddard Space Flight Center has co-authored a report that provides new evidence that pollution can modify clouds so that they help cool the Earth's climate.

The study's findings exemplify the complexity of the global climate and the fact that scientists do not understand the processes well enough to make unequivocal predictions about long-range climate trends such as the greenhouse effect.

In a study published in the journal Science, Michael D. King, of Goddard's Laboratory for Atmospheres, and his colleagues observed the effects of pollution from ships burning fossil fuels on shallow layer clouds.

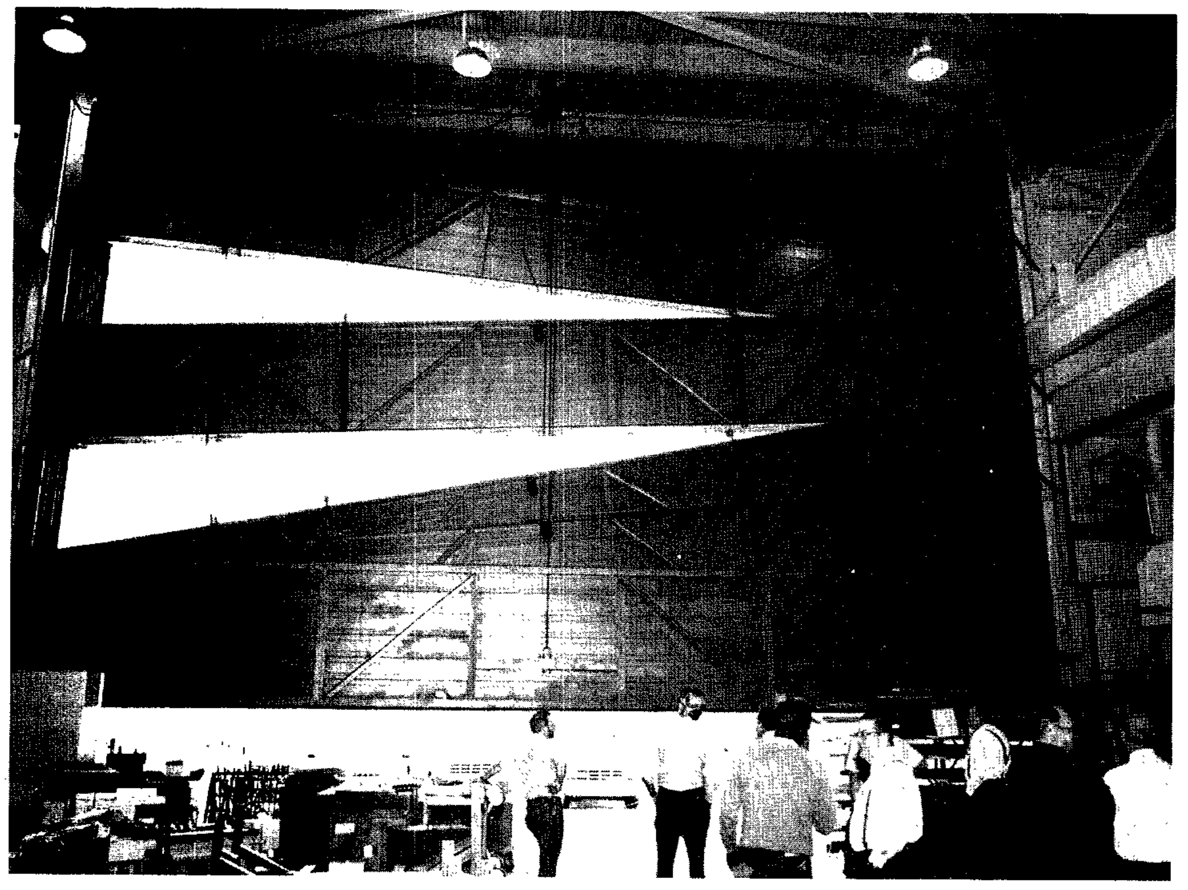
The study, co-authored by Lawrence F. Radke, University of Washington, and James A. Coakley Jr., Oregon State University, used simultaneous measurements from the NOAA-10 satellite and the University of Washington's C-131A research aircraft. The observations of these "ship track" clouds were conducted off the coast of California on July 10, 1987.

"Changes in cloud reflectivity, resulting from the burning of fossil fuels, are expected to have a cooling effect on global climate," said King. "Our study reports new evidence that the cooling effect will be larger than previously predicted."

Explaining the effect of pollution on clouds, King said, "Pollution serves as a source of particles around which cloud droplets form. These particles are called cloud condensation nuclei. Increases in pollution are expected to lead to increased numbers of these nuclei, which compete for liquid water in the cloud. With more nuclei, the cloud contains more droplets, which are smaller in size.

"Our paper shows that these changes are indeed taking place in the portions of maritime clouds that have been polluted by underlying ships," said King. "However, we discovered that the polluted clouds contained more liquid water than the surrounding clouds. These observations indicate that clouds with smaller droplets suppress the loss of water by precipitation, thereby allowing water to remain in the clouds for longer periods, which in turn increases cloud life span and prolongs their cooling effect on the Earth."

The U.S. Global Change Research Program, in which NASA's Office of Space Science and Applications is a major participant, will develop the scientific measurements for analysis of competing processes, such as the warming effect of atmospheric greenhouse gases and the cooling effect of clouds. The result will be a more solid foundation on which to base policy decisions.



JSC Photo by Jack Jacob

CABLE FAILURE—No one was injured when the large Bldg. 10 overhead door came crashing down last Thursday after a cable failure. Lockheed employee Laura Cook had raised the door 6 or 8 feet when the cable broke. As the five sections fell, they became wedged in the guide tracks on each side. The door, installed in 1963, was later stabilized and openings covered to protect the workers and materials inside. JSC's Plant Engineering Division is developing a plan to repair the door. Meanwhile, all traffic through the door is prohibited.

Car decals to be issued

The JSC Security Division will begin issuing redesigned vehicle decals to all permanently badged employees on March 1.

New decals will be issued in the main lobby of buildings in various on- and off-site locations during March to facilitate the change. Current decals will not be valid after April 5.

JSC Security Officer Ron Wade said the reregistration is a semi-annual event necessitated when employees leave or trade in cars and don't return their decals.

You must complete a vehicle registration record, JSC Form 1572, before you can receive a new decal. Blank forms will be available at the badge offices in Bldgs. 1, 5, 30 and 100, at the JSC Security Division Office, Bldg. 45, Rm. 211, and from contractor security officers. Completing the form before going to a decal desk will speed up the registration process.

Current decals must be removed, but do not need to be returned.

Decal desks will be open during business hours at the following on-site locations:

Bldg. 1, March 1-2; Bldg. 4, March 5; Bldg. 29, March 6; Bldg. 16, March 7; Bldg. 30, March 8-9; Bldg. 419, March 12; Bldg. 32, March 13; Bldg. 37, March 14; Bldg. 45, March 15.

Off-site locations include:

Nova Bldg., March 16; RSOC, March 19-20; Ellington Field, March 21; Barrios Bldg., March 22; IBM Corp., March 23; Lockheed, March 26; CSC, March 27; McDonnell Douglas, March 28; and Ford Aerospace, March 29.

JSC retiree badges now available

A specially designed JSC retirement badge is now available to those retiring from the center, in addition to the NASA retirement badge usually issued at retirement.

The new JSC badge, designed by JSC's Security Division, pictures the different generations of the space program experienced at the center. The last organization where the employee worked before retirement also is named.

The JSC retirement badge may be used in the same manner as the NASA retiree badge on site, but will not be honored at other NASA facilities.

The JSC retirement badge is optional. The receptionist will type to suit any information the retiree requests regarding directorates, divisions, branch names, mail codes, and acronyms on the badge. Retirees desiring the JSC badge may have them prepared in the badging office during regular business hours.

Cupid's arrow goes through hoop for JSC worker

By James Hartsfield

Almost anyone would agree that Cupid's arrow doesn't always follow a direct path, but for JSC employee Rex Boyce, it went through hoops and will end up in Cancun, Mexico.

Boyce, a T-38 quality assurance inspector at Ellington Field, was surprised by his wife, Dinah, with two tickets to see the Houston Rockets play the Boston Celtics on Valentine's Day eve. An avid Rockets' fan, he attended the game with his brother.

But then luck, or Cupid, or fate, or what anyone wants to call it, took over. At halftime, Boyce's ticket stub number was called out of more than 15,000 possibilities for a chance to shoot in a free-throw contest. Shoot he did, and he found his target.

Boyce was allowed only 24 seconds, and he made a basket from behind the three-point line to win a free trip for two to Cancun.

"It was just an unbelievable Valentine's," he said. "They called my number which I thought would never happen. And when I got home and told her, she couldn't believe it either."

Although it could have been an added ribbon on the present, the Rockets ended up losing 107-94. But one die-hard fan still left happy.

"I was so excited from halftime, I don't really know what happened after that," Boyce added.

Space News Roundup

The **Roundup** is an official publication of the National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Texas, and is published every Friday by the Public Affairs Office for all space center employees.

Swap Shop deadline is every Friday, two weeks before the desired date of publication.

Editor .... Kelly Humphries

Associate Editor .. Linda Copley

Lunar and Mars Program Office comes to JSC

(Continued from Page 1)

of implementing the architecture.

"We are now doing, what for a spacecraft would be, Phase A studies," Craig said. "The difference is that this is not a vehicle, it's a constellation of vehicles and systems. That's one of our challenges. We have to design a mission, an architecture of vehicles and systems: outposts on the surface of the Moon and Mars, space transfer vehicles that journey through the void, robotic spacecraft that lead the way, and heavy-lift launch vehicles that carry the largest elements to Earth orbit."

One of the office's primary tasks is to determine how the exploration initiative is executed in the future. Technologies and expertise from all areas—communications, life sciences, transportation, Space Station *Freedom*—will need to be corralled and organized efficiently to accomplish the goals set forth by President George Bush in his speech commemorating the 20th anniversary of the first Moon landing, Craig said.

"We will interface with every major NASA organization and will be working with every NASA organization and Headquarters to figure out what the efficient allocation of resources is across the agency," he said.

"The exploration initiative provides a strategic focus and integrated basis for the planning of many agency activities: heavy-lift launch vehicles, Space Station *Freedom* evolution, technology development, life sciences research, the Deep Space Network, and more," Craig said. "It also provides a framework for center strategic planning. Although Adm. Truly has stated that center roles and missions for initiative hardware development will not be decided for several years, it is important that each center begin the process of identifying its priorities and interests and develop supporting capabilities.

In that vein, the New Initiatives Office will retain the Planet Surface Systems Office and Mars Sample Return Office.

"Johnson, with its history and experience, has a very real responsibility to help shape the initiative," Craig said. "I think we've been given a wonderful opportunity here as a center to help the agency sort this thing out and define what it's going to be. It's an awfully important challenge for JSC, but I know that we're up to it."

One of the biggest challenges for both NASA and JSC is developing the ability to handle several large programs simultaneously, Craig said.

"This center has a lot of work to do," Craig said. "It's got a lot of work to do on the shuttle. It's got a whole lot of work to do on space station and it's got a lot of work to do on the lunar and Mars initiative. We cannot use the methods we've used in the past of working on one program at a time. We are going to have to find ways for all our people to work on each of these programs as their expertise is needed. Section and branch supervisors and their counterparts in program and project offices will play a big role in meeting this challenge."

JSC economic impact

(Continued from Page 1)

third behind California ($2.7 billion) and Florida ($1.2 billion) in states receiving NASA funds for contracts or grants.

The center employed 3,773 civil servants in fiscal '89 compared to 3,552 the year before. Peak space industry employment in the JSC area occurred in 1989, with 11,120 aerospace industry and support contractor personnel working on or near the center.

LDEF data book begins to reveal details of space environment

(Continued from Page 1)

The number and positions of surface impacts on LDEF is about what was expected, he said. There are more impacts on the leading edge and space-facing end of the 12-sided, school bus-sized cylinder. The majority of the leading edge impacts were expected to be caused by orbital debris from rocket and satellite break-ups, and the space-facing impacts are mostly natural micrometeoroids.

Kessler said that from a Space Station *Freedom* design viewpoint, "it is easy to protect against everything we're seeing so far."

Dr. Jim Alston of George W. Park Seed Co., Greenwood, S.C., co-principal investigator for the Space Exposed Experiment Developed for Students (SEEDS), said the thermal shield that protected 150,000 tomato seeds aboard LDEF looks good. The seeds are to be one of the first experiments removed from LDEF on Feb. 21 and will go through preliminary laboratory analysis before being sent to teachers for use in school projects.

So far, 90,000 SEEDS study kits have been requested by teachers throughout the country. Another 60,000 kits are still available to teachers who write to the NASA SEEDS Project, Code XEO, NASA Headquarters, Washington, D.C., 20546.

Alston estimated that between 2 and 4 million students will be conducting experiments on the space-faring tomato seeds this spring.

"What we're seeing and hearing about this morning is a little bit like looking at the cover of the LDEF data book," Kinard said. "There's a lot more information there. We're simply looking at surface effects right now."

Correction

A typographical error in the Feb. 9 Roundup eliminated a portion of the story on two new flight directors being appointed. Here is that paragraph:

Engelauf earned a master's in aeronautical and astronautical engineering from Stanford University in 1981 while working at NASA's Ames Research Center. He began working at Ames in 1978 as a wind tunnel facility engineer.